Illinois Department of Transportation

ILLINOIS CENTER FOR TRANSPORTATION

2013 NATIONAL WRONG-WAY DRIVING SUMMIT

PROCEEDINGS BOOKLET

Morris University Center (MUC)
Southern Illinois University - Edwardsville
Edwardsville, IL

July 18-19, 2013

Edited By:

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Proceedings of the
2013 National Wrong-Way Driving Summit

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16. Abstract

The first National Wrong-Way Driving (WWD) Summit was held July 18 and 19, 2013, at the Morris University Center (MUC) of Southern Illinois University Edwardsville (SIUE). The purpose of this summit, which was sponsored by the Illinois Center for Transportation (ICT) and Illinois Department of Transportation (IDOT), was to provide a platform for practitioners and researchers to exchange ideas, evaluate current countermeasures, and develop best practices to reduce WWD crashes and incidents through a 4E's approach (Engineering, Education, Enforcement, and Emergency Response)

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Acknowledgments

The 2013 National Wrong-Way Driving Summit was sponsored by the Illinois Center for Transportation (ICT) and Illinois Department of Transportation (IDOT). The organizing committee, led by Priscilla Tobias, state safety engineer for IDOT, thanks the speakers, moderators, vendors, and attendees for their contributions to the summit program.

The conference room rental, coffee breaks, breakfasts, working lunch, invited lunch speaker, lanyards, and name tags were partially sponsored by Southern Illinois University Edwardsville, American Traffic Safety Services Association (ATSSA), and the Traffic and Parking Control Company, Inc. (TAPCO).

The planning committee also thanks the students from the Institute of Transportation Engineers (ITE) student chapter of Southern Illinois University Edwardsville (SIUE) for their assistance.

Contents

Executive Summary

The first National Wrong-Way Driving (WWD) Summit was held July 18 and 19, 2013, at the Morris University Center (MUC) of Southern Illinois University Edwardsville (SIUE). The purpose of this summit, which was sponsored by the Illinois Center for Transportation (ICT) and Illinois Department of Transportation (IDOT), was to provide a platform for practitioners and researchers to exchange ideas, evaluate current countermeasures, and develop best practices to reduce WWD crashes and incidents through a 4E's approach (Engineering, Education, Enforcement, and Emergency Response).

To enhance the quality of this summit, a significant number of attendees were brought together to discuss various topics during individual presentations, as well as to take part in broader topical group discussions. Participants included representatives from the National Transportation Safety Board (NTSB), Federal Highway Administration (FHWA), American Traffic Safety Services Association (ATSSA), Illinois State Toll Highway Authority, state departments of transportation (DOTs), state police and highway patrols, universities, and consulting firms. Overall, approximately 130 attendees from 23 states participated in this summit, including from states that have already implemented and tested various countermeasures and those in which WWD has been found to be a major of concern.

The emphasis of the first day of the summit was on the national scene, research and programs, best practices, and ways to prevent WWD crashes. Following that, speakers from the NTSB, FHWA, and various agencies from Illinois, California, Texas, Maine, and Michigan gave presentations focusing on the national picture and trends based on research findings, best practices, and WWD programs, including data, program elements, implementation and challenges, and program effectiveness. Specific types of WWD crashes (e.g., involving older drivers or alcohol) and relevant types of countermeasures (e.g., signing, striping, and geometric improvement) were also discussed in-depth. Attendees, who had been pre-assigned to five groups, convened to discuss WWD issues and countermeasures implemented in their states. Following that, the group moderators presented discussion results and key findings to all the attendees.

The second day began with overview of highlights from the previous day. Discussions were then held about actions to take after detection of a WWD movement, such as ways to alert the at-fault driver and other drivers, provide for correction of the WW maneuver, and manage incident response by law enforcement and EMS. The final session of the summit was a panel discussion with two members from state DOTs and two from state law enforcement agencies who reviewed lessons learned and implementation programs.

