VDOT Pedestrian Safety Action Plan

Presented by
Mark Cole, VDOT

May 22, 2019
In 2018, 227 vulnerable road users died, 28% of all traffic deaths.
Virginia Pedestrian Crash Assessment
4 Big Issues Relevant to Pedestrian Safety

1. Crossing the Street/Road
95% of Virginia’s pedestrian deaths & injuries occur when crossing the street.

2. Land Use
If its urban or suburban, pedestrians will almost always be present.

3. Speed
Chance of death increases with speed, especially for ped and cyclists.

4. Visibility
3/4 of ped deaths and 2/3 of cyclists deaths occur in limited light conditions.
Where Pedestrian Crashes Occur

Fatal
- Signalized Intersection: 30 (7%)
- Unsignalized Intersection: 57 (14%)
- Mid-Block: 282 (66%)
- Other: 56 (13%)

Injury
- Signalized Intersection: 134 (7%)
- Unsignalized Intersection: 431 (22%)
- Mid-Block: 1012 (52%)
- Other: 383 (19%)
Pedestrian Crashes and Posted Speed Limit

- **25 MPH or Less**: 94% of pedestrians survive
- **30 to 35 MPH**: 79% of pedestrians survive
- **40 MPH or Greater**: 65% of pedestrians survive
Pedestrian Injury Crashes: Crosswalks

- Crosswalk Present, Pedestrian Struck in Crosswalk: 39 (8%)
- Crosswalk Present, Pedestrian Not Struck in Crosswalk: 22 (5%)
- No Crosswalk Present: 8%

Legend:
- Crosswalk Present, Pedestrian Struck in Crosswalk
- Crosswalk Present, Pedestrian Not Struck in Crosswalk
- No Crosswalk Present
VDOT Pedestrian Safety Action Plan (PSAP)

Goals

• Understand Virginia’s pedestrian safety concerns and identify solutions to address them

• Make policy, procedure, and practice changes to help ensure safe pedestrian travel

• Consider the relationship between land development and pedestrian safety

• Consider maintenance issues for pedestrian access and safety

• Identify HSIP pedestrian safety projects
### Salem Pedestrian Crash Heat Map Example

#### Categorical Heat Map

**Salem Pedestrian Injury Crashes (2012-2016)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Functional Classification</th>
<th>Funding</th>
<th>Roadway Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interstate</td>
<td>Arterial</td>
<td>Collector</td>
</tr>
<tr>
<td>Total Crashes</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Category</strong></td>
<td><strong>#</strong></td>
<td><strong>#</strong></td>
<td><strong>#</strong></td>
</tr>
<tr>
<td><strong>Spring (March - May)</strong></td>
<td>55</td>
<td>2</td>
<td>107</td>
</tr>
<tr>
<td><strong>Summer (June - August)</strong></td>
<td>48</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td><strong>Autumn (September - November)</strong></td>
<td>67</td>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td><strong>Winter (December - February)</strong></td>
<td>50</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td><strong>Signalized Intersection</strong></td>
<td>38</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td><strong>Unsignalized Intersection</strong></td>
<td>50</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td><strong>Mid-Block</strong></td>
<td>116</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td><strong>Parking Lot</strong></td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Crosswalk Present, Pedestrian Struck In Crosswalk</strong></td>
<td>45</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td><strong>Crosswalk Present, Pedestrian Not Struck In Crosswalk</strong></td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Crosswalk Present, Unclear If Pedestrian Was Struck In Crosswalk</strong></td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>No Crosswalk Present</strong></td>
<td>172</td>
<td>2</td>
<td>74</td>
</tr>
</tbody>
</table>

#### Summary

- **Total Crashes**: 220
- **Spring**: 55
- **Summer**: 48
- **Autumn**: 67
- **Winter**: 50
- **Signalized Intersection**: 38
- **Unsignalized Intersection**: 50
- **Mid-Block**: 116
- **Parking Lot**: 9
- **Other**: 7
- **Crosswalk Present, Pedestrian Struck In Crosswalk**: 45
- **Crosswalk Present, Pedestrian Not Struck In Crosswalk**: 2
- **Crosswalk Present, Unclear If Pedestrian Was Struck In Crosswalk**: 1
- **No Crosswalk Present**: 172
Step 1: Policy Review

