Printing Instructions

**Desktop Print**
Send the file called *RRRwD_TradingCards/Desktop.pdf* to your desktop printer. It is recommended to use manual feed and send even pages first. Flip printed pages on the long side. Place back in manual feed tray and then send odd pages starting on page 3. The short lines at the edge of the cards should be used as a cutting guide.

*Note: Pages seven and eight have multiple copies of the same card.*
Systemic Analysis
How healthy is your road system?

Diagnosis
11% of all curves have 3 or more risk factors.

Lab Results:
- Curve A
- Curve B
- Curve C
- Curve D
- Curve E

Systemic vs. Systemwide
Systemic does not mean treating all locations. It allows agencies to treat the highest-risk sites within limited budgets.

Symptoms
Severe roadway departure crashes on curves.

Possible Risk Factors
- Avg. Daily Traffic > 1,000 vehicles
- Curve Radius < 1,000 feet
- Intersection within Curve
- Visual Trap within Curve
- Severe Crash within Curve

Treatment
Identify highest risk sites and treat with low-cost countermeasures such as chevron signs or rumble strips.

Follow-Up
Track and evaluate safety improvements. Further remediation can be implemented as needed.

TOOL
Source: FHWA

COUNTERMEASURE
Edge Line and Shoulder Rumbles

COUNTERMEASURE
Curve Signing

COUNTERMEASURE
Edge and Center Line Markings

COUNTERMEASURE
Center Line Rumbles

COUNTERMEASURE
SafetyEdgeSM

Source: Thurston County, Washington

Source: FHWA
Advance curve warning signs alert a driver to changes in the road alignment and chevrons delineate the curve. These countermeasures are effective to reduce:

- Curve crashes
- Nighttime crashes

https://safety.fhwa.dot.gov/provencountermeasures/enhanced_delineation/

<table>
<thead>
<tr>
<th>Crash Reductions for Installing Chevrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nighttime Crashes on curves</td>
</tr>
<tr>
<td>Non-intersection</td>
</tr>
<tr>
<td>Fatal and Injury crashes</td>
</tr>
</tbody>
</table>

Source: CMF Clearinghouse IDs 2438 and 2439

Edge rumble strips are milled corrugations in pavement to alert inattentive drivers that they are leaving the roadway to reduce:

- Run-off-road crashes
- Fixed object crashes
- Rollovers
- Distracted/drowsy driver crashes

https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips

<table>
<thead>
<tr>
<th>Fatal and Injury Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run-Off-Road</td>
</tr>
<tr>
<td>(two-lane rural)</td>
</tr>
<tr>
<td>Run-Off-Road</td>
</tr>
<tr>
<td>(rural freeways)</td>
</tr>
</tbody>
</table>

Source: CMF Clearinghouse IDs 3454 and 3447

A "systemic safety improvement" means a proven countermeasure(s) that is widely implemented based on high-risk roadway features that are correlated with particular severe crash types, rather than crash frequency.

(23 CFR Part 924.3)

https://safety.fhwa.dot.gov/systemic/

Systemic improvements:

- Supplements traditional analysis
- Used for crash types that are not concentrated such as rural roadway departures

You don't have to wait for a crash to happen to save lives!

SafetyEdge™ is a paving technique producing a durable 30-degree edge to prevent tire-scrubbing, which often results in:

- Head-on crashes
- Rollovers
- Run-off-road crashes

https://safety.fhwa.dot.gov/safetyEdge

Center rumble strips are milled corrugations in pavement to alert inattentive drivers that they are crossing the center line to reduce:

- Head-on crashes
- Run-off-road left crashes
- Distracted/drowsy driver crashes

https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips

<table>
<thead>
<tr>
<th>Fatal and Injury Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-On RwD</td>
</tr>
<tr>
<td>(two-lane rural)</td>
</tr>
</tbody>
</table>

Source: CMF Clearinghouse ID 3360

Retroreflective pavement markings improve nighttime highway visibility. Wider lines (6”–8”) have an increased safety effect, reducing:

- Curve crashes
- Nighttime crashes
- Head-on crashes

https://safety.fhwa.dot.gov/roadway_dept/night_visib/pavement-markings.cfm

<table>
<thead>
<tr>
<th>Crash Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adding edge and center line marking</td>
</tr>
<tr>
<td>Wider edge lines</td>
</tr>
</tbody>
</table>

Source: AASHTO Highway Safety manual, CMF Clearinghouse IDs 101 and 4792
High Friction Surface Treatment

Slope Flattening

Clear Zone

Center Line Buffer Area

Barriers

Shoulder Widening
Establishing and maintaining a clear zone provides an unobstructed, traversable area where an errant driver can recover to reduce:

- Fixed Object Crashes
- Rollover Crashes

https://safety.fhwa.dot.gov/roadway_dept/countermeasures/safe_recovery/clear_zones/

<table>
<thead>
<tr>
<th>Increase Distance to Trees By</th>
<th>Crash Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 feet</td>
<td>22%</td>
</tr>
<tr>
<td>5 feet</td>
<td>34%</td>
</tr>
<tr>
<td>8 feet</td>
<td>49%</td>
</tr>
<tr>
<td>10 feet</td>
<td>57%</td>
</tr>
<tr>
<td>13 feet</td>
<td>66%</td>
</tr>
</tbody>
</table>