Based on the discussions and presentations during the summit, the countermeasures listed in the table below were found to be effective or worthy of implementation for mitigating WWD incidents and crashes:

<table>
<tr><th colspan="4">Engineering</th></tr>
<tr><th>Signing</th><th>Pavement Marking</th><th>Geometric Improvement</th><th>ITS Technologies</th></tr>
<tr>
<td>▪ Implementing standard wrong-way sign package
▪ Improved static signs
▪ Lowering sign height
▪ Using oversized signs
▪ Mounting multiple signs on the same post
▪ Applying red retro-reflective tape to the vertical posts
▪ “Freeway Entrance” sign for all on ramps (ensure the right-way driving)</td>
<td>▪ Stop bar
▪ Wrong-way arrow
▪ Turn/through lane-only arrow
▪ Raised pavement markers
▪ Short dashed lane to delineate through turns</td>
<td>▪ Entrance/exit ramp separation
▪ Raised curb median
▪ Longitudinal channelizer
▪ Change ramp geometrics:
❖ Obtuse angle
❖ Sharp corner radii</td>
<td>▪ LED illuminated signs
▪ Dynamic signs to warn other drivers
▪ Use existing GPS navigation technologies to provide wrong-way movement alerts
▪ Provide consistent messages or alerts that are intuitive to the driver</td>
</tr>
<tr><th colspan="4">Enforcement</th></tr>
<tr><td colspan="4">▪ Alert law enforcement agency
▪ DUI enforcement
▪ Dynamic message sign to give warning to right-way drivers
▪ Portable spike barriers to stop WW drivers; implemented by Harris County Toll Road Authority (HCTRA), Texas</td></tr>
<tr><th colspan="4">Education</th></tr>
<tr><td colspan="4">▪ Public awareness and understanding of:
❖ Basics of road designs and interchange types
❖ Acts to do (witnessing a wrong-way driver)
▪ Focus groups:
❖ Older drivers
❖ DUI drivers
❖ Young drivers</td></tr>
</table>

These presentation slides from the summit are provided on the following pages. Appendix A contains short bios and contact information for moderators and presenters, in alphabetical order. The summit agenda, the survey questionnaire and results, and contact information for all attendees are presented in Appendices B, C, and D, respectively.

Presentation Slides

All presentation slides from the summit are provided in this section. To contact any presenter with questions about his or her presentations (e.g., methodology, data collection, results, etc.), please refer to Appendix A.

Wrong-Way Driving: Study Findings and Objectives

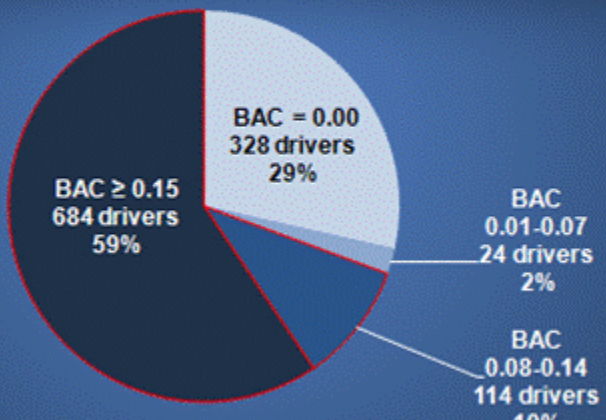
Deborah Bruce, National Transportation Safety Board

Fatality Analysis Reporting System (FARS)

- National Highway Traffic Safety Administration data
- Between 2004 and 2009, there were 1,566 wrong-way fatal crashes on high-speed divided highways
- 2,139 fatalities
- 1,566 wrong-way drivers and 1,934 right-way drivers

