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Evaluating the Impacts of the 2017 Legislative Mandated Speed Limit Increases

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MDOT Michigan Department of Transportation

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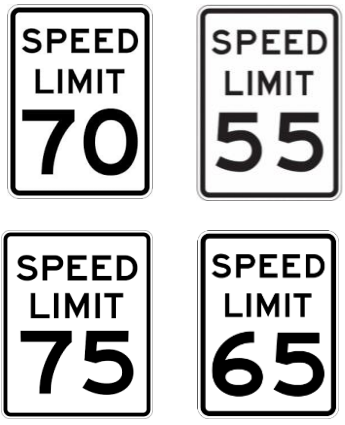
Overview

- Background on Speed Limit Policies in Michigan and Nationwide
- Study Objectives
- Public Perceptions
- Operational Impacts
- Safety Impacts
- Economic Impacts
- Conclusions



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US Speed Limit Policy – An Overview

- Posted speed limits are a means of indicating the maximum permissible speed under ideal roadway, traffic and weather conditions.
- Speed limits also provide a basis for the enforcement of unreasonably high travel speeds.
- These limits are typically established in consideration of the design speed of the road, which influences various geometric design features (e.g., stopping sight distance, minimum horizontal curve radius, maximum grade).
- Three major legislative decisions have influenced speed limit policies in the United States.
  - Emergency Highway Energy Conservation Act of 1974
  - Surface Transportation and Uniform Relocation Assistance Act of 1987
  - National Highway System Designation Act of 1995

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Michigan Speed Limit Increases

- Michigan Public Act 445 and 447 of 2016
  - Speed limits increased from 70 mph to 75 mph on 614 miles of freeways.
  - Speed limits increased from 55 mph to 65 mph on 943 miles of non-freeways.
  - Truck speed limits increased to 65 mph on all state trunklines where passenger car speed limits were 65 mph or higher.

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Michigan Speed Limit Increases

- The objective of this study was to evaluate the impacts of the resultant speed limit increases, which went into effect in 2017.
  - Public perception surveys
  - Examination of changes in travel speeds
  - Assessment of impacts on traffic crashes
  - Evaluation of economic impacts

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Examining Public Perceptions of Speed Limit Changes

- MSU State-of-the-State Survey
  - Survey questions approved in November 2019
  - Survey launched January 2020
- Data collected from YouGov.com
  - 1000 respondents completed the survey
  - Sample representative of Michigan adult population
  - Screening to identify respondents with experience driving on roadways of interest

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Survey Questions

- Under ideal conditions, what speed do you typically drive on:
  - Michigan freeways with a 70 mph speed limit?
  - Michigan rural freeways with a 75 mph speed limit?
  - Northern Michigan highways with a 55 mph speed limit?
- If it were up to you, what would the speed limit be on:
  - Michigan rural freeways?
  - Rural highways in Northern Michigan?
- Do you feel more or less safe since the speed limit increases?
- Should the speed limit for trucks and buses be the same, 5 mph lower, or 10 mph lower than for passenger cars on those freeways?
- How strongly do various factors impact your speed while driving?

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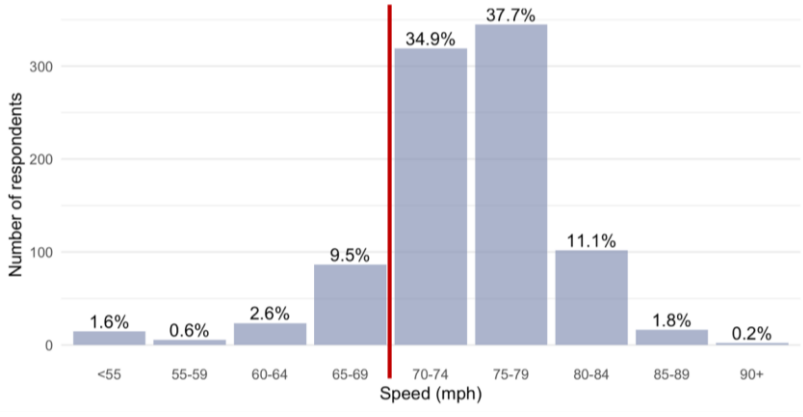
Under ideal conditions, what speed do you typically drive on Michigan freeways with a 70 mph speed limit?



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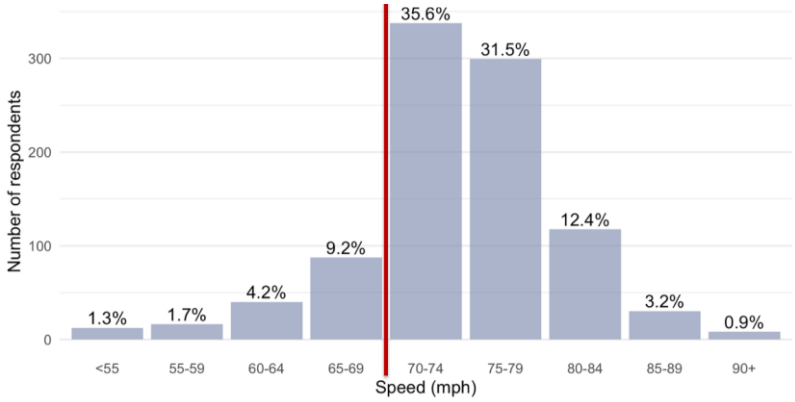
If it were up to you, what would the speed limit be on freeways in Michigan where the limit is currently set at 70 mph?



