An Analysis of the Safety Impacts and Costs of Crossover Median Crashes in Wisconsin

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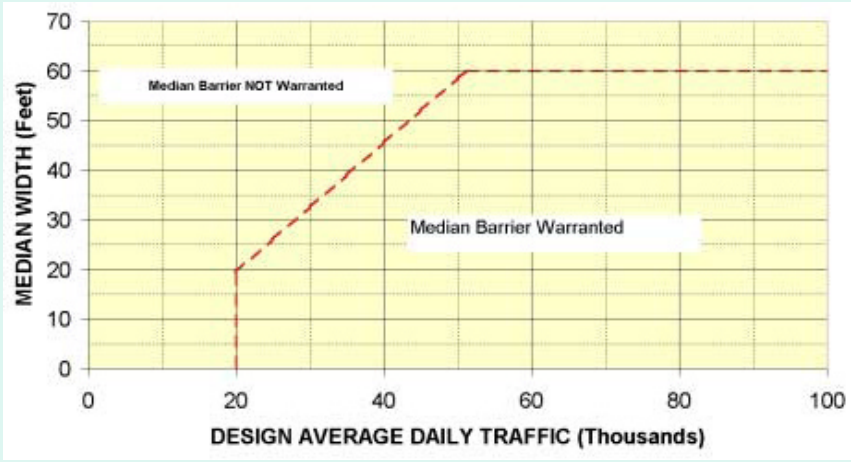
Objectives of Research

- Determine the magnitude of crossover median crashes
- Understand the relationship between crossover median crashes, median width, and ADT
- Characteristics and causes of CMCs
- Investigate the cost of CMCs
  - Crash Outcome Data Evaluation Systems (CODES) analysis
  - Benefit/Cost analysis



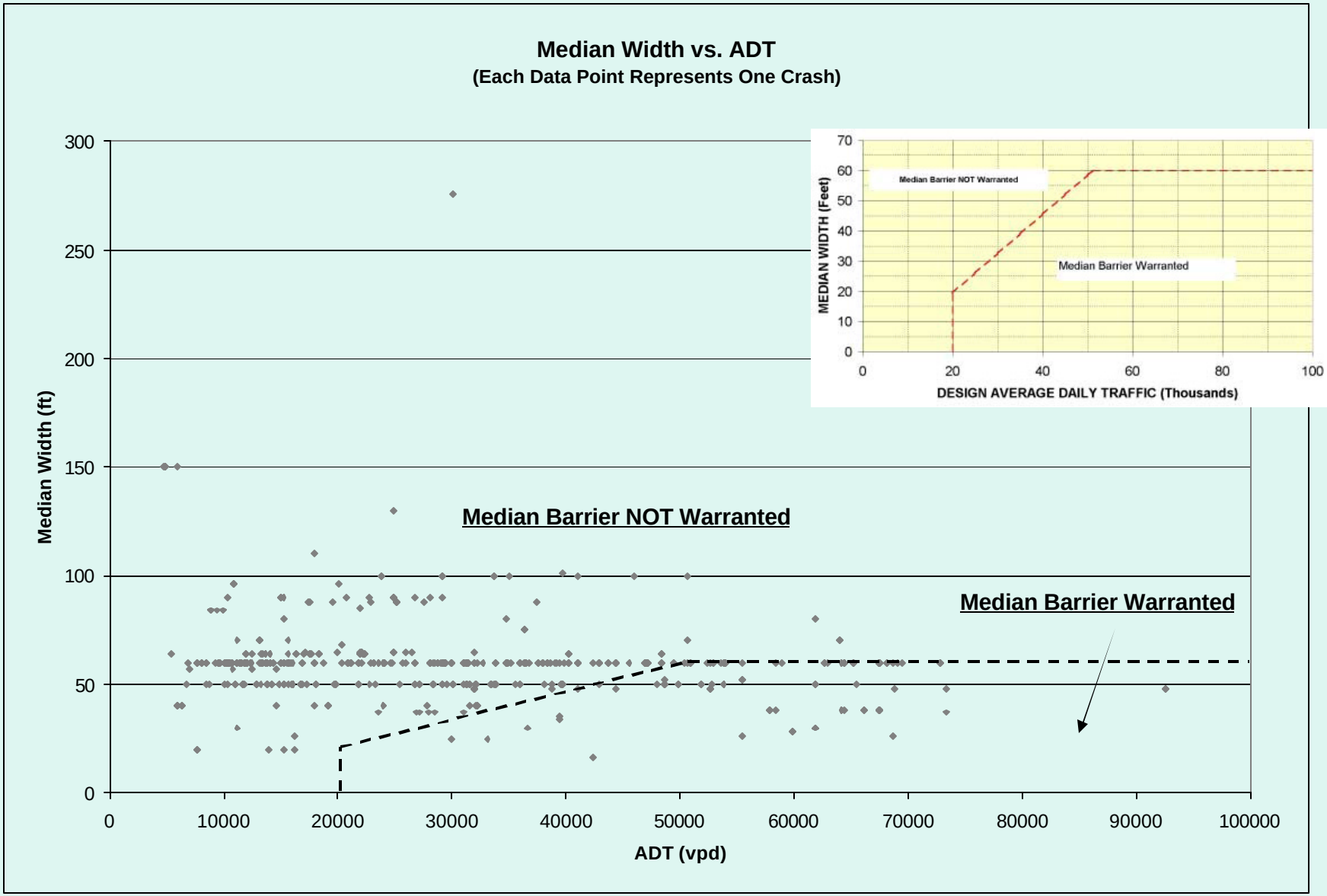
Data Collection

- Manual review of 15,194 crash reports
  - 2001 – 2003
    - Interstates 39, 43, 90, 94
    - USH 10, 12, 14, 18, 41, 51, 53, 141, 151
    - STH 23, 29, 30, 35, 54, 57, 172, 441
  - Districts 1, 3-8
    - District 2 gathered earlier by WisDOT staff