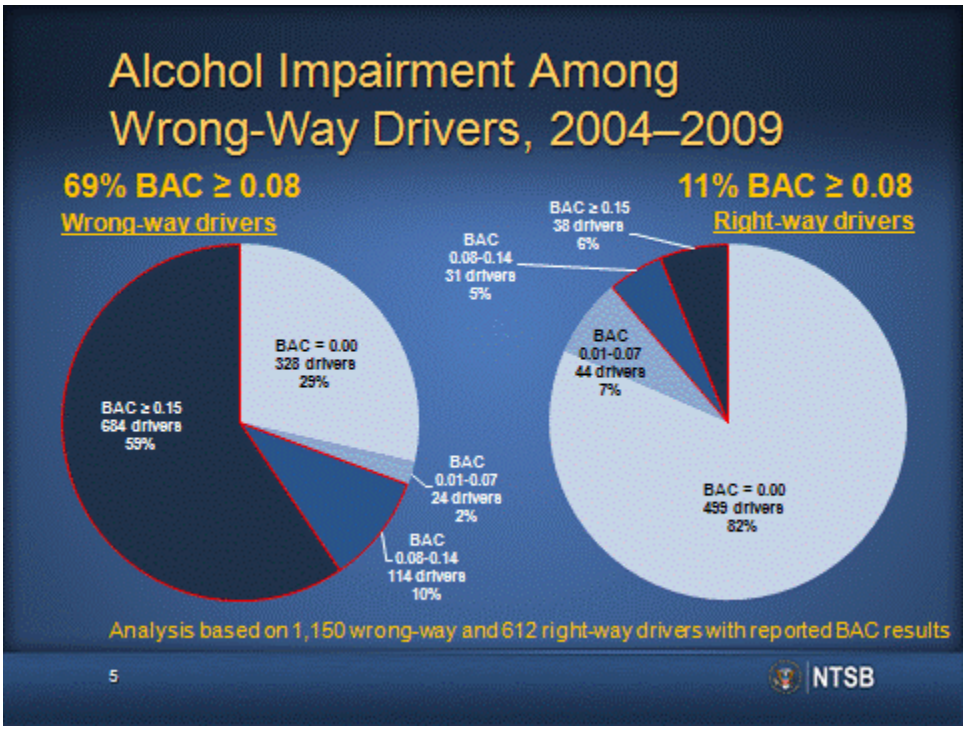
23 NTSB

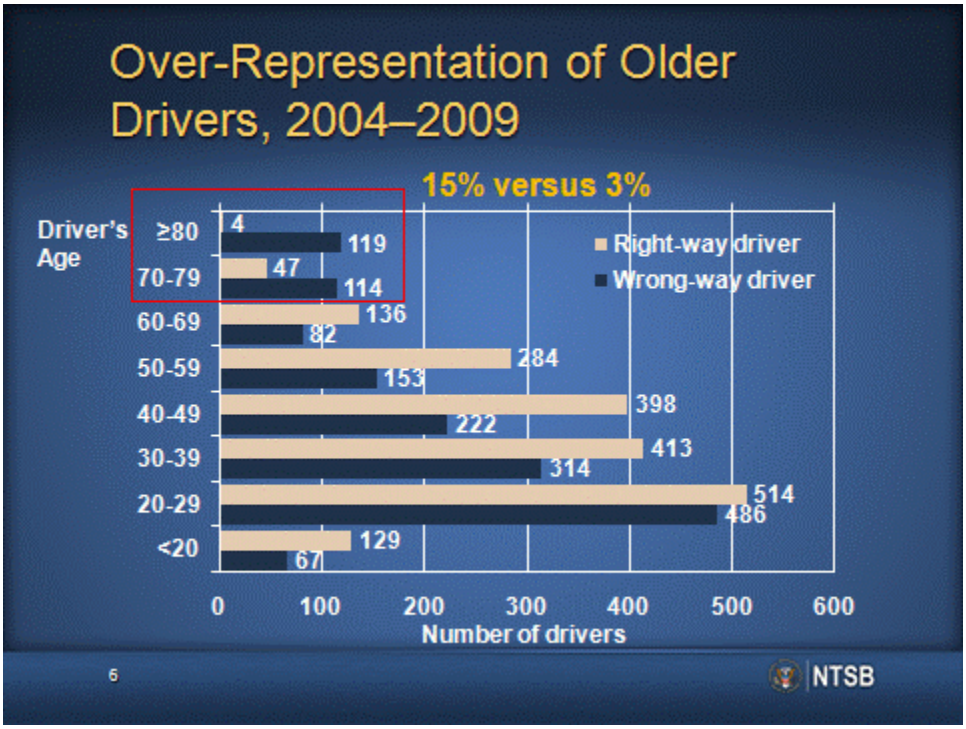
Wrong-Way Driving –SIR
69% Alcohol Impairment