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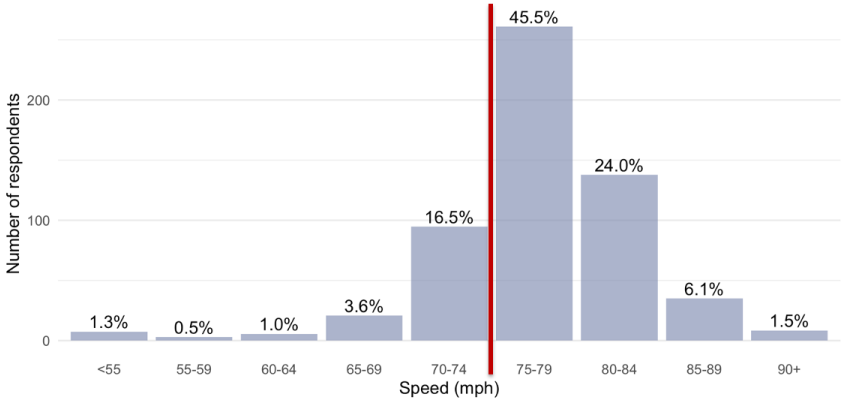
Under ideal conditions, what speed do you typically drive on Michigan rural freeways with a 75 mph speed limit?



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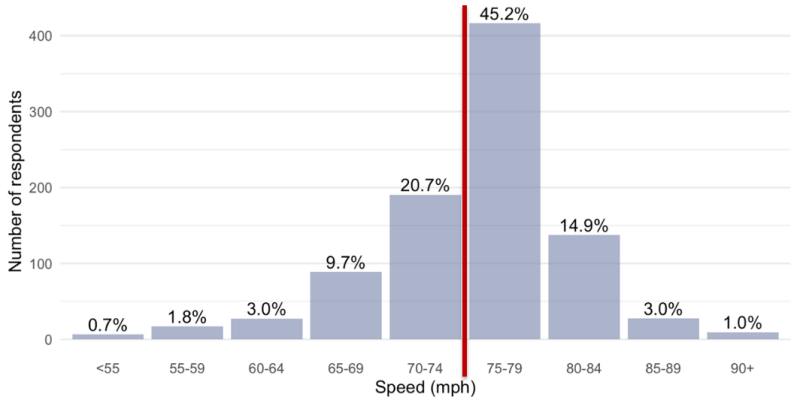
If it were up to you, what would the speed limit be on freeways in Michigan where the limit is currently set at 75 mph?



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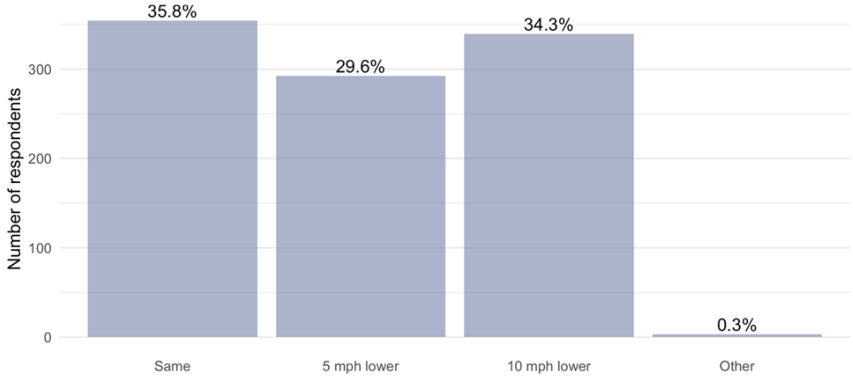
Should the speed limit for trucks and buses be the same, 5 mph lower, or 10 mph lower than for passenger cars on those freeways?



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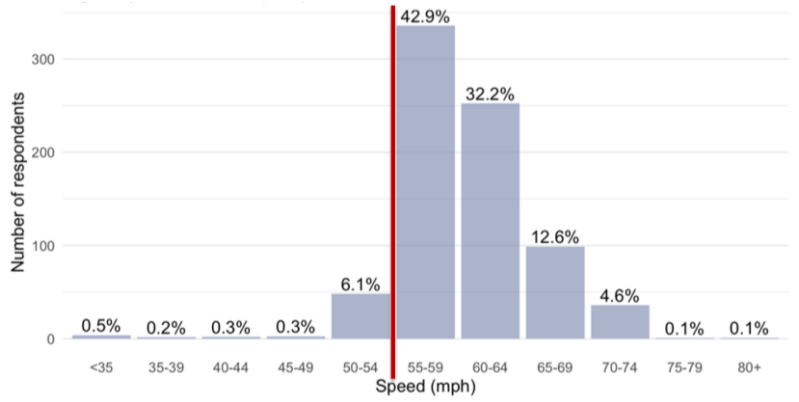
Under ideal conditions, what speed do you typically drive on Northern Michigan highways with a 55 mph speed limit?



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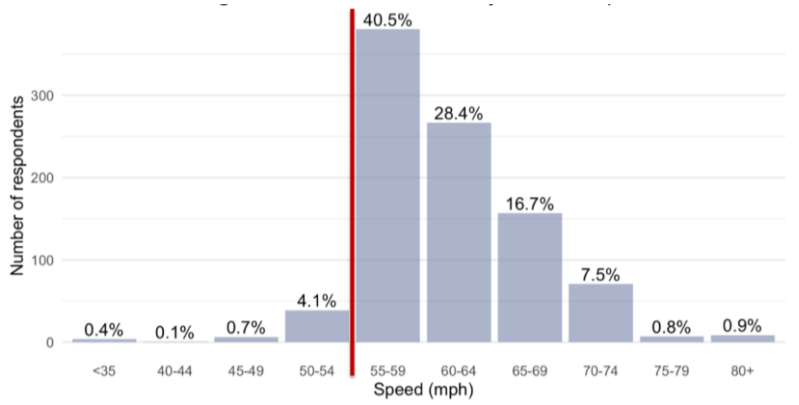
If it were up to you, what would the speed limit be on rural highways in Northern Michigan where the limit is currently set at 55 mph?