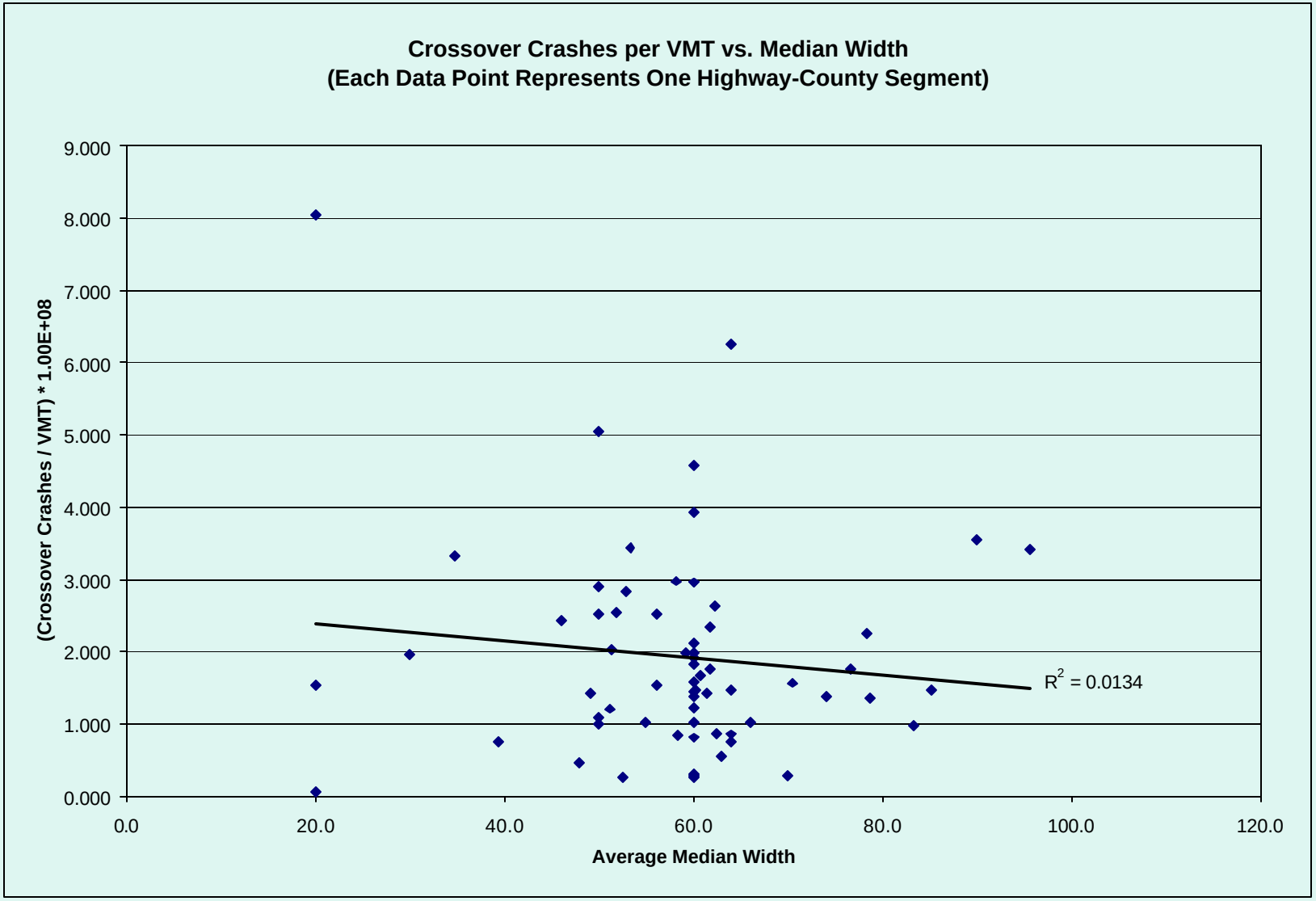
Results

- Initial total: 732 CMCs
  - Object crossover crashes *-64*
    - Tire crossovers 52
    - Other object crossovers 12
  - Median barrier crossover crashes *-32*
  - Intentional median crossover crashes *-5*
- Final total: 631 CMCs (2001 – 2003)
  - 624 vehicle crossover crashes
  - 7 trailer crossover crashes

Crossover Median Crashes



Crossover Median Crashes, Median Width, and ADT



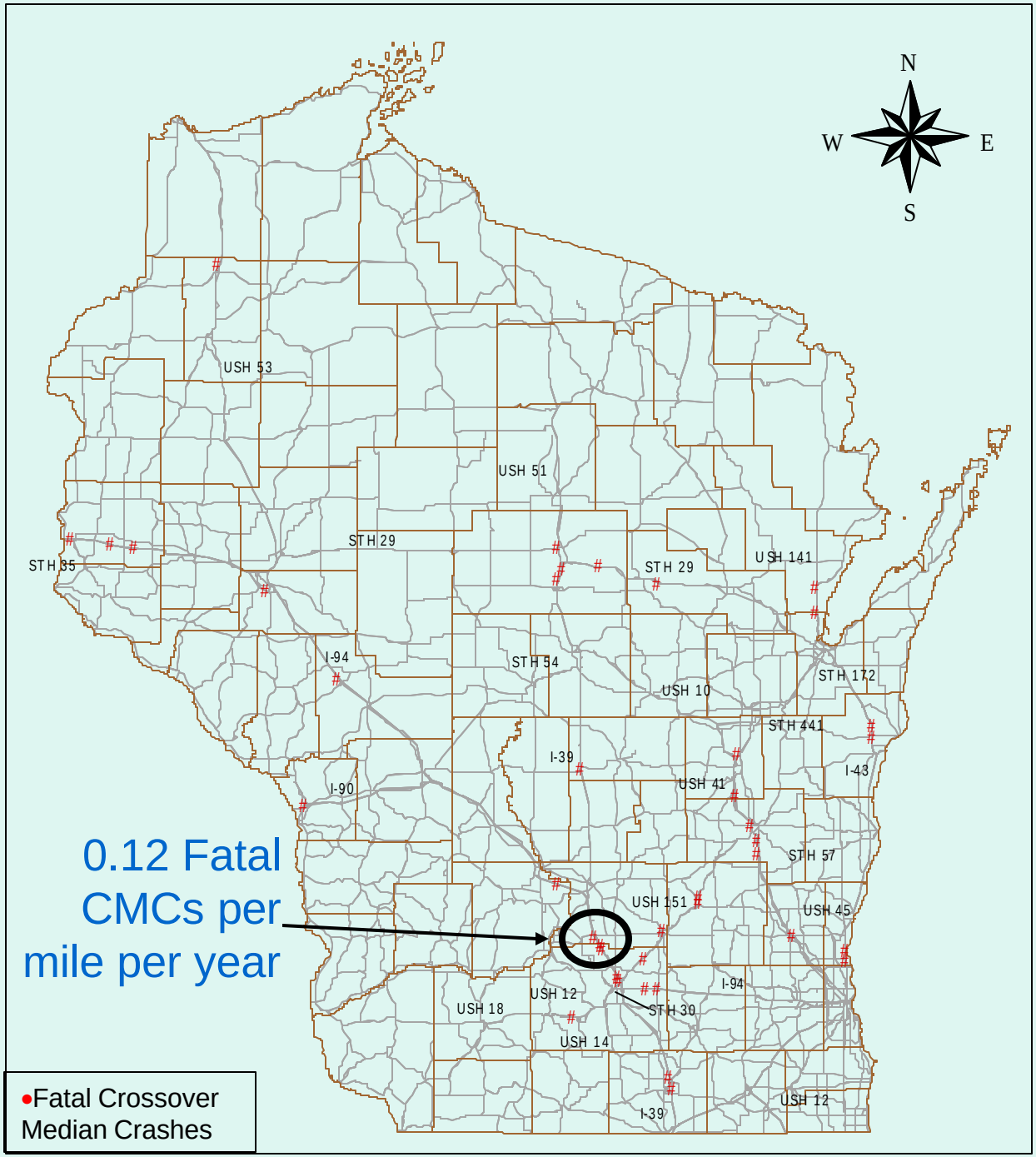
Crossover Median Crashes, Median Width, and Crash Severity

Median Width (ft)	Crossover Median Crashes
< 30	13 (2%)
30 – 39	33 (5%)
40 – 49	34 (5%)
50 – 59	135 (22%)
60 – 69	348 (55%)
70 – 79	10 (2%)
80 +	58 (9%)

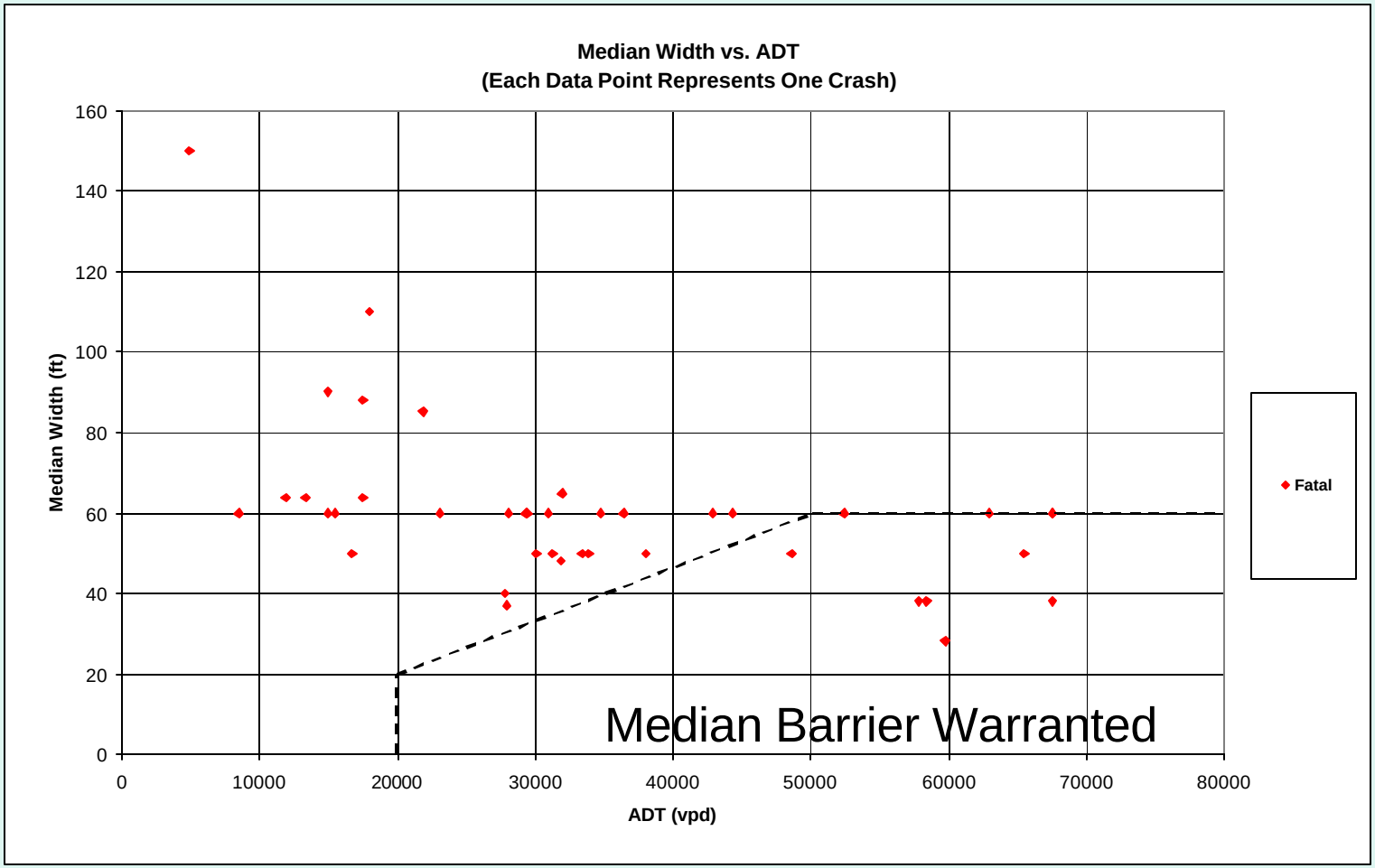
- Property Damage Only: 254 (40%)
- Personal Injury: 336 (53%)
- Fatal: 41 (7%)