Analysis based on 1,150 wrong-way drivers with reported BAC results

8 NTSB


Alcohol Impairment Among Wrong-Way Drivers, 2004–2009
69% BAC ≥ 0.08
Wrong-way drivers
11% BAC ≥ 0.08
Right-way drivers
BAC = 0.00
328 drivers
29%
BAC ≥ 0.15
684 drivers
59%
BAC
0.01-0.07
24 drivers
2%
BAC
0.08-0.14
114 drivers
10%
BAC ≥ 0.15
38 drivers
6%
BAC
0.08-0.14
31 drivers
5%
BAC
0.01-0.07
44 drivers
7%
BAC = 0.00
499 drivers
82%
Analysis based on 1,150 wrong-way and 612 right-way drivers with reported BAC results
5
NTSB


Over-Representation of Older Drivers, 2004–2009
15% versus 3%
Driver's Age
≥80
70-79
60-69
50-59
40-49
30-39
20-29
<20
4
119
47
114
136
82
284
153
398
222
413
314
514
486
129
67
Right-way driver
Wrong-way driver
0
100
200
300
400
500
600
Number of drivers
6
NTSB

SIR Investigations

- Arlington, TX
- Fountain, CO
- Carlisle, PA
- Dallas, TX
- Beloit, WI
- Fernley, NV

- 8 Fatalities
- 8 Injuries
- Wrong-way driver BAC 0.18 or more

12 NTSB

Crash Elements vs. Data Results

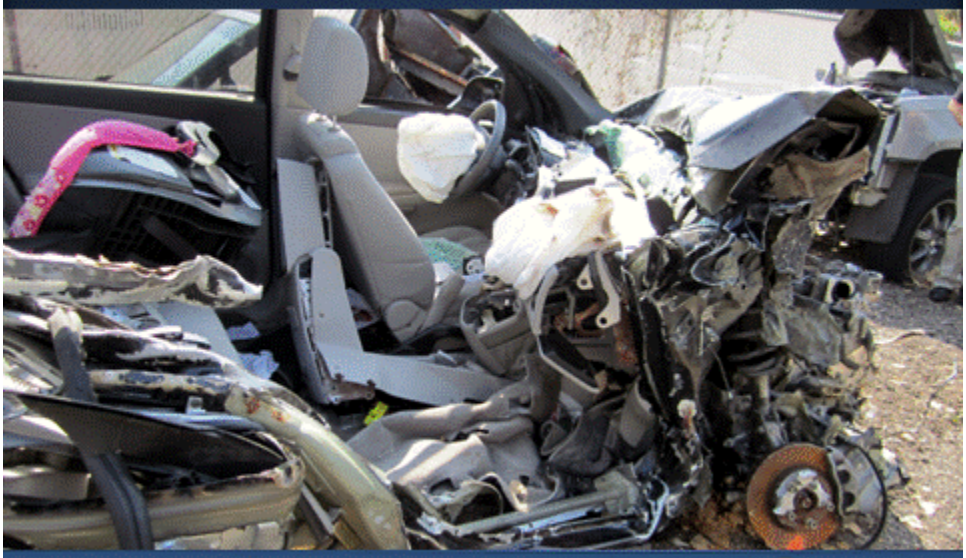
- Majority of wrong-way drivers were intoxicated
- Older drivers
- Potential medical impairment
- Improper ramp use
- Crash severity typically resulted in fatalities

14 NTSB

Fountain, Colorado

15 NTSB

Arlington, Texas



17 NTSB

Beloit, Wisconsin

15 NTSB

Safety Issues

- Driver impairment
- Highway design and traffic control devices to prevent wrong-way movements, and wrong-way driver monitoring programs
- Wrong-way navigation alerts in vehicles

12 NTSB

Alcohol Ignition Interlocks

- Prevent engine start until breath sample is analyzed
- Running retests ensure driver remains unimpaired

- Reduce recidivism; use by all offenders estimated to save over 1,000 lives/year
- 17 states and 4 California counties require interlocks for all offenders

13 NTSB

New In-Vehicle Alcohol Detection Technologies

- Most fatal alcohol impairment accidents involve drivers with no prior DWIs
- Driver Alcohol Detection System for Safety (DADSS) Program
  - Breath-based system
  - Touch-based device
- Prototype research vehicle currently in development