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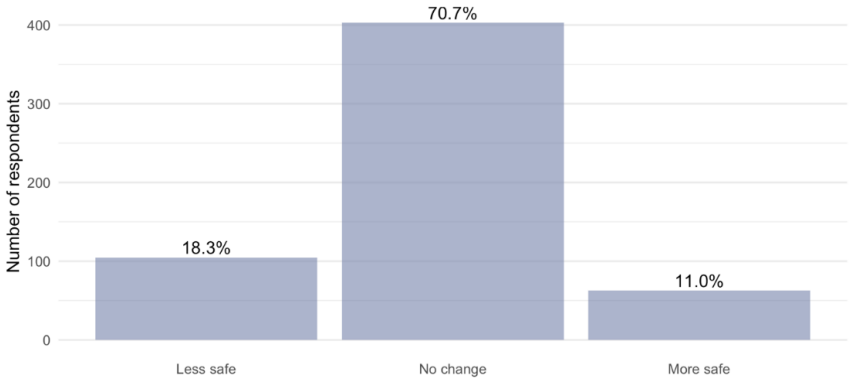
Do you feel more or less safe since the speed limit increases?



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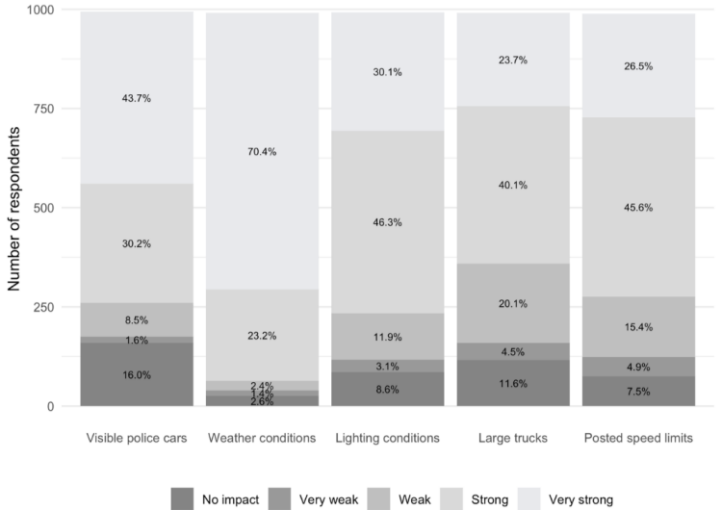
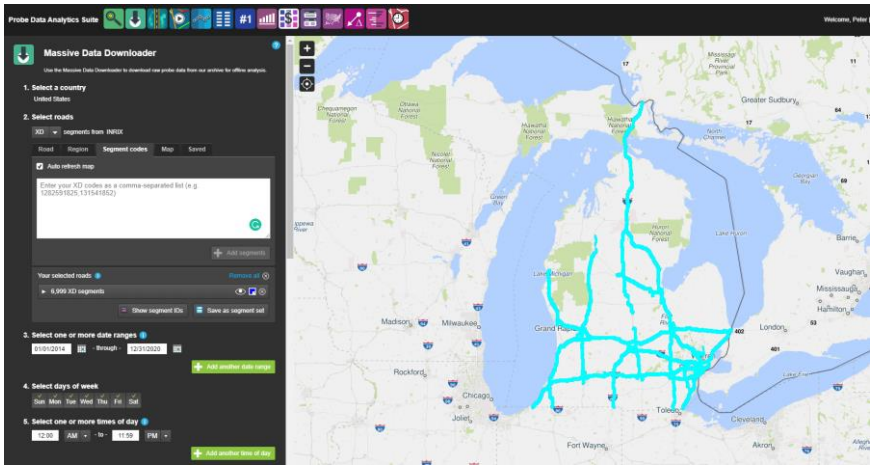
How strongly do these factors impact your speed while driving in Michigan?



Evaluation of Changes in Travel Speeds on Freeways

Probe Vehicle, Light Detection and Ranging (LIDAR), and Permanent Traffic Recorder (PTR) Speed Data for Freeways

Probe Vehicle Data



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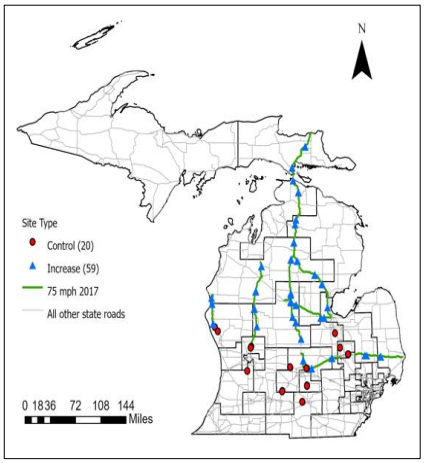
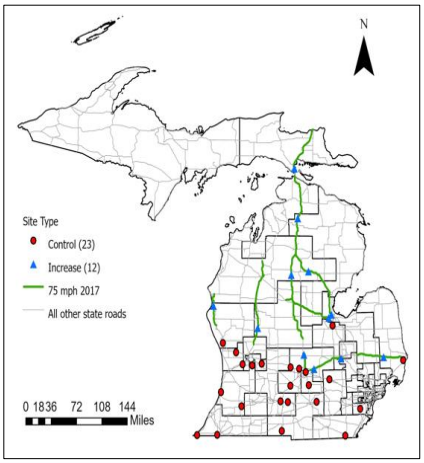
LIDAR and PTR Locations for Freeways