Fatal Crossover Median Crashes

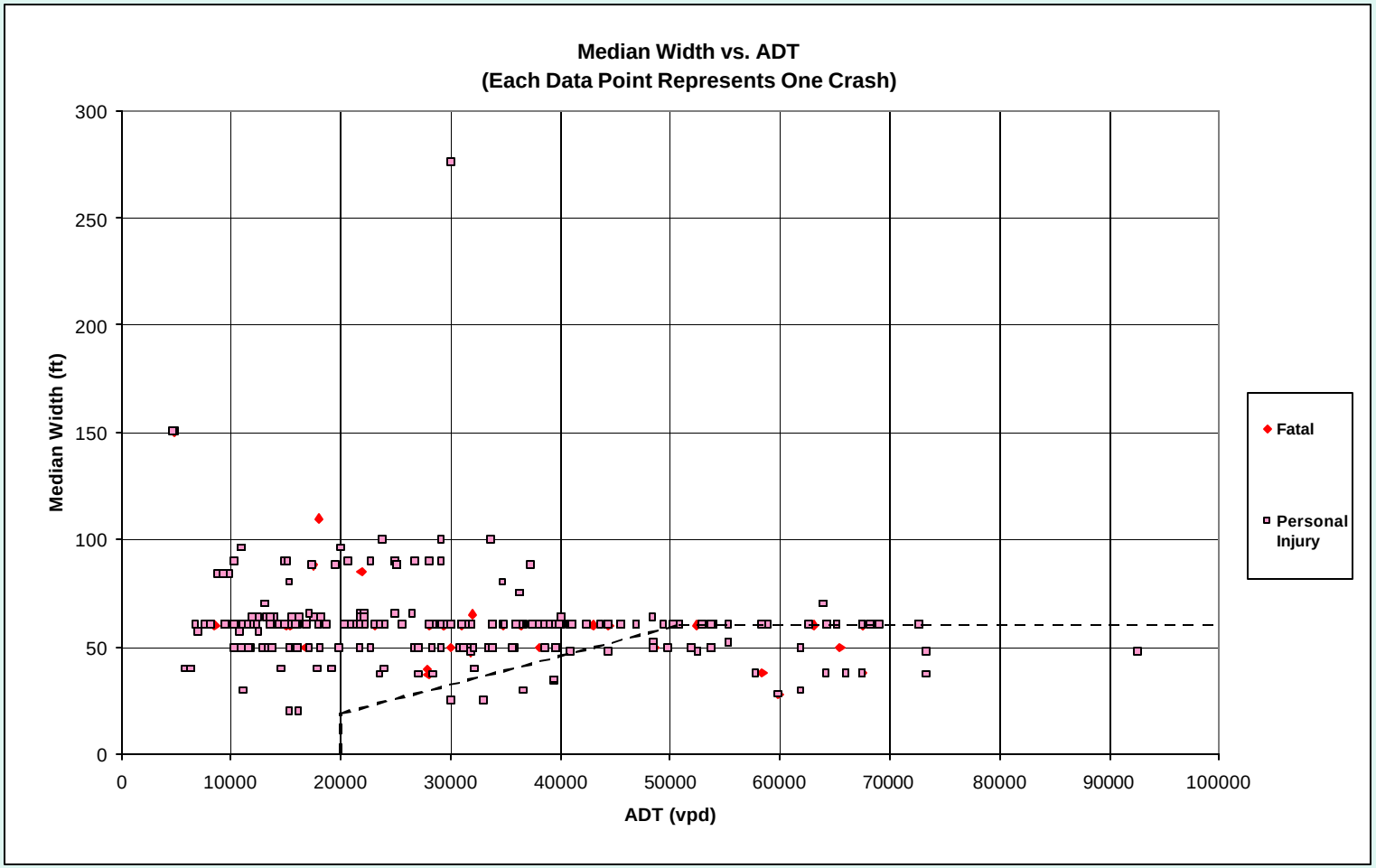
- 41 Fatal CMCs
  - 53 Fatalities
- 32 out of 53 (60%) = Crash with opposing direction vehicle
- 15 out of 53 (28%) = Ejection