Step 2: Crash and Data Analysis

Step 3: Countermeasure Selection
## Step 1: Policy Review

### Roadway Design
- Traffic Engineering
- Permitting and land use
- Speed setting
- Pedestrian planning
- Maintenance

<table>
<thead>
<tr>
<th>Policy Type</th>
<th>Tier</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Streets</td>
<td>♦</td>
<td>VDOT accepts responsibility for maintenance of eligible sidewalks. Includes list of accepted exceptions for providing sidewalks and pedestrian accommodations.</td>
<td>VDOT does not track implementation; exceptions listed in policy are subject to widely varied interpretation.</td>
</tr>
<tr>
<td>Crosswalk Marking</td>
<td>★</td>
<td>VDOT updated guidance as part of TE-384. Considers speed, AADT, and land use context.</td>
<td>Complexity of guidance may lead to less-than-optimal implementation.</td>
</tr>
<tr>
<td>Signalized Intersection Countermeasures</td>
<td>♦</td>
<td>Northern Virginia Region guidance considers signal phasing, crossing distance, and turning conflicts for installing pedestrian signals.</td>
<td>No existing guidance statewide.</td>
</tr>
<tr>
<td>Uncontrolled Crossing Countermeasures</td>
<td>★</td>
<td>TE-384 includes multiple countermeasures, such as PHBs and RRFBs.</td>
<td>Does not specifically address refuge islands and does not offer VDOT-specific criteria for PHBs.</td>
</tr>
<tr>
<td>Speed Setting</td>
<td>♦</td>
<td>Engineering judgment provides opportunity to consider pedestrian safety.</td>
<td>No guidance or process available for pedestrian activity besides school zone speed setting.</td>
</tr>
<tr>
<td>Design Standards</td>
<td>♦</td>
<td>Includes references to refuge islands (medians), crosswalk markings, and signals.</td>
<td>Unclear guidance for assembly of beacons and signs for PHBs and RRFBs</td>
</tr>
<tr>
<td>Road Diets</td>
<td>♦</td>
<td>Northern Virginia Region reviews resurfacing for road diet opportunities.</td>
<td>No existing statewide guidance.</td>
</tr>
</tbody>
</table>

**Key:**
- ♦: No Specific Policy Applicable
- ♦: Incomplete Guidance or Irregular Application
- ★: Gear Policy and Consistent Application
Example Policy Recommendations

- Update VDOT-specific **guidance for ped safety countermeasures** at intersections

- Include ped safety treatments in **maintenance resurfacing** projects

- Develop **road diet design criteria**

- Create guidance for **Pedestrian Priority Zones**
Current Status of Policy Work

- Ranked top five policy recommendations to focus on first with stakeholder group. Top 5 include:
  1. Update VDOT ped crossing guidance – UNDERWAY
  2. Incorporate ped safety into maintenance – UNDERWAY
  3. Develop Virginia Road Diet Guidelines – UNDERWAY
  4. Create flowchart for PSAP projects in HSIP program
  5. Develop Pedestrian Priority Zone Criteria

- Plan to finish top three items this year
- Plan to begin items 4-5 this year
Step 2: Crash and Data Analysis

- Crash Cluster (Crash-based)
- Priority Corridor (Predictive)
What is a “crash cluster”?

Dense clusters of pedestrian crash locations, regardless of severity of the pedestrian injury

- Uses geocoded pedestrian crash data (2012-2016) prepared for the Virginia Pedestrian Crash Assessment report

- Density is measured by unweighted distance between “nearest neighbor” crash locations

- More intense clusters appear as bright orange-red spots

328 Total Clusters Statewide --- 19 Identified for cut sheets
## Priority Corridor Evaluation: Criteria Considered

### LAND USE FACTORS
- ✓ Pedestrian destinations (parks, trails, and schools)
- ✓ MPO urban area/land use data layer
- ❑ Bus stops and transit/passenger rail stations

### DESIGN/INFRASTRUCTURE FACTORS
- ❑ Signal density
- ❑ Intersection locations
- ❑ N/A: Sidewalk and path accommodations maintained by VDOT
- ❑ N/A: Crossing distance

### SPEED FACTORS
- ✓ Posted speed limits
- ❑ Operational speeds

### VOLUME/OTHER FACTORS
- ✓ Pedestrian crash data
- ✓ Vehicle traffic volumes
- ✓ Population and employment density (US Census)
- ✓ Vehicle ownership (US Census)
- ✓ Poverty levels (US Census)
- ✓ Prevalence of impaired (alcohol) citations

### VISIBILITY FACTORS
- ❑ N/A: Lighting
- ❑ N/A: Pavement markings and crossing
Priority Corridor Identification

- Top 1% Scored Segments
- Identify nearby segments within top 10%
- Aggregate segments into priority corridors
Example: Cut Sheet

Richmond: Broad Street (US 33/250)

Crash History
- All crashes occurred on a 6-lane, two-way undivided highway.
- All crashes occurred in a 25 mph zone.
- 3 out of 7 crashes involved improper or illegal action by the driver.
- 6 out of 7 crashes occurred during the daylight. The remaining crash occurred during dark/lighted conditions.
- No crashes involved alcohol.