LIDAR Locations



PTR Station Locations



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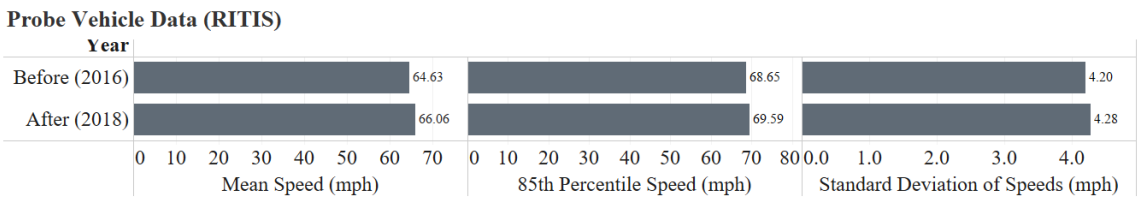
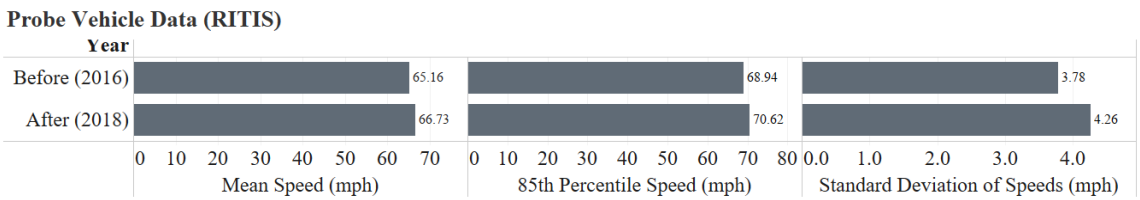
Speed Trends on CONTROL Sites (Freeways)



Speed Trends on INCREASE Sites (Freeways)



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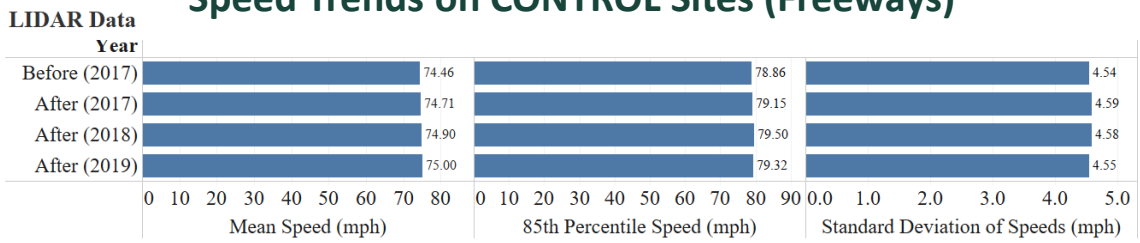
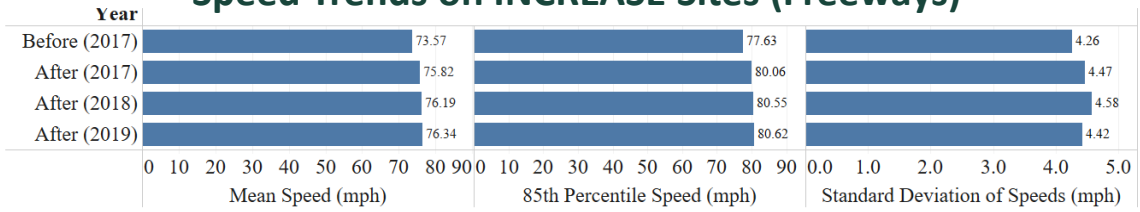
Speed Trends on CONTROL Sites (Freeways)



Speed Trends on INCREASE Sites (Freeways)



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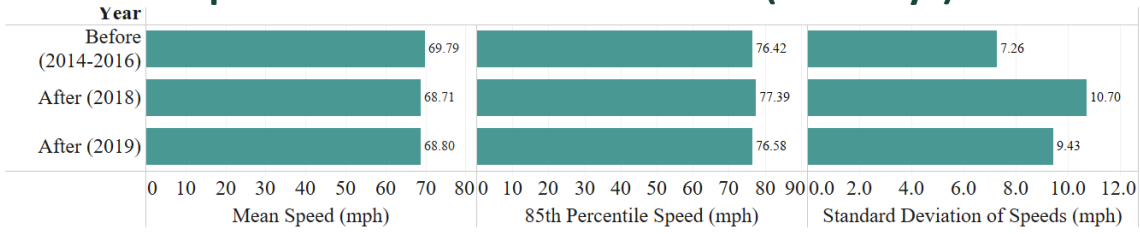
Speed Trends on CONTROL Sites (Freeways)



Speed Trends on INCREASE Sites (Freeways)

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Evaluation of Changes in Travel Speeds on Two-Lane Roads

LIDAR, and Camera Speed Data for Two-Lane Roads

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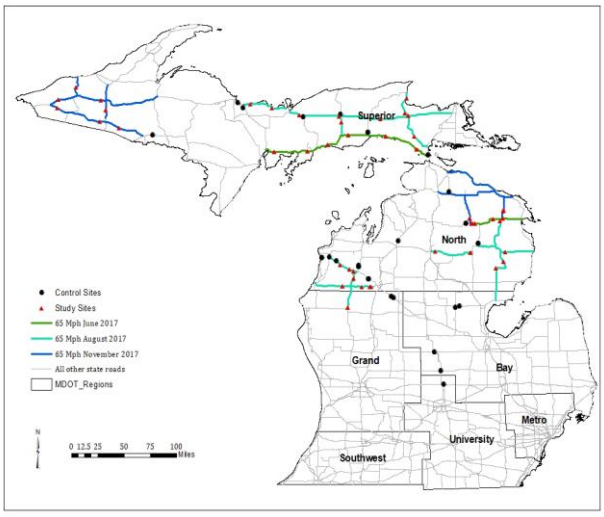
Speed Data Collection Locations on Two-Lane Roads



