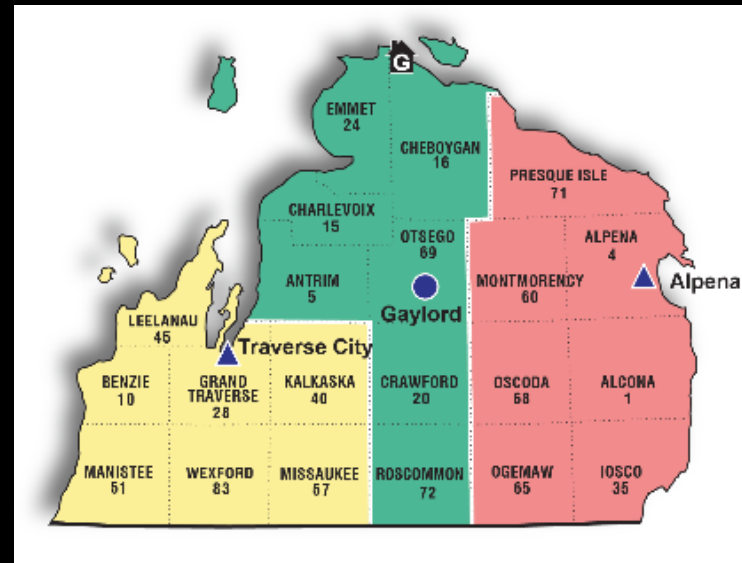


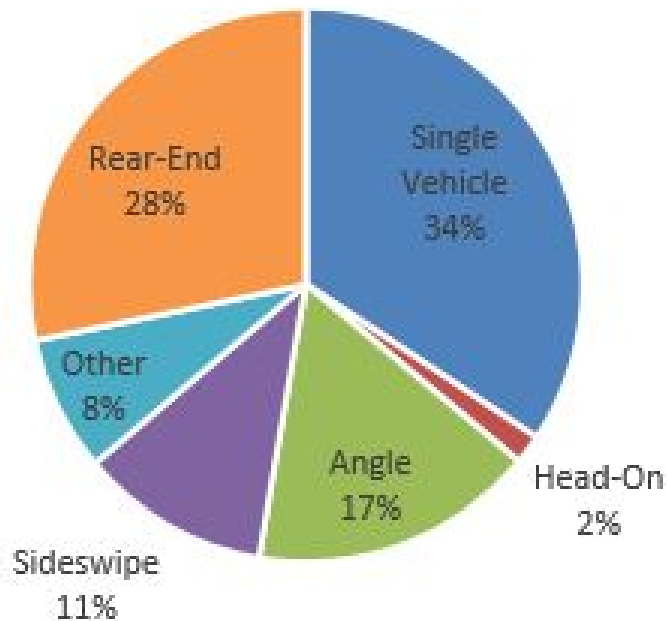
Garrett Dawe, P.E.
North Region Operations Engineer