Source: NCHRP Report 440

Flattening steep slopes provides a better opportunity for vehicles to traverse the slope, reducing the likelihood of:

- Rollovers
- Fixed object crashes

Crash Reductions (%) for Single Vehicle Crashes

<table>
<thead>
<tr>
<th>Before Sideslope</th>
<th>After Sideslopes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1V:4H</td>
</tr>
<tr>
<td>1V:2H</td>
<td>10</td>
</tr>
<tr>
<td>1V:3H</td>
<td>8</td>
</tr>
<tr>
<td>1V:4H</td>
<td>—</td>
</tr>
<tr>
<td>1V:5H</td>
<td>—</td>
</tr>
</tbody>
</table>

Source: AASHTO Highway Safety Manual

Adding a paved shoulder provides an errant driver an opportunity to regain control. Shoulders have been shown to be effective at reducing all roadway departure crashes. Adding shoulders may also allow for installation of rumble strips and the SafetyEdgeSM.

Roadside and median barriers are designed to redirect and slow vehicles while shielding them from obstacles likely to result in a more severe crash, such as:

- Rigid fixed objects
- Bodies of water
- Steep slopes
- Opposing traffic

https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/

HFST is a pavement surface treatment using calcined bauxite that provides exceptional skid-resistant properties at high friction demand locations such as curves, ramps, or intersections where problems with wet conditions, speed, or geometrics contribute to:

- Run-off-road crashes
- Head-on crashes

https://safety.fhwa.dot.gov/roadway_dept/pavement_friction

Crash Reductions on Curves

- Total 24%
- Wet Crashes 52%

Source: CMF Clearinghouse (CMF ID’s 7900 and 7901)

A center line buffer area provides extra space between the two solid center line markings, further separating opposing directions of traffic to reduce:

- Head-on Crashes

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Buffer Width</th>
<th>*Head-on Rwd Crash Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-lane</td>
<td>2 feet</td>
<td>35%</td>
</tr>
<tr>
<td>2-lane</td>
<td>4 feet</td>
<td>64%</td>
</tr>
<tr>
<td>2-lane</td>
<td>10 feet</td>
<td>90%</td>
</tr>
<tr>
<td>4-lane</td>
<td>Not significant</td>
<td></td>
</tr>
</tbody>
</table>

*Preliminary results from NCHRP Project 17-66

The crashworthiness of barriers is evaluated through crash testing. The current crash test criteria is contained in the AASHTO Manual for Assessing Safety Hardware (MASH) 2016.

Adapted from the AASHTO Highway Safety Manual (HSM) for 2 lane rural roads with no existing shoulders. For existing shoulders to be widened, see the HSM.
CRASH TYPE

Tree Crashes

Head-On Crashes

Rollover Crashes

Curve Crashes

Rural Roadway Departure Crashes

Source: Oregon State Police

Source: FHWA

Source: Oregon State Police

Source: FHWA

Use Safety Data
Identify Stakeholders
Choose Proven Solutions
Implement Solutions
Safer Roads Ahead

Risks Ahead
LRSPs START HERE!

Café

Store

TOOL

LOCAL ROAD SAFETY PLANS

Local Road Safety Planning Lab

Implementation

Safety

Data

Stakeholder

Plan

Choose Solutions

Implement Solutions

Participate Lab
Rollover crashes result in over 3,600 fatalities each year on rural roads, which is 30% of Rural RwD fatalities.

- 44% of these rural fatalities are on curves
- 78% of these rural fatalities are where speed limits are 50 mph or higher

Credit: Bigmouse/iStock/Thinkstock

Countermeasures
- Flatten Slopes
- SafetyEdge®
- Rumbles
- Friction
- Barrier

Head-on RwD crashes (which include opposing direction sideswipes) result in over 3,300 fatalities each year on rural roads, which is 28% of Rural RwD fatalities.

- 32% of these rural fatalities are on curves
- 84% of these rural fatalities are where speed limits are 50 mph or higher

Credit: skalapendra/iStock/Thinkstock

Countermeasures
- Center Line Markings
- Rumbles
- SafetyEdge®
- Center Buffer Area
- Median Barrier

Tree crashes result in over 2,300 fatalities each year on rural roads, which is 19% of Rural RwD fatalities.

- 50% of these rural fatalities are on curves
- 63% of these rural fatalities are where speed limits are 50 mph or higher

Credit: skalapendra/iStock/Thinkstock

Countermeasures
- Removal
- Maintain Clear Zone
- Rumbles
- Friction
- Barrier

Rural Roadway Departures account for 34% of all fatalities.

Objectives to Reduce RwD Crashes

1st - Keep vehicles on the roadway.
2nd - Reduce the potential for crashes.
3rd - Minimize the severity of crashes.

LRSP Benefits
- Defines and prioritizes achievable safety investments
- Serves as a communication tool
- Supports funding applications
- Creates a sustainable safety effort and greater awareness of road safety
- Supports development of lasting partnerships
- Supports reduction in severe crashes

Do what you can, with what you have, where you are. -Theodore Roosevelt

Curve crashes account for 42% of rural RwD fatalities.
Reduce the potential for serious injury and fatal roadway departure crashes on all public rural roads by increasing the systemic deployment of proven countermeasures.

**BENEFITS**
- Partnerships
- Data-driven Deployment
- Safer Rural Roads

US Department of Transportation
Federal Highway Administration