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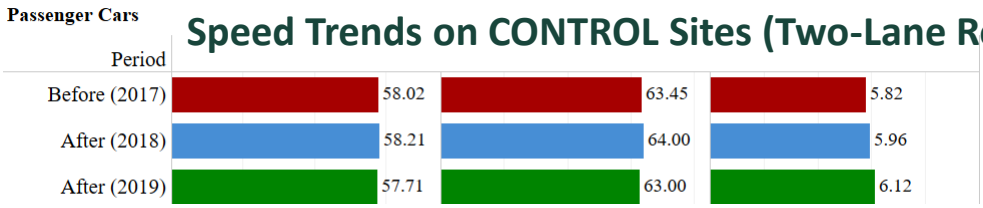
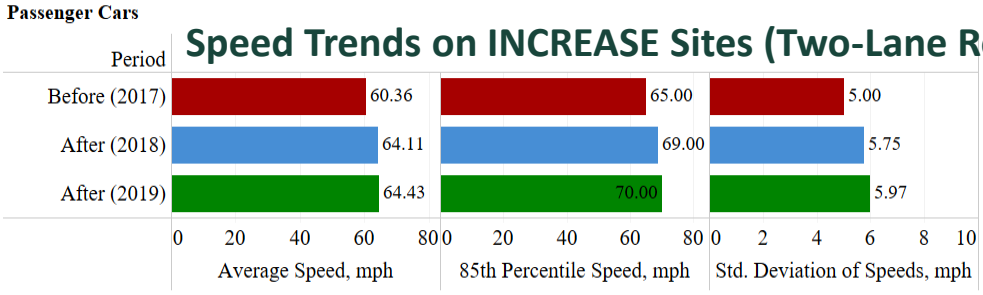
Speed Trends on CONTROL Sites (Two-Lane Roads)



Speed Trends on INCREASE Sites (Two-Lane Roads)



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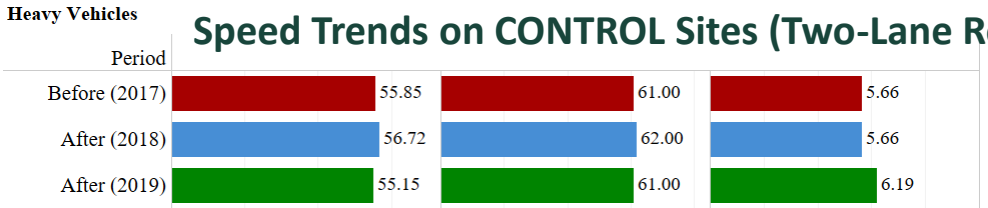
Speed Trends on CONTROL Sites (Two-Lane Roads)



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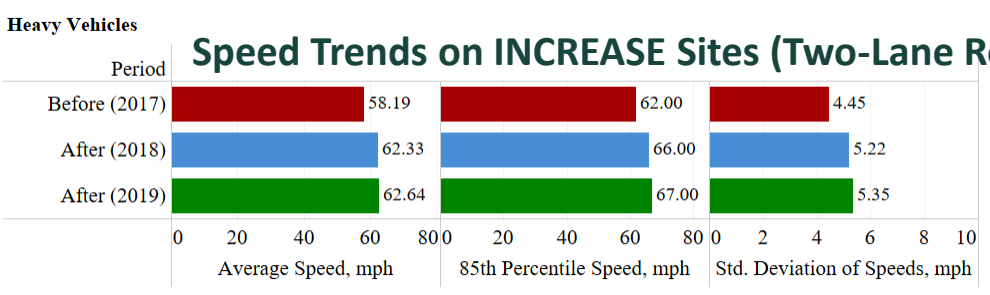

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Crash Data Analysis

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Freeways: Comparison of Pre- and Post- Increase Annual Crash Frequencies

Crash Type		Comparison Routes (70 MPH) 2,472 Miles			Speed Limit Increase Routes (75 MPH) 1,217 Miles		
		Pre-Conversion	Post-Conversion	Percent Change	Pre-Conversion	Post-Conversion	Percent Change
All Crashes	Fatal	80.0	83.5	4.4%	10.7	16.5	54.7%
	Serious Injury	368.0	382.0	3.8%	53.3	63.5	19.1%
	Minor Injury	1,190.3	1,279.5	7.5%	150.0	203.5	35.7%
	Possible Injury	3,445.3	3,386.0	-1.7%	282.7	318.5	12.7%
	Property Damage Only	22,641.3	23,543.5	4.0%	3,137.0	3,638.5	16.0%
	Total	**27,725.0**	**28,674.5**	**3.4%**	**3,633.7**	**4,240.5**	**16.7%**
Animal Crashes		**2,621.0**	**2,867.0**	**9.4%**	**1,665.3**	**1,952.5**	**17.2%**
Non-Animal Crashes	Fatal	80.0	83.5	4.4%	10.7	15.5	45.3%
	Serious Injury	365.0	375.0	2.7%	51.3	60.0	16.9%
	Minor Injury	1,160.0	1,236.5	6.6%	132.7	171.0	28.9%
	Possible Injury	3,358.3	3,274.5	-2.5%	243.0	261.0	7.4%
	Property Damage Only	20,140.7	20,838.0	3.5%	1,530.7	1,780.5	16.3%
	Total	**25,104.0**	**25,807.5**	**2.8%**	**1,968.3**	**2,288.0**	**16.2%**
	Single Vehicle	9,806.7	9,351.5	-4.6%	1,382.3	1,559.5	12.8%
	Rear End	8,802.0	9,373.5	6.5%	287.0	332.0	15.7%
	Sideswipe Same	4,812.3	5,304.0	10.2%	191.3	242.0	26.5%
	Other	1,683.0	1,778.5	5.7%	107.7	154.5	43.5%
	Total	**25,104.0**	**25,807.5**	**2.8%**	**1,968.3**	**2,288.0**	**16.2%**