Benefits of Paving Shoulders

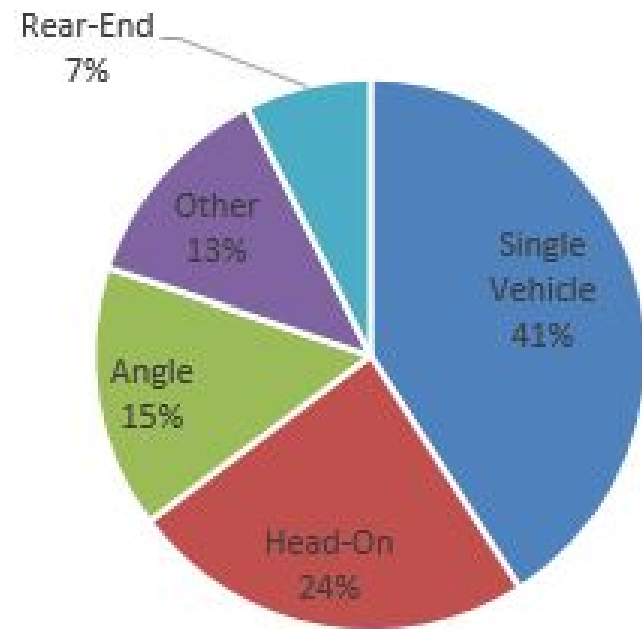


High Level Crash Analysis

Total Crashes - Trunkline

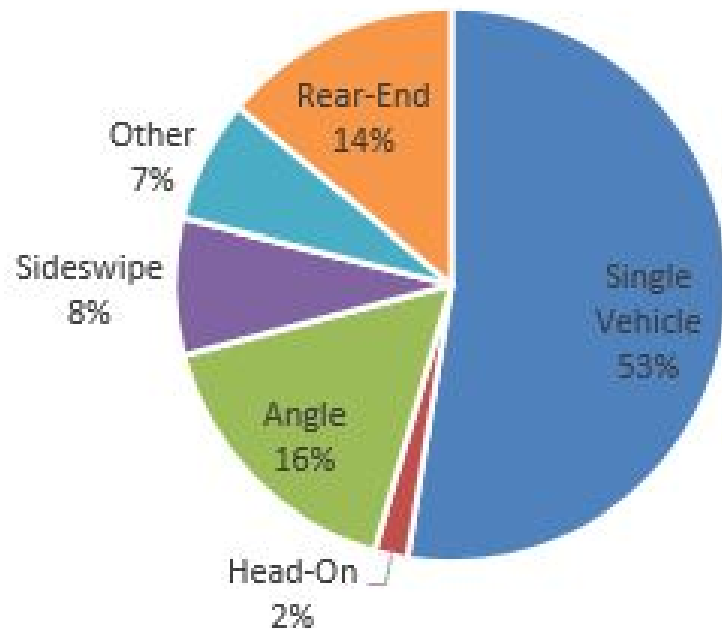


Fatal Crashes - Trunkline

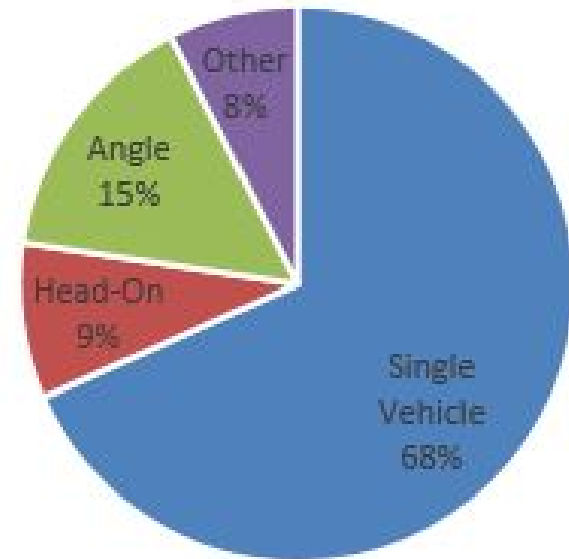


High Level Crash Analysis

Total Crashes - Local Roads



Fatal Crashes - Local Roads



Req'ts for Shoulder Width – 3R

A. Non-Freeway, NHS

Geometric Elements	Non-Freeway, NHS 3R Minimum Guidelines			
Design Speed (see Section 3.06)	Posted Speed Minimum			
Shoulder Width <i>NOTE: Minimum shoulder widths apply for posted speeds greater than 45 mph. Restrictions such as right of way and roadside context sensitivity issues may preclude the use of minimum shoulders within city, village or township limits with posted speeds of 45 mph and less.</i>	Current ADT Two-Way		Inside Shoulder	Outside Shoulder
	Two Lane (and three lane when the center lane is a left turn lane)	<750		3'-0" Gravel
		750 - 5000		6'-0" (3'-0" Paved)
		>5000 - 10,000		8'-0" (3'-0" Paved)
		>10,000		8'-0" (7'-0" Paved)
	Multi-Lane Undivided	≤ 10,000 > 10,000		6'-0" (3'-0" Paved) 8'-0" (3'-0" Paved)
	Multi-Lane Divided	≤ 10,000 > 10,000	3'-0" Paved 3'-0" Paved	6'-0" (3'-0" Paved) 8'-0" (3'-0" Paved)
See Bridge Design Manual Appendix 12.02 for Bridge Widths				