Fatal Crashes



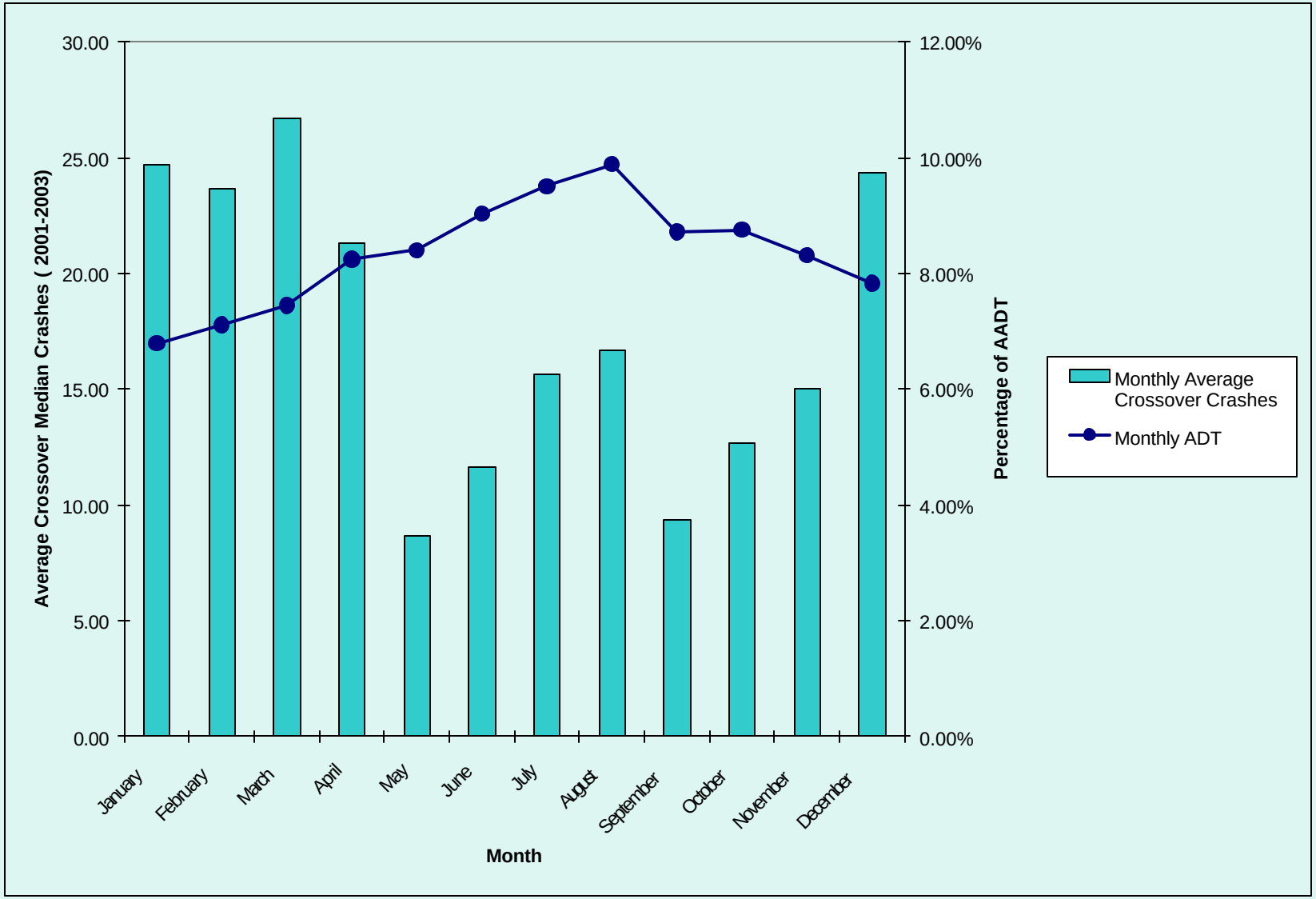
Fatal and Injury Crashes



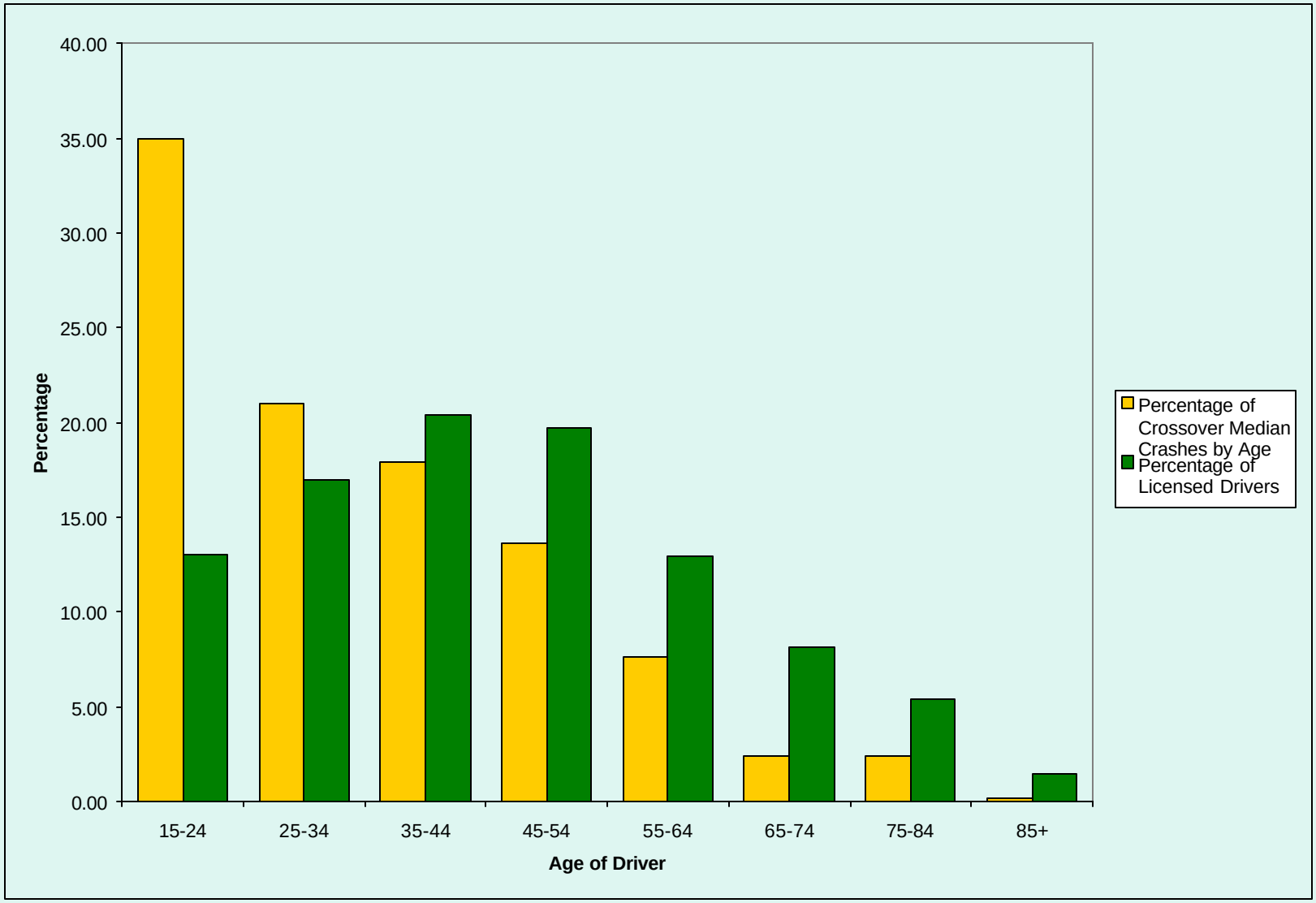
Initial Action for Crossover Median Crashes

Initial Action	Crossover Median Crashes
Lost Control on Dry Pavement	263 (42%)
Lost Control Due to Weather	278 (44%)
Ice	*118*
Snow	*93*
Wet	*66*
Wind	*1*
Vehicle Collision	70 (11%)
Barrier	5 (0.8%)
Signpost	5 (0.8%)
Other	3 (0.4%)
Object/Trailer Crashes	7 (1%)
Total Crossover Crashes	**631 (100%)**

Crossover Median Crashes by Month

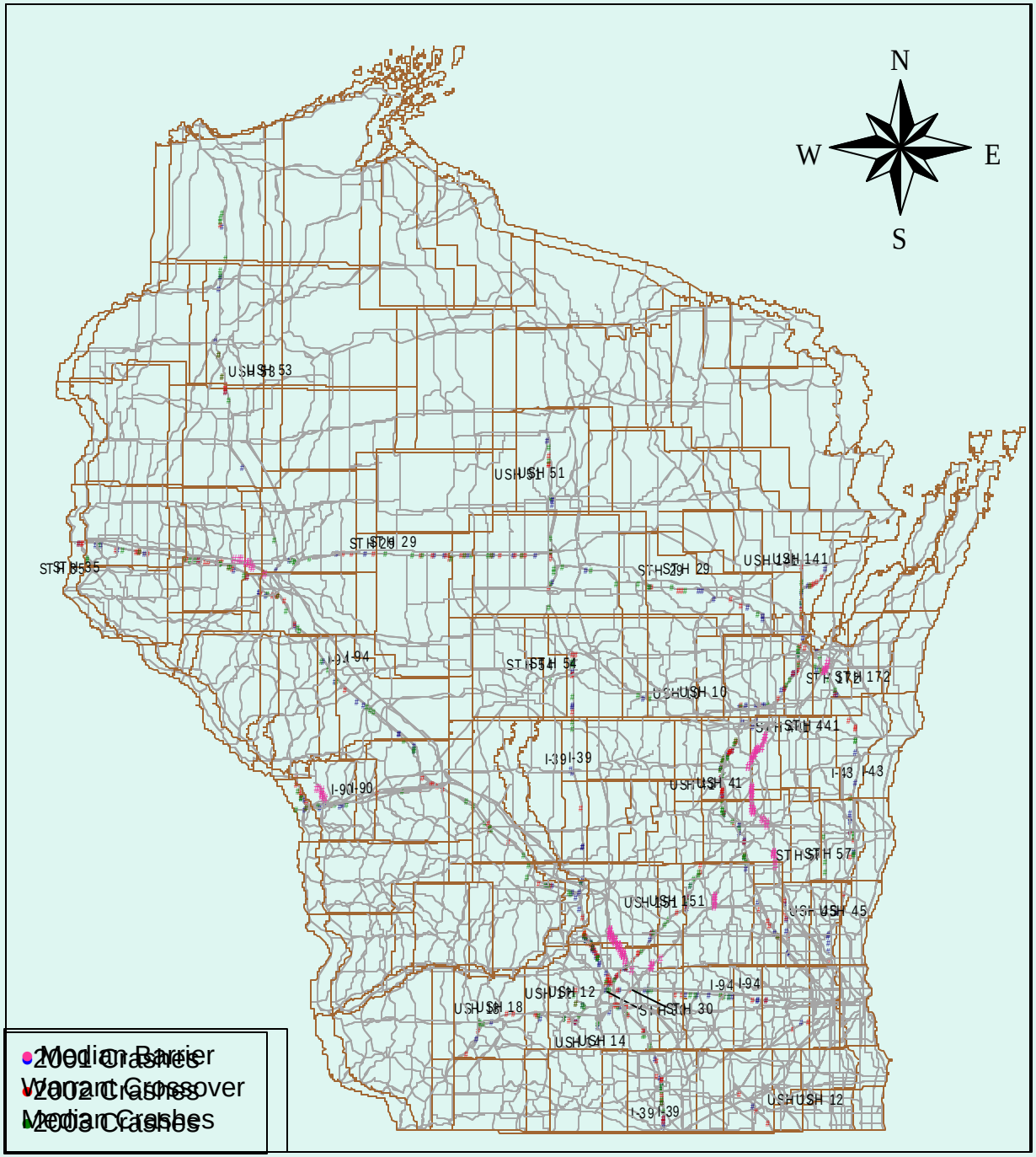


Crossover Median Crashes by Age of Driver



Mapping Crossover Median Crashes

- 0.5 Crossover Median Crashes per mile per year (3 year basis)