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Freeways: Comparison of Pre- and Post- Increase Crash Rates (per 100 MVMT)

Crash Type		Comparison Routes (70 MPH) 2,472 Miles			Speed Limit Increase Routes (75 MPH) 1,217 Miles		
		Pre-Conversion	Post-Conversion	Percent Change	Pre-Conversion	Post-Conversion	Percent Change
All Crashes	Fatal	0.32	0.32	-1.6%	0.33	0.44	33.0%
	Serious Injury	1.47	1.44	-2.0%	1.64	1.68	2.3%
	Minor Injury	4.76	4.83	1.5%	4.62	5.39	16.6%
	Possible Injury	13.78	12.79	-7.2%	8.72	8.44	-3.1%
	Property Damage Only	90.57	88.92	-1.8%	96.72	96.43	-0.3%
	Total	**110.91**	**108.30**	**-2.3%**	**112.03**	**112.39**	**0.3%**
Animal Crashes		**10.48**	**10.83**	**3.3%**	**51.35**	**51.75**	**0.8%**
Non-Animal Crashes	Fatal	0.32	0.32	-1.6%	0.33	0.41	24.3%
	Serious Injury	1.46	1.42	-3.0%	1.58	1.59	0.5%
	Minor Injury	4.64	4.67	0.6%	4.09	4.53	10.8%
	Possible Injury	13.43	12.37	-7.9%	7.49	6.92	-7.7%
	Property Damage Only	80.57	78.70	-2.3%	47.19	47.19	0.0%
	Total	**100.42**	**97.47**	**-2.9%**	**60.69**	**60.64**	**-0.1%**
	Single Vehicle	39.23	35.32	-10.0%	42.62	41.33	-3.0%
	Rear End	35.21	35.40	0.5%	8.85	8.80	-0.6%
	Sideswipe Same	19.25	20.03	4.0%	5.90	6.41	8.7%
	Other	6.73	6.72	-0.2%	3.32	4.09	23.2%
	Total	**100.42**	**97.47**	**-2.9%**	**60.69**	**60.64**	**-0.1%**

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Two-Lane Highways: Comparison of Pre- and Post- Increase Annual Crash Frequencies

Crash Type		Comparison Routes (55 MPH) 4,589 Miles			Speed Limit Increase Routes (65 MPH) 932 Miles		
		Pre-Conversion	Post-Conversion	Percent Change	Pre-Conversion	Post-Conversion	Percent Change
All Crashes	Fatal	98.3	100.5	2.2%	3.0	6.5	116.7%
	Serious Injury	314.0	370.0	17.8%	28.3	35.5	25.3%
	Minor Injury	724.3	780.0	7.7%	52.0	53.5	2.9%
	Possible Injury	1,354.3	1,262.0	-6.8%	75.7	94.5	24.9%
	Property Damage Only	14,489.3	16,299.5	12.5%	1,452.7	2,066.5	42.3%
	Total	**16,980.3**	**18,812.0**	**10.8%**	**1,611.7**	**2,256.5**	**40.0%**
Animal Crashes		**9,161.3**	**11,135.5**	**21.5%**	**1,124.0**	**1,659.5**	**47.6%**
Non-Animal Crashes	Fatal	97.3	98.5	1.2%	3.0	6.5	116.7%
	Serious Injury	302.7	354.5	17.1%	26.0	33.0	26.9%
	Minor Injury	680.3	720.0	5.8%	44.7	41.5	-7.1%
	Possible Injury	1,240.0	1,129.5	-8.9%	62.7	75.0	19.7%
	Property Damage Only	5,498.7	5,374.0	-2.3%	351.3	441.0	25.5%
	Total	**7,819.0**	**7,676.5**	**-1.8%**	**487.7**	**597.0**	**22.4%**
	Single Vehicle	3,274.7	3,010.0	-8.1%	294.0	353.0	20.1%
	Head On	208.3	215.5	3.4%	8.3	10.5	26.0%
	Head On Left-Turn	175.7	200.0	13.8%	7.7	7.5	-2.2%
	Angle	963.0	944.0	-2.0%	33.7	39.0	15.8%
	Rear End	2,151.0	2,144.0	-0.3%	71.3	90.5	26.9%
	Sideswipe Same	455.0	501.5	10.2%	33.7	38.0	12.8%
	Sideswipe Opposite	247.3	257.0	3.9%	14.3	22.0	53.5%
	Other	344.0	404.5	17.6%	24.7	36.5	48.0%
	Total	**7,819.0**	**7,676.5**	**-1.8%**	**487.7**	**597.0**	**22.4%**

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Two-Lane Highways: Comparison of Pre- and Post- Increase Crash Rates (per 100 MVMT)