Req'ts for Shoulder Width



Req'ts for Shoulder Width – 3R

B. Non-Freeway, Non-NHS

Geometric Elements	Non-Freeway, Non-NHS 3R Minimum Guidelines		
Design Speed	Posted Speed Minimum		
<p>Shoulder Width</p> <p><i>NOTE: Minimum shoulder widths apply for posted speeds greater than 45 mph. Restrictions such as right of way and roadside context sensitivity issues may preclude the use of minimum shoulders within city, village or township limits with posted speeds of 45 mph and less.</i></p>	Current ADT Two-Way	Inside and Outside Shoulder Width	
	≤750	2'-0" (Gravel)	
	750 - 2000	3'-0" (Paved)	
	> 2000	6'-0" (3'-0" Paved)	
	Multi-Lane (Divided & Undivided)	Inside (Divided)	Outside (Both sides for un-divided)
	3'-0" Paved	6'-0" (3'-0" Paved)	
See Bridge Design Manual Appendix 12.02 for Bridge Widths			

Req'ts for Shoulder Width



Incorporating into TZD

- TZD Strategy: *Develop an exception process for NOT constructing full paved shoulders with 3R projects on roadways of 45 MPH speed limit or higher.*
- Completed analysis to determine return on investment and financial impact to R&R program.

Region Statistics

- 1,628 miles of trunkline with speed limit ≥ 45 mph
 - 30% have paved shoulder $\geq 6'$ or are curbed with no useable shoulder
 - 70% (1,146 miles) have paved shoulder $< 6'$.
- Crash analysis for 1,146 miles with $< 6'$ paved shoulder and speed limit ≥ 45 mph
 - Run Off Road Right
 - All Other Crashes (Animal excluded)

Run Off Road Right Crashes

Year	Total Crashes	Minor Crashes	A-injured or Killed Persons
2010	355	335	21
2011	434	409	29
2012	440	425	15
2013	561	538	25
2014	437	422	17

All Other Crashes

Year	Total Crashes	Minor Crashes	A-injured or Killed Persons
2010	843	793	65
2011	822	769	66
2012	888	831	76
2013	909	846	84
2014	953	894	88

Crash Reductions

- Per latest MDOT Time of Return spreadsheet...
- 5% reduction in All Crashes for every 1' of paved shoulder widening
- 20% reduction in Run Off Road Right Crashes when a shoulder rumble strip is installed

Cost Estimate

- Additional cost to widen paved shoulder
 - 3' to 6' paved w/2' gravel: \$100,000
 - 3' to 8' paved: \$130,000
- Costs include:
 - Trenching, Agg Base, HMA
 - Shoulder Corrugations
 - Subtract cost of surface gravel

Time of Return Calculations

NUMBER OF CRASHES OR INJURED PERSONS.

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	2010	2011	2012	2013	2014
All Crashes (Except RORR)	%REDUCTION	25%			
Number of Crashes	843	822	888	909	953
PDO+Minor Inj Crashes	793	769	831	846	894
A-Injured or Killed Persons	65	66	76	84	88
Run Off Road Right Crashes	%REDUCTION	45%			
Number of Crashes	355	434	440	561	437
PDO+Minor Inj Crashes	335	409	425	538	422
A-Injured or Killed Persons	21	29	15	25	17

Time of Return Calculations

Q-Reference	Q	A-Injuries	Fatalities	I/F
RURAL	\$267,800	4485	768	5.84
URBAN	\$252,700	7731	1207	6.41
BETWEEN	\$258,300	12216	1975	6.19

Data from Safety Programs Unit; E. Line.
 5-Year Statewide Trunkline Crash Figures Used.
 (From 1-1-08 Through 12-31-12).

Time of Return (T.O.R.) is based on 5.0 years of data.