Cost of Crossover Median Crashes

- NHTSA MVS (Motor Vehicle Safety) Software
- Costs
  - Medical
  - Emergency service
  - Market productivity lost
  - Household productivity lost
  - Insurance administration
  - Workplace
  - Legal
  - Travel delay
  - Property Damage
- Per occupant, not per crash

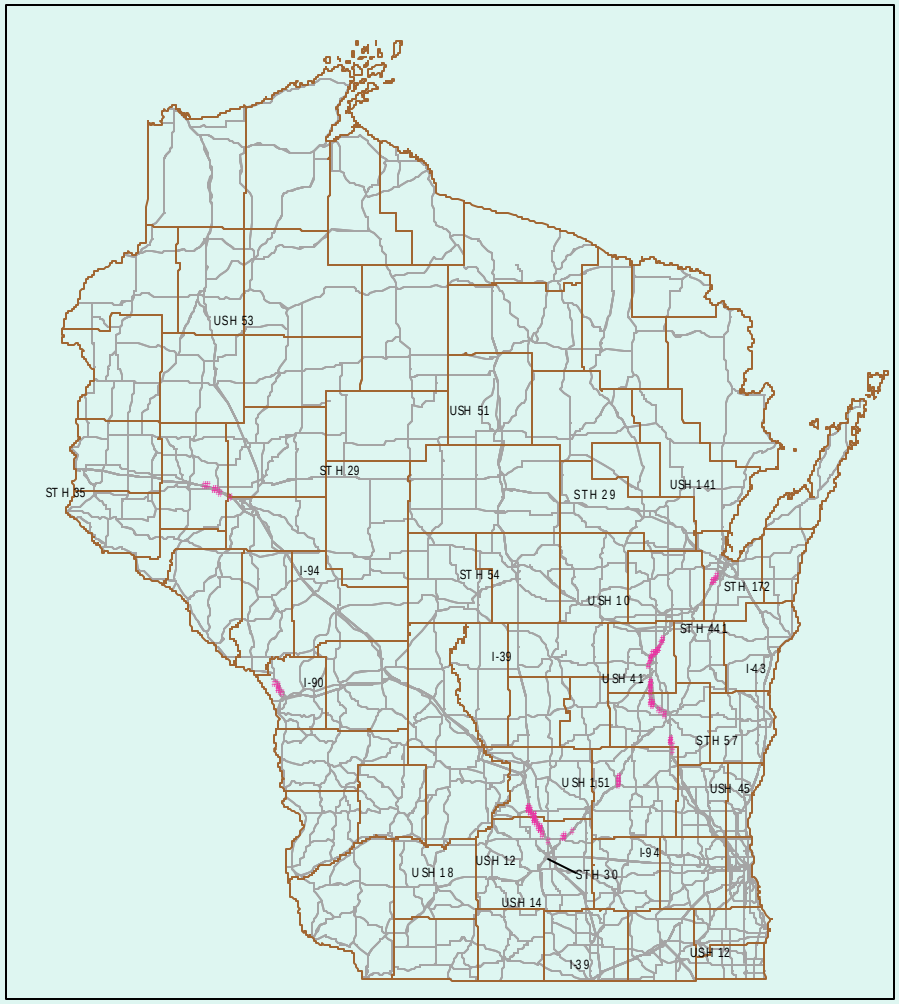
- CODES: Crash Outcome Data Evaluation System
  - Links hospitalization records to corresponding crash reports
  - Updates the medical costs for NHTSA MVS model
    - Medical Costs linked directly to hospital diagnosis codes

CODES: Cost Differential (2001 & 2002)

- Average Crash Cost (per occupant)
  - Crossover Median Crashes: $66,784
  - Comparison Group: $27,657
    - Crossover Median Crashes: $39,128 more
- Total Biannual Costs
  - Crossover Median Crashes: $37,797,172 more than the comparison group
    - $18,898,586 annually

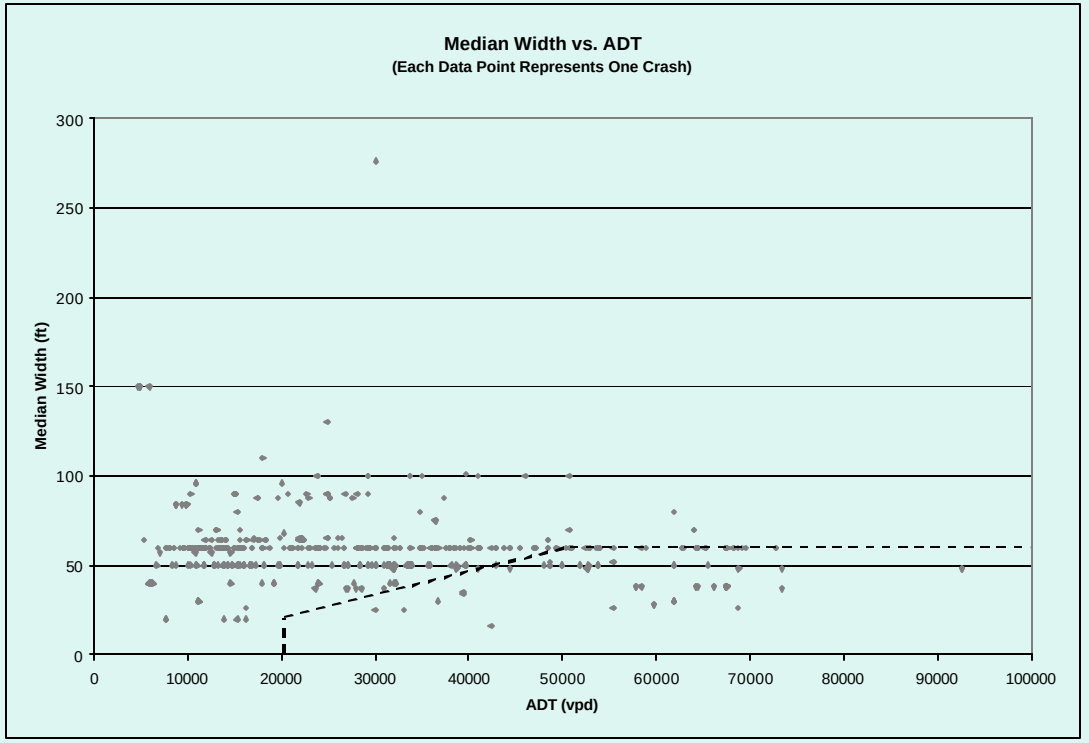
Findings - Hypotheses

- Hypothesis 1: Crossover median crashes are a significant problem for the state of Wisconsin
  - 2001 – 2003: 53 fatalities, over 600 injuries
  - 210 crossover median crashes per year
  - 6 high-frequency CMC locations



Findings - Hypotheses

- Hypothesis 2: Crossover median crashes and median width are not strongly correlated with each other
  - No significant relationship - true scatter plot
  - Narrow and large median widths have both low and high crossover median crash rates
  - WisDOT's current standard



Findings

- Younger drivers are more likely to be involved in a CMC
  - Drivers < 25 years old: 35% of CMCs
- High Frequency CMC Locations
  - I-39/I-90/I-94 Dane & Columbia Counties
  - I-94 Dunn County
  - USH 41 Fond Du Lac, Winnebago, Brown Counties
  - USH 53 La Crosse County
  - USH 151 Dane & Dodge Counties
- CMC costs exceed median barrier impact crashes by approximately $19 million annually

High Frequency Crash Locations

I-39/I-90/I-94 Columbia County

I-94 Dunn County

USH 41 Winnebago County

USH 53 La Crosse County

Recommendations

- Consider these findings not as standalone research, but as part of a comprehensive statewide safety management plan
  - Overall WisDOT safety management strategy
  - Median safety policy
  - Operational and maintenance costs

Recommendations

- Consider median-based countermeasures at high crash locations
  - Monitor median barrier hits and crash frequency
  - Compare costs of installation and maintenance vs. crashes prevented

Recommendations

- Traditional three-strand cable barrier
- High-tensioned cable barrier
  - Brifen Wire Rope Safety Fence (WRSF)
  - Trinity Cable Safety System (CASS)

Questions?