14 NTSB

Wrong-Way Signage

- Standard signage in the MUTCD to deter Wrong-Way Entry
  - 'ONE WAY' sign
  - 'DO NOT ENTER' sign
  - 'WRONG WAY' sign

15 NTSB

Improvements to Signage

Courtesy of the New York State Department of Transportation

16 NTSB

Improvements to Signage

- State DOT and local jurisdiction improvements to signage at exit ramps
  - Lowering sign height
  - Using oversized signs
  - Mounting multiple signs on the same post
  - Implementing standard wrong-way sign package
  - Applying red retro-reflective tape to the vertical posts

17 NTSB

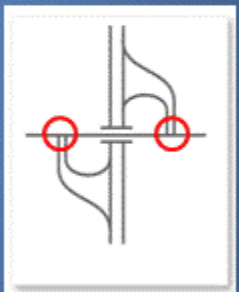
Wrong-Way Pavement Markings

- Standard pavement markings in the MUTCD to deter Wrong-Way Entry
  - Wrong-Way Arrow
  - Turn Lane-Use Arrow
  - Turn/Through Lane-Use Arrow

18 NTSB

Improvements to Exit Ramp Design

- Majority of wrong-way entries occur at partial cloverleaf interchanges
- Change ramp geometrics
  - Obtuse angle
  - Sharp corner radii
  - Non-traversable medians
- Provide roadway lighting



Partial Cloverleaf (Parclo)

Wrong-Way Monitoring Programs

- States that have conducted projects to monitor wrong-way drivers on freeways
  - California
  - Texas
  - Arizona
- Provided an effective means of identifying wrong-way accident trends

Automation Assists

- Use existing GPS navigation technologies to provide wrong-way movement alerts
- Provide consistent messages or alerts that are intuitive to the driver