NOINFB = No-Inflation Annual Benefit = BTOTAL/years \$12,405,679

With an inflation rate of 2.50%

B = Annual Benefit = Present Value (with Inflation) \$15,880,318

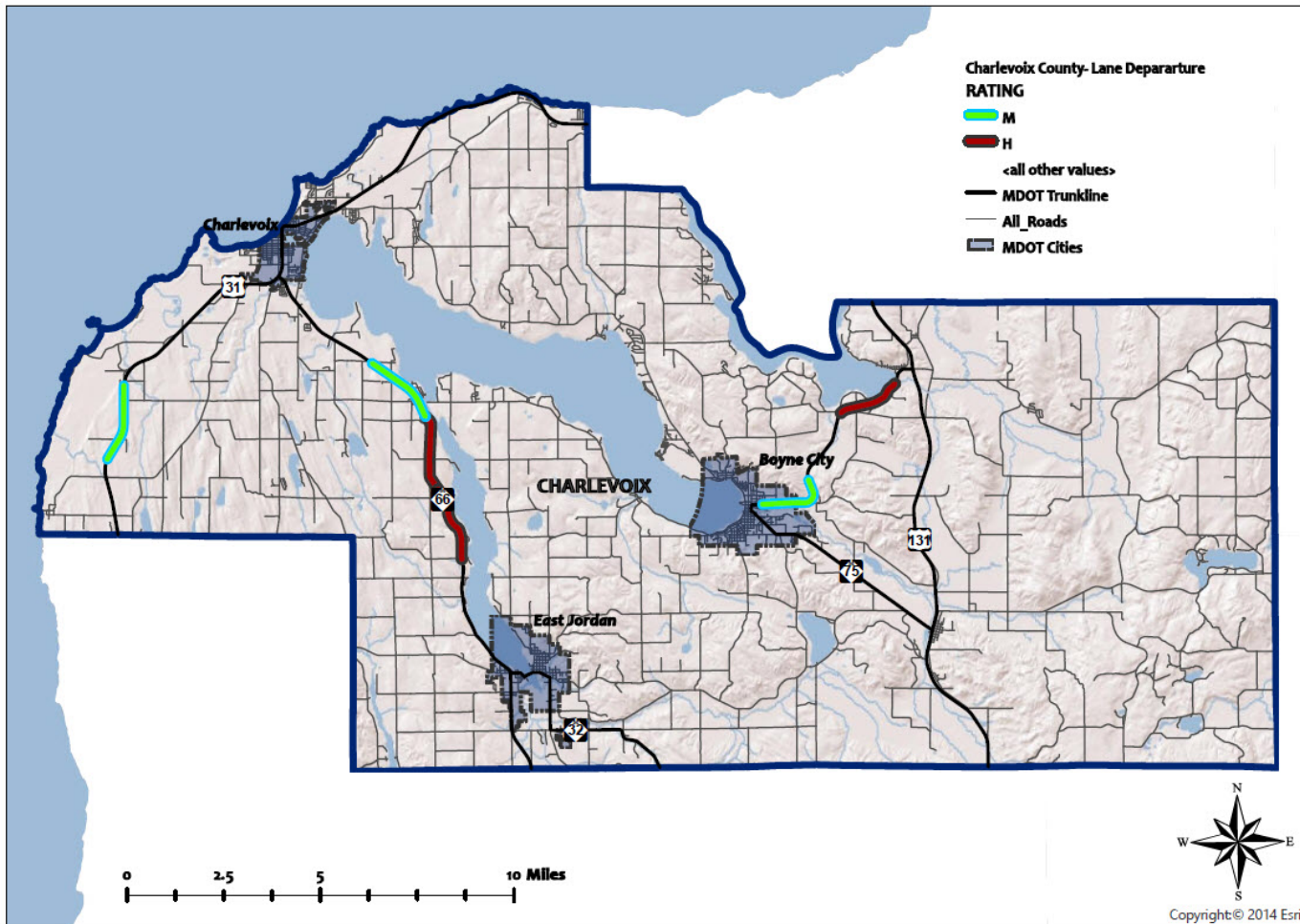
Time of Return Results

	8' Paved Shoulder	6' Paved, 2' Agg Shoulder
Total Cost	\$149,451,000	\$113,335,000
Annual Safety Benefit	\$15,880,318	\$10,610,248
Annual Maintenance Savings	\$1,124,000*	\$674,400
Total Annual Benefit	\$17,120,318	\$11,284,648
<i>Time of Return</i>	<i>8.7 Years</i>	<i>10.0 Years</i>