- Discussion…

Study Design

- Step 1: Literature review
- Step 2: Crossover median crash data collection
  - Site selection
  - Data collection
- Step 3: Data Analysis
  - Median width
  - Crash severity
  - Initial first action
  - Crash vehicle type
  - Driver demographics
- Step 4: Benefit/cost analysis
  - CODES
- Step 5: Writing of Report

Hypotheses

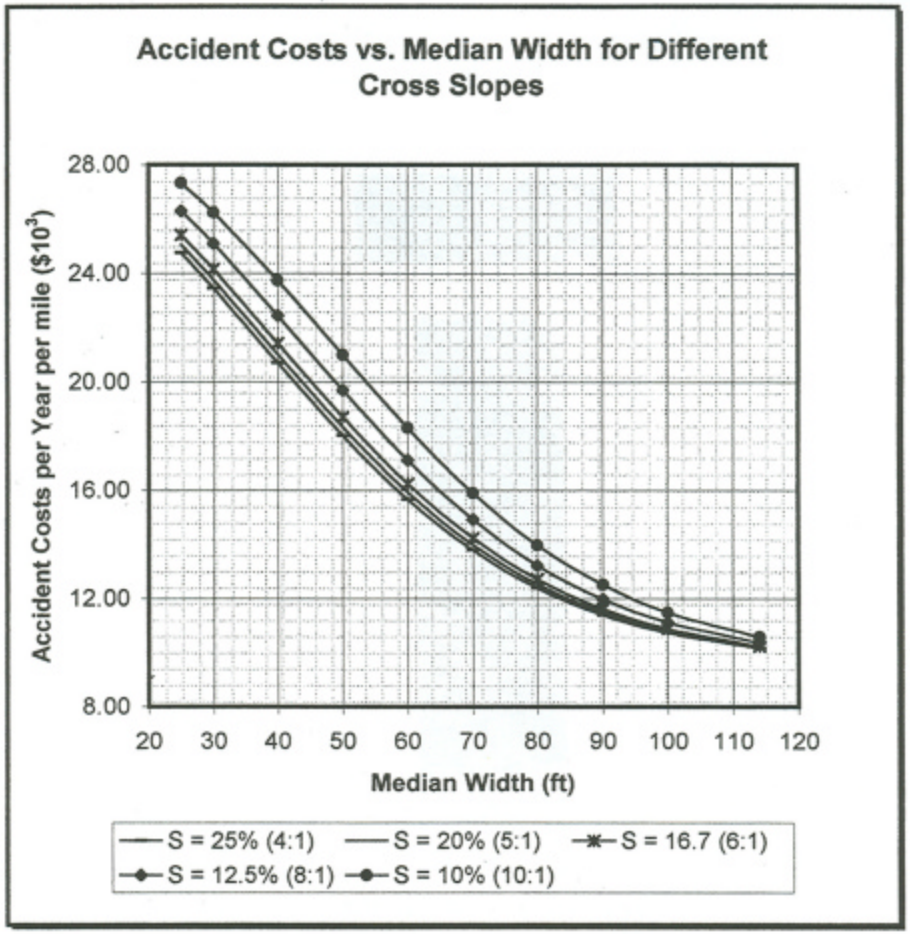
- Hypothesis 1: There are a significant number of crossover median crashes in Wisconsin

- Hypothesis 2: There is a relationship between median width and the rate of crossover median crashes

Median Standards

- AASHTO: No specific guidelines
  - 40 ft. – “sense of separation”
  - 60 ft. – “potential to be landscaped in a park-like manner”
- Wisconsin Facilities Development Manual
  - Design Class A3 Highways: arterial, minimum ADT 7000 vpd, minimum design speed = 65mph
    - > 55 mph speed limit = 60 ft. median width
    - 50-55 mph speed limit = 50 ft. median width

Previous Wisconsin Research



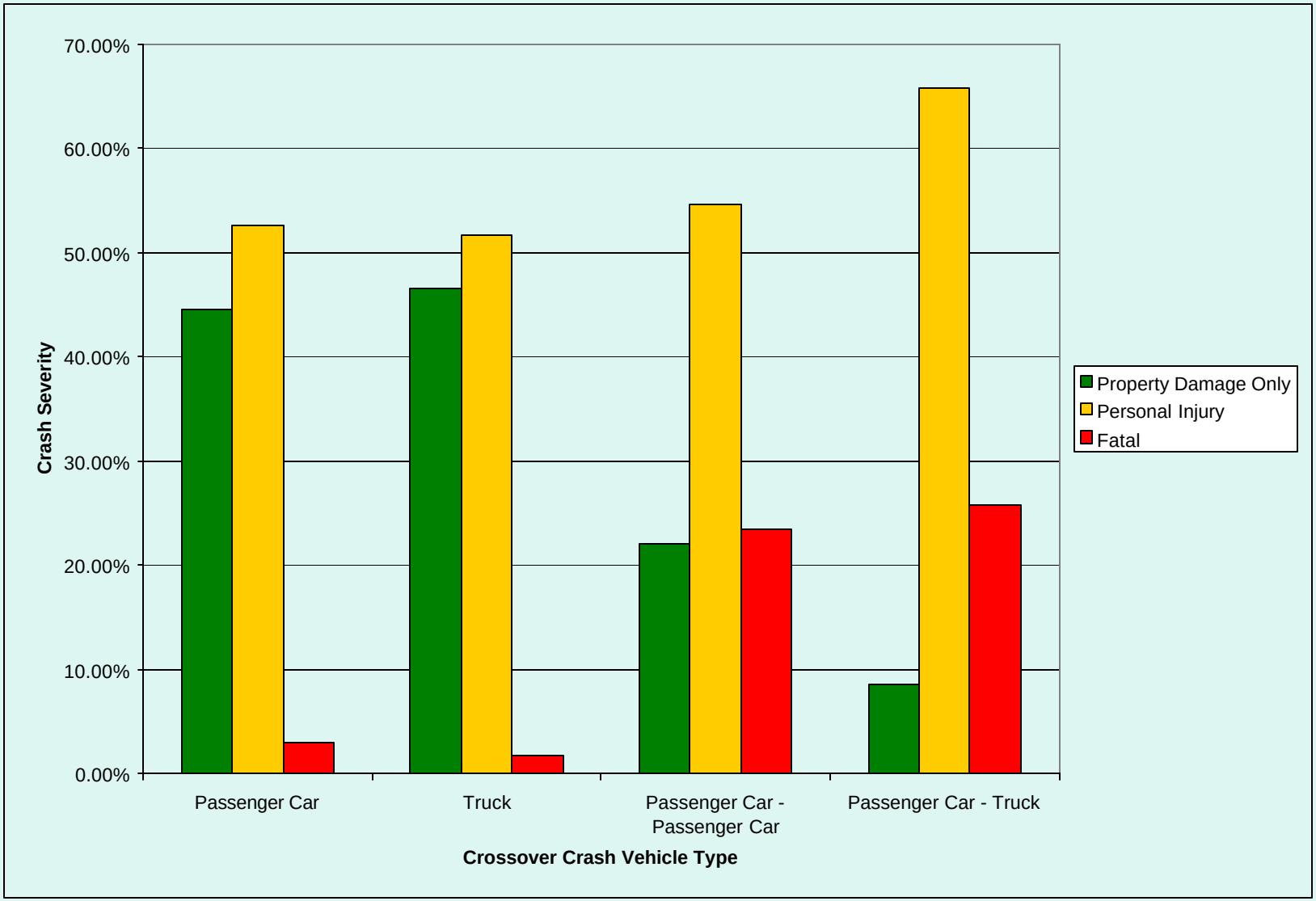
- Costs decrease with larger median widths
- Costs decrease with steeper cross slopes
  - Less traversable

- Median width 50-75 ft. = 4:1 cross slope
- Median width >75 ft. = 6:1 cross slope or greater