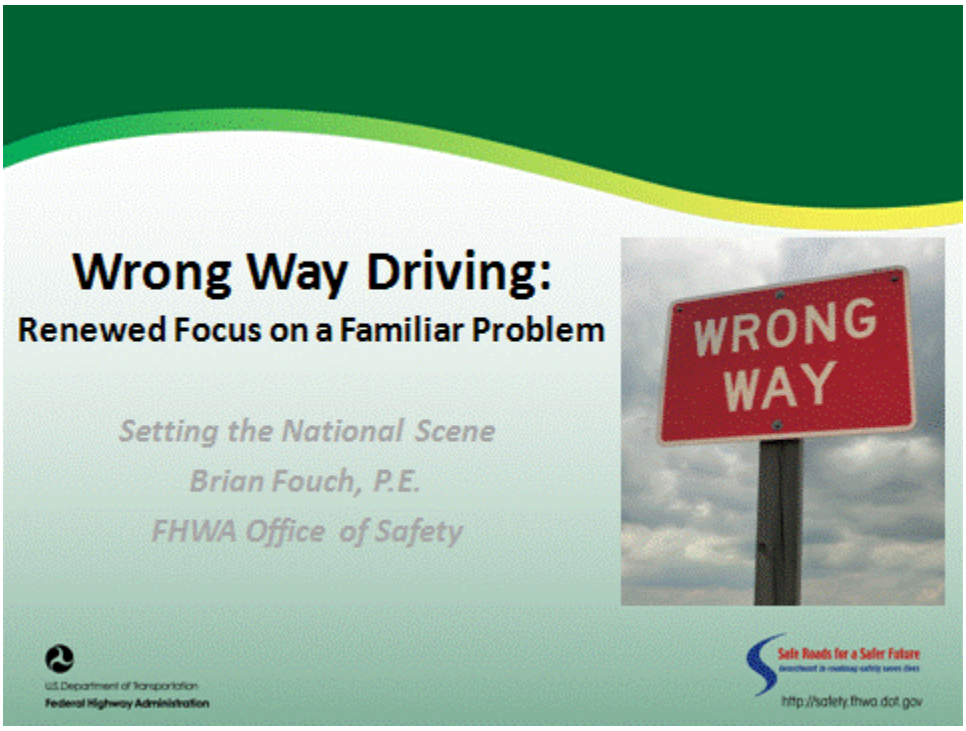
21 NTSB

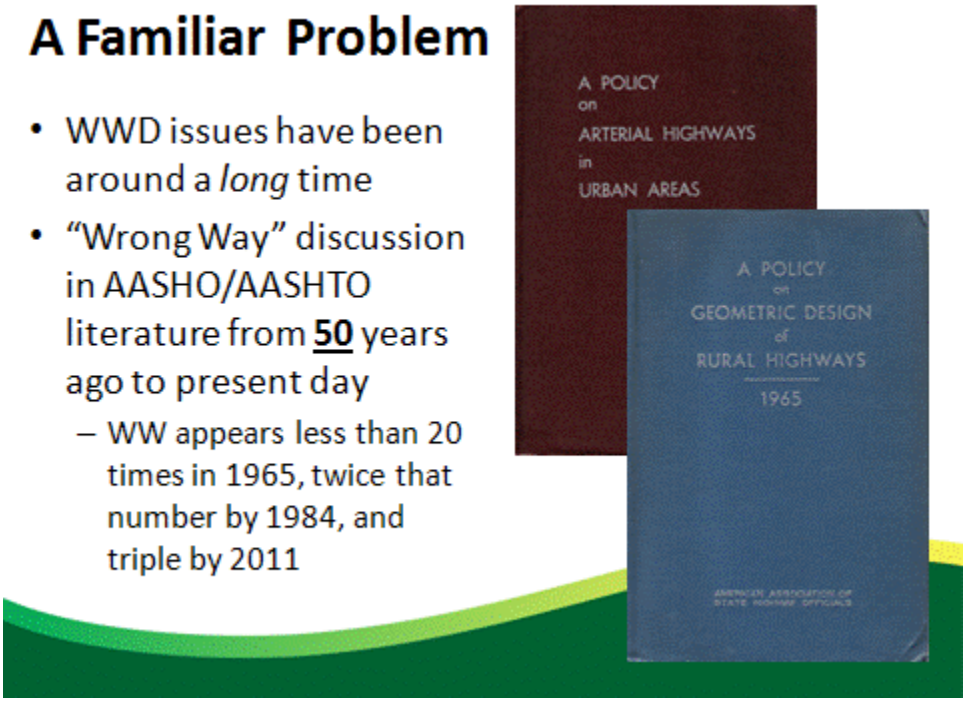
National Transportation Safety Board

http://www.ntsb.gov/doclib/safetystudies/SIR1201.pdf

Wrong-Way Driving: Renewed Emphasis on a Familiar Problem

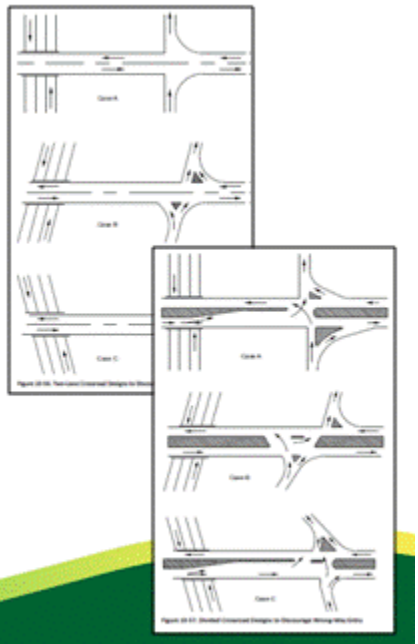
Brian Fouch, Federal Highway Administration Office of Safety





A Familiar Problem

- Once characterized as "*an inherent problem of diamond interchanges*" (AASHO, 1965)
- Familiar strategies that remain relevant today
  - Sharp, angular pavement edges
  - Raised channelization and islands
  - Signs and markings to simplify decisions
  - Crossroad medians separating opposing directions



Sources: AASHTO "A Policy on Geometric Design of Highways and Streets" (2011)