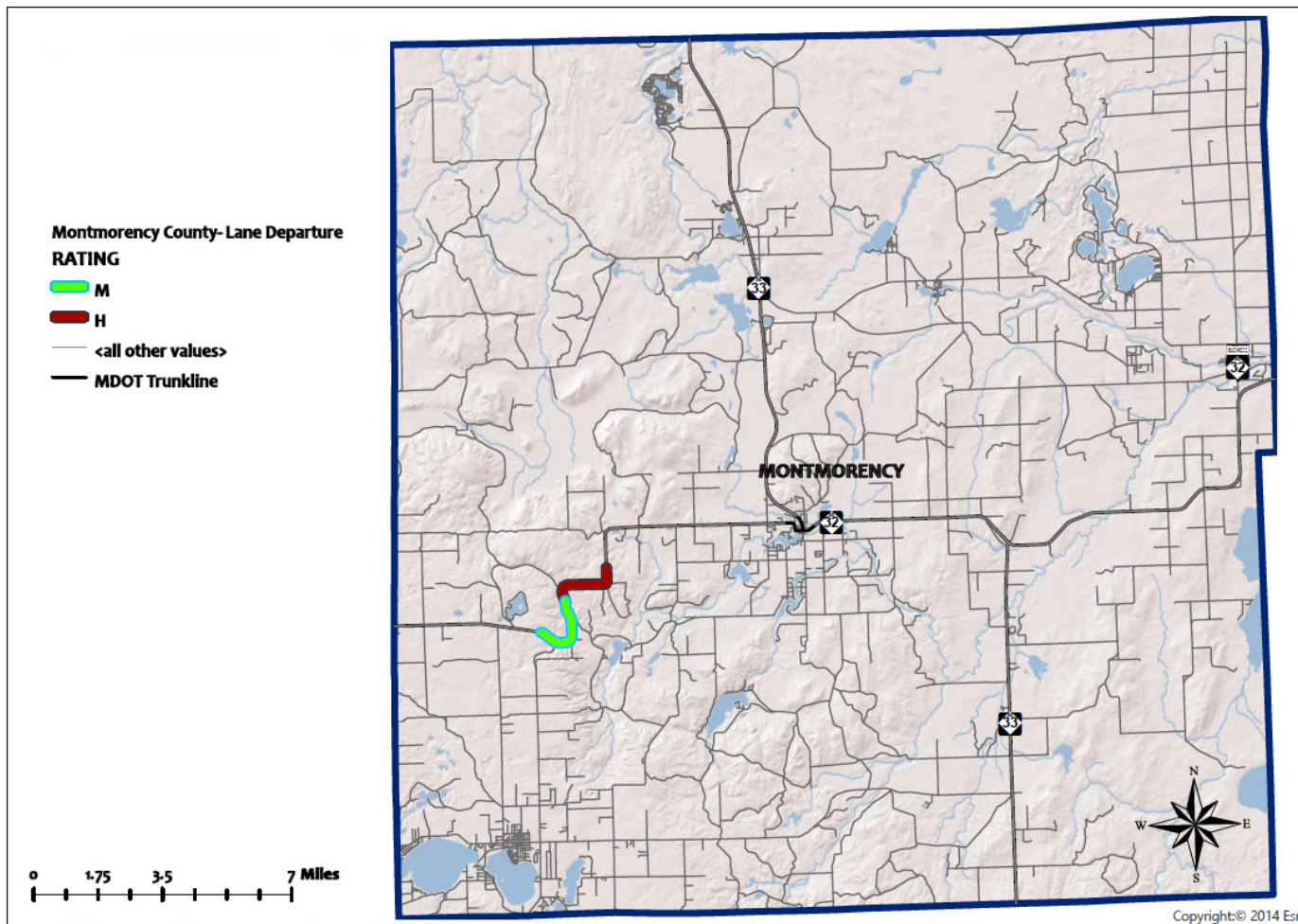
Impact to Projects (2017-2021)

Total Length of Projects (Miles)	Total Project Costs	Increased Cost to add 6' Paved Shoulders	Increased Cost to add 8' Paved Shoulders
69.719	\$132,677,911	\$2,825,696	\$3,927,148
<i>% of Program</i>		<i>2.1%</i>	<i>3.0%</i>
<i>Less Road Miles</i>		<i>1.5</i>	<i>2.1</i>

Trunkline Lane Departure



Trunkline Lane Departure



Incorporating into TZD

- New TZD Strategies:
 - Develop route-level plan for paving shoulders on segments with high or above average lane departure crash ratings
 - Construct at least 6' paved shoulders on 3R projects with summer ADT > 10,000.
 - Construct at least 6' paved shoulders on 3R projects with a high lane departure crash rating, regardless of ADT.

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Questions?



Toward Zero DeathsTM
National Strategy on Highway Safety