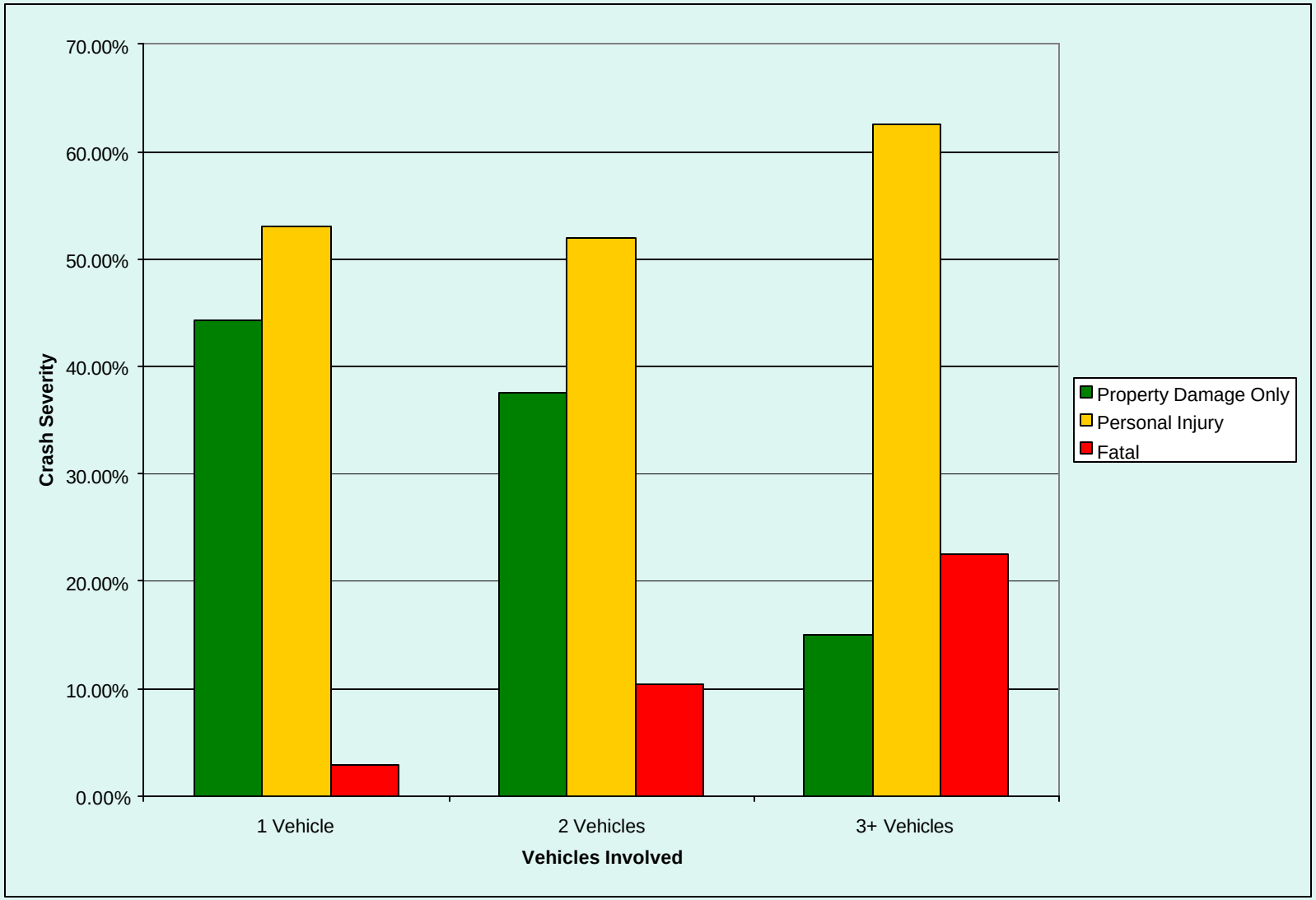
Statistical Analysis

- Discrete outcome models
  - Outcome of a physical event (crashes)
    - Non-negative integers
- Multinomial logit model
  - More than two discrete outcomes
- Results
  - Key significant variables
  - Most contributing: initial act of causation

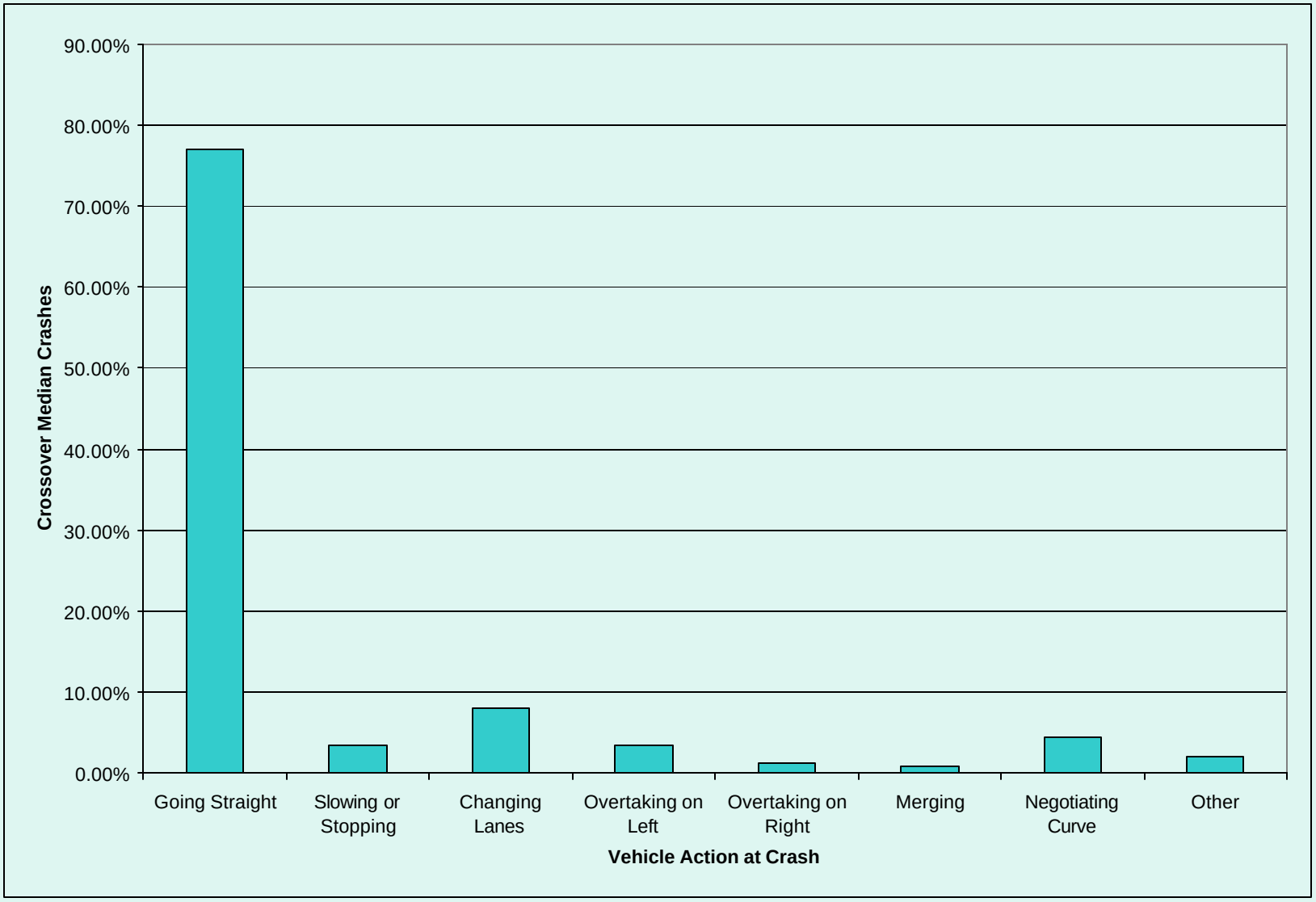
Crossover Median Crashes, Crash Vehicle Type, and Crash Severity