Crash Type		Comparison Routes (55 MPH) 4,589 Miles			Speed Limit Increase Routes (65 MPH) 932 Miles		
		Pre-Conversion	Post-Conversion	Percent Change	Pre-Conversion	Post-Conversion	Percent Change
All Crashes	Fatal	1.29	1.25	-2.6%	0.39	0.73	90.1%
	Serious Injury	4.11	4.62	12.3%	3.65	4.01	9.9%
	Minor Injury	9.49	9.74	2.6%	6.70	6.05	-9.7%
	Possible Injury	17.74	15.75	-11.2%	9.75	10.68	9.6%
	Property Damage Only	189.84	203.48	7.2%	187.21	233.64	24.8%
	Total	**222.48**	**234.85**	**5.6%**	**207.70**	**255.13**	**22.8%**
Animal Crashes		**120.03**	**139.02**	**15.8%**	**144.85**	**187.63**	**29.5%**
Non-Animal Crashes	Fatal	1.28	1.23	-3.6%	0.39	0.73	90.1%
	Serious Injury	3.97	4.43	11.6%	3.35	3.73	11.4%
	Minor Injury	8.91	8.99	0.8%	5.76	4.69	-18.5%
	Possible Injury	16.25	14.10	-13.2%	8.08	8.48	5.0%
	Property Damage Only	72.04	67.09	-6.9%	45.28	49.86	10.1%
	Total	**102.44**	**95.83**	**-6.5%**	**62.85**	**67.50**	**7.4%**
	Single Vehicle	42.90	37.58	-12.4%	37.89	39.91	5.3%
	Head On	2.73	2.69	-1.4%	1.07	1.19	10.5%
	Head On Left-Turn	2.30	2.50	8.5%	0.99	0.85	-14.2%
	Angle	12.62	11.78	-6.6%	4.34	4.41	1.6%
	Rear End	28.18	26.77	-5.0%	9.19	10.23	11.3%
	Sideswipe Same	5.96	6.26	5.0%	4.34	4.30	-1.0%
	Sideswipe Opposite	3.24	3.21	-1.0%	1.85	2.49	34.7%
	Other	4.51	5.05	12.0%	3.18	4.13	29.8%
	Total	**102.44**	**95.83**	**-6.5%**	**62.85**	**67.50**	**7.4%**

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Economic Analysis

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Benefit/Cost Analysis Factors

- Agency Infrastructure Costs (Denominator)
  - Speed limit signs
  - Warning signs (SRZs, curve warning, no passing zones, etc.)
  - Pavement markings (NPZ, auxiliary lanes and tapers, etc.)
- Value of Road User Benefits/Disbenefits (Numerator)
  - Fuel consumption
  - Travel time
  - Traffic crashes
- Scope
  - 608.7 miles of freeway (1844.8 miles for trucks)
  - 966.1 miles of non-freeway highways

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MDOT Infrastructure Costs

Roadway Type	Signs	Pavement Markings	Labor/ Other	Total	Equivalent Annualized Cost*
Freeway	$17,620	$0	$115,244	$132,864	$11,130
Non-Freeway	$25,312	$12,591	$110,006	$147,909	$23,926

- Assumes 15-year service life for signs and labor/other costs
- Pavement marking costs incurred annually
- 3 percent discount rate.

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Fuel Economy vs. Speed

- Heavy trucks:
  - 7 mpg at 55 mph
  - Decreases by 0.1 mpg for every 1 mph increase in speed (Bridgestone; Garthwaite, 2011; Oak Ridge National Laboratory, 2013)
- Passenger vehicles:
  - 25 mpg at 70 mph
  - Decreases by 0.4 mpg for every 1 mph increase in speed (Thomas, West, & Huff, 2013)
- MSU's LIDAR data used for pre/post travel speeds
  - Non-congested daytime conditions
  - 56 freeway and 36 non-freeway locations

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Fuel Prices

Average Retail Fuel Price in Michigan by Date (AAA)

Date	Regular Unleaded ($/gal)	Diesel ($/gal)
March 31, 2022 Average Price	$4.09	$4.96
Feb 28, 2022 Average Price	$3.56	$3.99
March 31, 2021 Average Price	$2.84	$3.05

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Increased Fuel Consumption (Disbenefit)

Freeways

Vehicle Type	Pre-Increase Mean Speed (mph)	Post-Increase Mean Speed (mph)	VMT 2019 (millions)	Fuel Unit Cost ($/gal)	Pre-Increase Fuel Economy (mpg)	Post-Increase Fuel Economy (mpg)	Change in Annual Fuel Consumption (gallons)	Change in Annual Fuel Consumption Cost ($)
Passenger	73.43	76.17	3,415.70	$3.50	23.63	22.53	7,031,742	$24,611,098
Heavy Trucks	62.30	65.11	3,405.32	$4.00	6.27	5.99	25,482,528	$101,930,112
TOTAL							32,339,522	$126,368,243

Non-Freeways

Vehicle Type	Pre-Increase Mean Speed (mph)	Post-Increase Mean Speed (mph)	VMT 2019 (millions)	Fuel Unit Cost ($/gal)	Pre-Increase Fuel Economy (mpg)	Post-Increase Fuel Economy (mpg)	Change in Annual Fuel Consumption (gallons)	Change in Annual Fuel Consumption Cost ($)
Passenger	59.21	63.22	863.69	$3.50	29.32	27.71	1,705,260	$5,968,409
Heavy Trucks	57.43	61.73	98.65	$4.00	6.76	6.33	992,283	$3,969,132
TOTAL							2,697,543	$9,937,542

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Travel Time Savings (Benefit)

Freeways

Vehicle Type	Pre-Increase Mean Speed (mph)	Post-Increase Mean Speed (mph)	Value of Time Unit Cost ($/veh/ hr)*	Pre-Increase Travel Time (hours)	Post-Increase Travel Time (hours)	Annual Travel Time Savings (hours)	Annual Value of Time Savings ($)
Passenger	73.43	76.17	$19.66	46,516,343	44,843,049	1,673,294	$32,896,954
Heavy Trucks	62.3	65.11	$34.68	54,660,047	52,301,043	2,359,004	$81,810,249
TOTAL						4,032,297	$114,707,202

Non-Freeways

Vehicle Type	Pre-Increase Mean Speed (mph)	Post-Increase Mean Speed (mph)	Value of Time Unit Cost ($/veh/ hr)*	Pre-Increase Travel Time (hours)	Post-Increase Travel Time (hours)	Annual Travel Time Savings (hours)	Annual Value of Time Savings ($)
Passenger	59.21	63.22	$19.66	14,586,924	13,661,686	925,238	$18,190,185
Heavy Trucks	57.43	61.73	$34.68	1,717,830	1,598,169	119,661	$4,149,840
TOTAL						1,044,899	$22,340,025