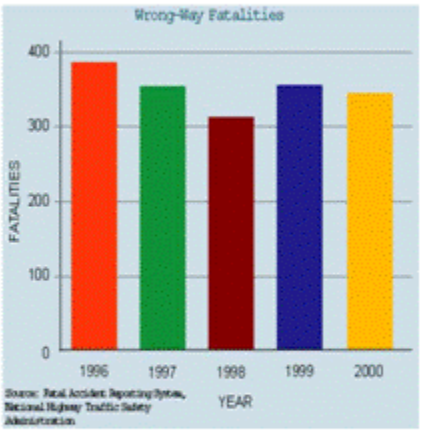
Photos: Jeff Shaw, FHWA

Opportunity for a National Effort

- NTSB Special Investigation is the catalyst
- Illinois taking on the critical Champion role
- Spurring FHWA, AASHTO, ATSSA, TRB, NHTSA, GHSA, etc., to work together on this issue

An Important Issue

- Peoples LIVES at stake
- Around 360 fatalities/yr[1]
- Very consistent over time



WWD crashes have many times higher severity outcomes compared to other crashes

Sources:
1. NTSB Special Investigation Report 12/01
2. FHWA Public Roads, Volume 66, Issue 2 (Sept/Oct 2002)

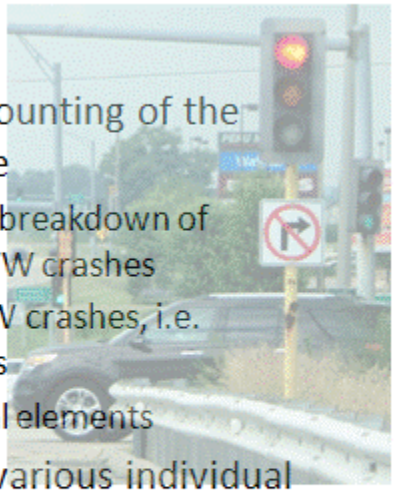
Similar Challenges – Similar Lessons

- Paved Edge Drop-Off crashes
  - SafetyEdge
- Cross-Median crashes
  - Cable Median Barrier
- Highway-Rail Grade Crossing crashes
  - Operation Lifesaver
  - Section 130

AASHTO
AASHTO TECHNOLOGY IMPLEMENTATION GROUP

OPERATION LIFESAVER
Rail Safety Education

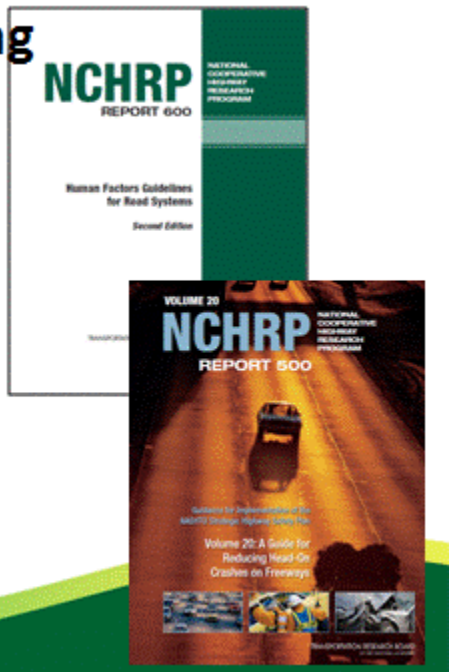
Reframing the Issue



- Need a more complete accounting of the problem on a national scale
  - Generally, a more thorough breakdown of frequency and severity of WW crashes
  - Differentiating origins of WW crashes, i.e. Entries vs. U-turns vs. others
  - Driver profile and behavioral elements
- Synthesis effort (based on various individual state studies) could be a good start

Reframe the Thinking

- Avoid trap of "drivers fault"/status quo is fine
- Apply pertinent Human Factors knowledge
- Understand there are actions that can be taken to address the problem proactively



Reframe the Approach

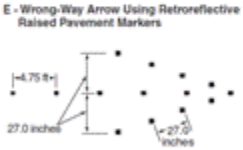
- A risk-oriented approach that is informed by data
  - Certain designs or traffic control schemes?
  - Critical intersection volumes?
- Widespread deployment of effective but underutilized countermeasures (*SYSTEMIC*)

Reconsider Possible Strategies

- Many ideas from 20-30 years ago remain relevant

Have they all been folded into national guidelines and state design/TCD standards?