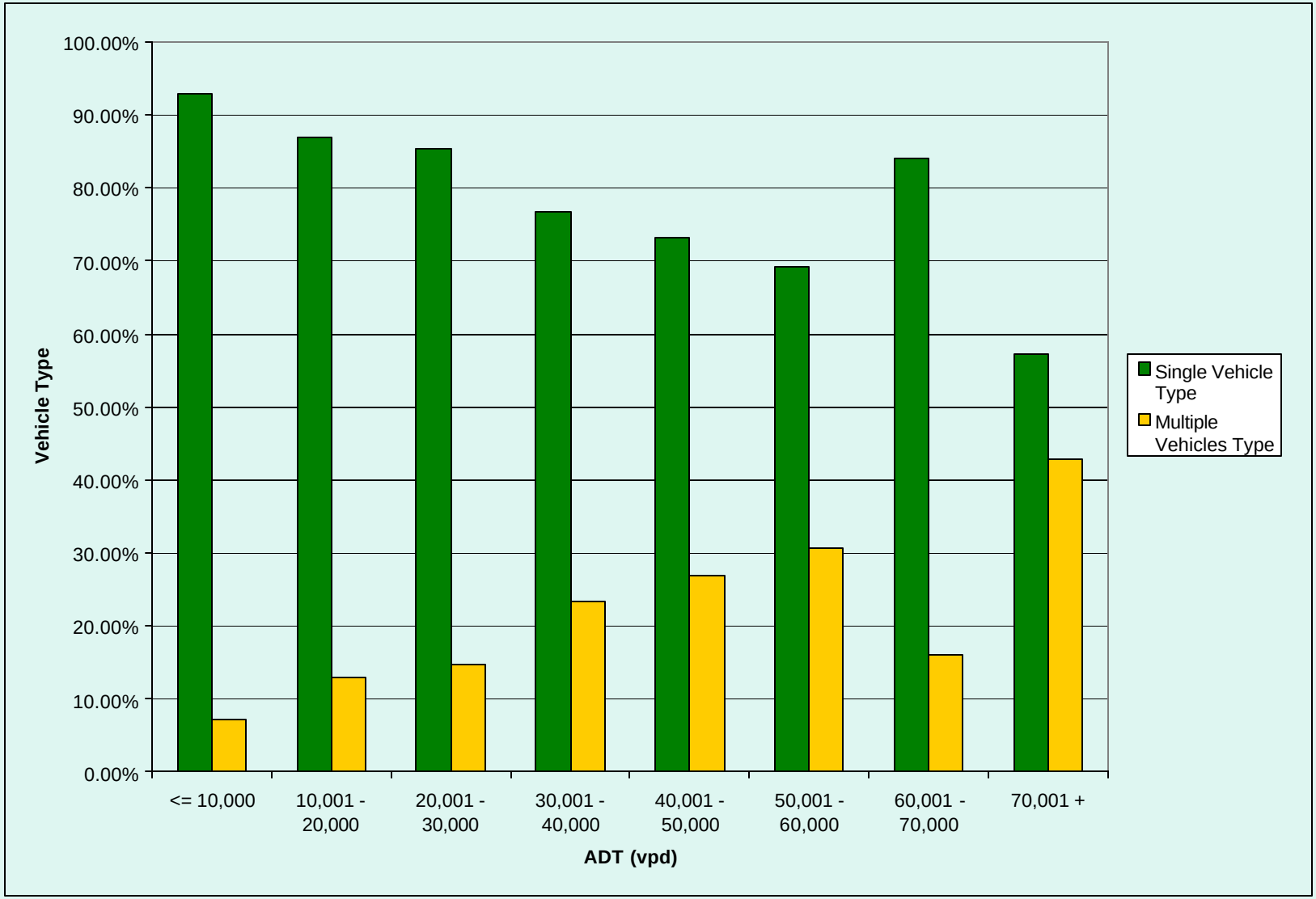
Crossover Median Crashes, Total Vehicles, and Crash Severity



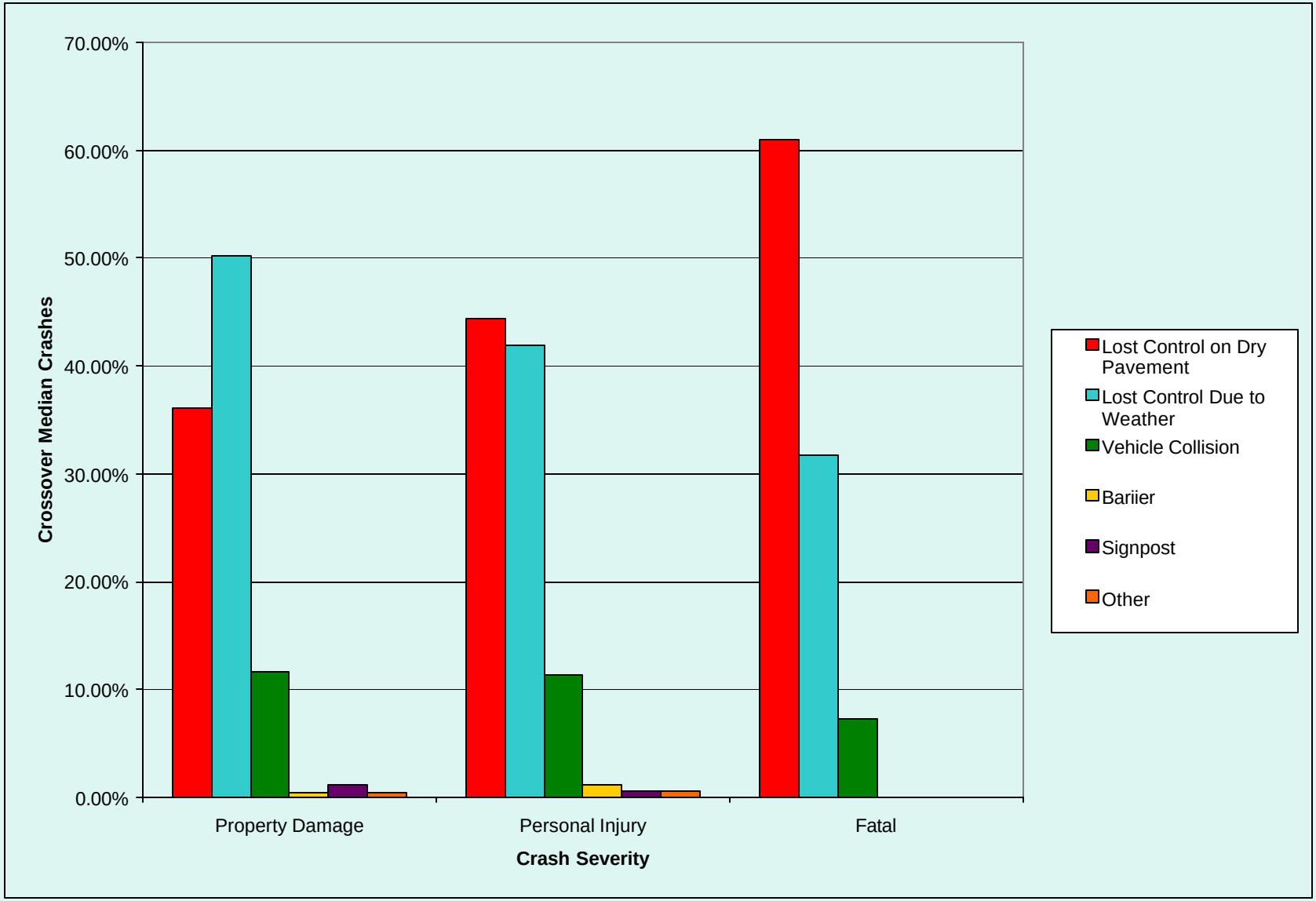
Vehicle Action at Crossover Median Crash



Crossover Median Crashes, Crash Vehicle Type, and ADT



Crash Severity and Initial Causation of Crossover Median Crashes



Alcohol-Related Crossover Median Crashes

- Mostly due to lost control on dry pavement
  - 62% of alcohol-related CMCs vs. 42% of all CMCs
- Larger Portion of Younger Drivers
  - < 25 years old: 48% of alcohol-related CMCs vs. 35% of all CMCs
  - < 35 years old: 74% of alcohol-related CMCs vs. 56% of all CMCs

CODES: Crossover Median Crashes (2001 & 2002)

Type of Model	Total Estimated Costs ($)	Number of Cases	Per Case Cost
NHTSA MVS Model Only	52,902,100	966	54,764
Mixed Model Estimates			
Diagnostic Group Model (Hospitalized Cases Only)	18,437,524	82	224,848
NHTSA MVS Model Only (Adjusted)	46,076,200	884	52,122
Total – Mixed Model	64,513,724	966	66,784

- Percent Change in per unit costs: 21.9%

CODES: Comparison Group (2001 & 2002)

Type of Model	Total Estimated Costs ($)	Number of Cases	Per Case Cost
NHTSA MVS Model Only	80,209,693	3117	25,733
Mixed Model Estimates			
Diagnostic Group Model (Hospitalized Cases Only)	9,797,724	64	153,089
NHTSA MVS Model Only (Adjusted)	76,408,790	3053	25,027
Total – Mixed Model	86,206,514	3117	27,657

- Percent Change in per unit costs: 7.5%

Findings

- Most CMCs involved either personal injury or a fatality
  - Personal injury: 53%; Fatality: 7%
- Most CMCs involved only one vehicle (81%)
- Most CMCs involved vehicles traveling straight on the roadway (77%)
- Most common causes of a CMC
  - Lost control on dry pavement: 42%
  - Lost control due to weather: 44%

Recommendations

- Gather additional median geometric data on locations studied to complete a full benefit/cost analysis
- Expand public awareness to the dangers of crossover median crashes
  - Winter weather driving
  - Younger drivers
  - Seatbelts

Project Limitations

- Only three years of data
  - Five or more would provide a more complete picture
- Confounding variables
  - Median width & ADT alone can’t explain crossover median crash frequency
  - Driver behavior

Acknowledgements

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