Crash Cluster Description
- Mixed-use, urban setting
- College campus adjacent
- 6 travel lanes, median-divided
- Signalized intersections with no formal mid-block crossings
- 25 mph speed limit
- 16,000 to 26,000 AADT

Countermeasure Recommendations
- High visibility crosswalks
- Advance stop/yield signage
- Pedestrian refuge

Community: Richmond
VDOT District: 4 (Richmond)

Crash Severity
K: Killed: 0
A: Severe: 3
B: Apparent: 4
C: Possible: 0

Crashes by Year
- 2012: 6
- 2013: 2
- 2014: 4
- 2015: 2
- 2016: 1

Pedestrian Refuge & High Visibility Crosswalks
Advance Pedestrian Warning Signage

Asheville, NC: Lyndal Zupreva
Cary, NC: VHB
Step 3: Countermeasure Selection

Table 1. Application of pedestrian crash countermeasures by roadway feature.

<table>
<thead>
<tr>
<th>Roadway Configuration</th>
<th>Vehicle AADT &lt;9,000</th>
<th>Vehicle AADT 9,000–15,000</th>
<th>Vehicle AADT &gt;15,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤30 mph</td>
<td>35 mph</td>
<td>&gt;40 mph</td>
</tr>
<tr>
<td>2 lanes (1 lane in each direction)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 lanes with raised median (1 lane in each direction)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4+ lanes with raised median (2 or more lanes in each direction)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Given the set of conditions in a cell:
- Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- Signifies that high-visibility enhancements should always occur in conjunction with other identified countermeasures.

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1. High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2. Raised crosswalk
3. Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4. In-Street Pedestrian Crossing sign
5. Curb extension
6. Pedestrian refuge island
7. Rectangular Rapid-Flash Beacon (RRFB)**
8. Island
9. Pedestrian Hybrid Beacon (PHB)**

Source: FHWA
<table>
<thead>
<tr>
<th>Pedestrian Crash Countermeasure for Uncontrolled Crossings</th>
<th>Conflicts at crossing locations</th>
<th>Excessive vehicle speed</th>
<th>Inadequate conspicuity/visibility</th>
<th>Drivers not yielding to pedestrians in crosswalks</th>
<th>Insufficient separation from traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crosswalk visibility enhancement</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>High-visibility crosswalk markings*</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Parking restriction on crosswalk approach*</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Improved nighttime lighting*</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>In-Street Pedestrian Crossing sign*</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Curb extension*</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Raised crosswalk</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Pedestrian refuge island</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Pedestrian Hybrid Beacon</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Road Diet</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
<tr>
<td>Rectangular Rapid-Flashin Beacon</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
<td>ṭ</td>
</tr>
</tbody>
</table>
Pedestrian Hybrid Beacon (PHB)

A beacon to warn and control traffic at unsignalized marked crosswalks. Key design components include: overhead beacons, overhead “CROSSWALK STOP ON RED” signs, a crosswalk, and countdown pedestrian signal heads.

CRF: 18–37%
Addresses:
- Visibility
- Crossing
- Awareness

Rectangular Rapid Flashing Beacon (RRFB)

A high-frequency blinking pedestrian warning sign used in tandem with a pedestrian cross sign. The beacon can be activated with pushbuttons or automated pedestrian detection.

CRF: 47%
Addresses:
- Visibility
- Crossing
- Awareness
Implementing the PSAP

PSAP Report and Crash Analysis Results accessible from Web

- Corridor and crash cluster “cut sheets” linked to map

Workshops held Summer 2018

Late 2018, VDOT announced funded PSAP projects

Policy updates underway

VDOT received 59 candidate PSAP project submittals... valued at more $43M within weeks of the funding announcement.

VDOT staff evaluated the candidate projects and, in November 2018, announced the award of $8M of Section 154 funding to PSAP projects.

A total of 25 projects selected for installation in 8 of 9 VDOT Districts.

Funding requested ranged between: $40K per project → $1.5M per project.
Thanks!

For more information, view VDOT’s PSAP report and map at:


Mark Cole, P.E.
VDOT Assistant State Traffic Engineer
mark.cole@vdot.virginia.gov