* Value of Time unit costs per vehicle based on MDOT Construction Congestion Cost (CO3) website
Note: 2019 VMT was utilized

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Increased Crashes (Disbenefit)
Raw Counts

	Severity	Average Annual Crash Frequency, 2014-2016 (Pre-Increase)	% Change in Crash Frequency (Post-Increase)	Change in Crash Frequency (Post-Increase)	Unit Cost Per Crash (2020 Dollars)*	Change in Annual Crash Costs
Freeways	K	10.7	54.7%	5.8	$12,176,441	$71,029,240
	A	53.3	19.1%	10.2	$706,090	$7,178,582
	B	150.0	35.7%	53.5	$213,983	$11,448,091
	C	282.7	12.7%	35.8	$135,397	$4,851,719
	PDO	3,137.0	16.0%	501.5	$12,828	$6,433,342
	Total	3,633.7	**16.7%**	**606.8**		**$100,940,973**
Non-Freeways	K	4.3	73.1%	3.2	$12,176,441	$38,558,730
	A	31.7	24.7%	7.8	$706,090	$5,531,038
	B	57.7	8.4%	4.8	$213,983	$1,034,251
	C	86.3	21.0%	18.2	$135,397	$2,459,709
	PDO	1,561.7	41.0%	639.8	$12,828	$8,207,910
	Total	1,741.7	**38.7%**	**673.8**		**$55,791,638**

*Comprehensive crash unit costs obtained from the FHWA's Crash Costs for Highway Safety Analysis

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Increased Crashes (Disbenefit)
Volume Adjusted

	Severity	Average Annual Crash Frequency, 2014-2016 (Pre-Increase)	% Change in Crash Frequency (Post-Increase)	Change in Crash Frequency (Post-Increase)	Unit Cost Per Crash (2020 Dollars)*	Change in Annual Crash Costs
Freeways	K	10.7	34.0%	3.6	$12,176,441	$44,152,234
	A	53.3	3.1%	1.7	$706,090	$1,180,528
	B	150.0	17.5%	26.3	$213,983	$5,622,764
	C	282.7	-2.4%	-6.8	$135,397	$(917,200)
	PDO	3,137.0	0.5%	14.8	$12,828	$189,317
	Total	3,633.7	**1.1%**	**39.6**		**$50,227,644**
Non-Freeways	K	4.3	55.2%	2.4	$12,176,441	$29,107,496
	A	31.7	11.8%	3.7	$706,090	$2,644,588
	B	57.7	-2.8%	-1.6	$213,983	$(349,845)
	C	86.3	8.5%	7.4	$135,397	$995,403
	PDO	1,561.7	26.4%	412.0	$12,828	$5,285,163
	Total	1,741.7	**24.3%**	**423.8**		**$37,682,806**

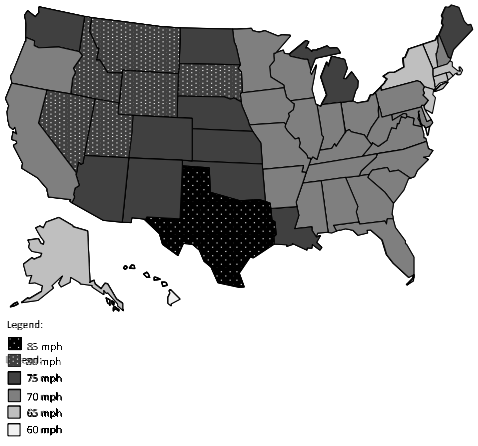
*Comprehensive crash unit costs obtained from the FHWA's Crash Costs for Highway Safety Analysis

Benefit/Cost Ratio
Comparison by Crash Estimation Method

$$\frac{B}{C} = \frac{Travel\ Time\ Savings - Increased\ Fuel\ Consuption\ Costs - Increased\ Crash\ Costs}{Infrastructure\ Costs}$$

Crash Estimation Method	B/C Freeway	B/C 2-Lane	B/C Combined
Raw Crashes	-10,133	-1,813	-4,455
Volume Adj Crashes	-5,576	-1,057	-2,492

Conclusions



Rural Interstate Speed Limits, 2012 (IIHS)

- Over the past 10 years, numerous states have increased their maximum speed limits.
- Additional states have considered, or are currently considering, similar increases.
- These most recent increases are unique in that they have been more selective in nature….

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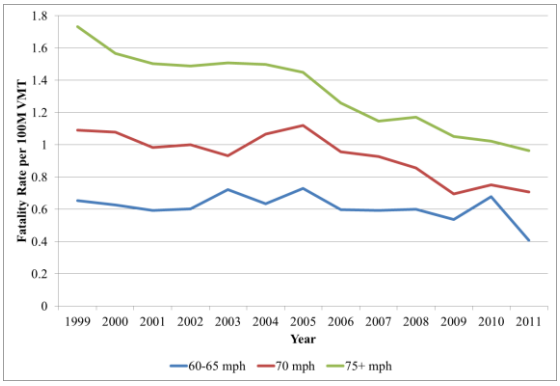
Conclusions



Rural Interstate Fatality Rate by Maximum Speed Limit, 1999-2011 (Savolainen and Gates, 2014)

- Overall, results have consistently shown that fatalities increase in those states with higher speed limits.
- If increases are introduced at a larger-scale, there are significant concerns as to the potential impacts.
- Additional concerns have arisen since the onset of the COVID-19 pandemic.
- Big issue nationally (e.g., NTSB, NCHRP 03-139), solutions are a challenge.

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Questions or Comments?

SPARTANS WILL.

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