- WWD-potential risk factors



Should these be specific "subset" of a safety analysis for New/Modified Interstate Access IJRs?

Consider New Possible Strategies

- WWD Summit – learning about peer successes

What new practices or technologies will you note for trying in your home state?

What partnerships need to be created or strengthened to be comprehensive (4E)?

Recruit New (and Old) Partners

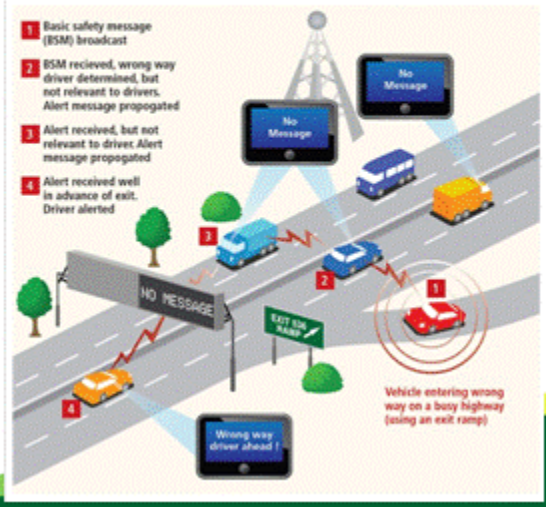
- Driver Education and Behavioral
  - Complete picture on comprehensive strategies
- Enforcement partners
  - Overlap impaired driving campaigns & WWD efforts?
- Older Driver groups (AARP)
  - Potential awareness and education partnership
- Industry

A comprehensive strategy is key for a successful National Campaign!

ITS - Connected Vehicle Technologies

Intelligent Transportation Systems Joint Program Office

- V2I and V2V applications currently being developed and can be adapted to address WWD



NTSB Recommendations to FHWA

- 5 formal recommendations (H-12-38 – H-12-42)
  - Work with NHTSA on Older Driver and SHSP strategies
  - Develop an assessment tool
  - Develop and distribute a manual
  - Review/revise MUTCD as appropriate
  - Issue HSIP policy memo on establishing WWD programs

Thank You!

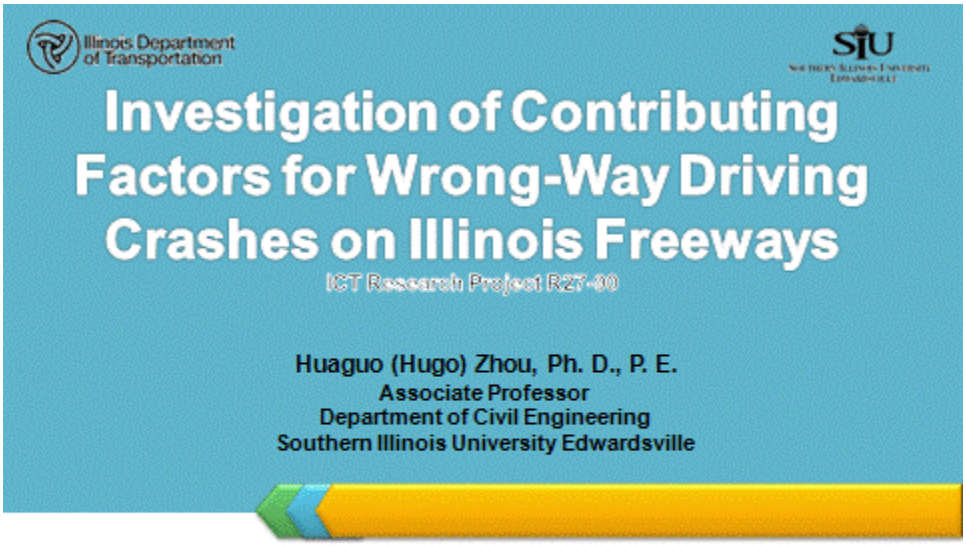
- FHWA Office of Safety WWD Contact Information

Brian Fouch, P.E.
Roadway Safety Design Team Leader
Email: brian.fouch@dot.gov
Phone: (202) 366-0744

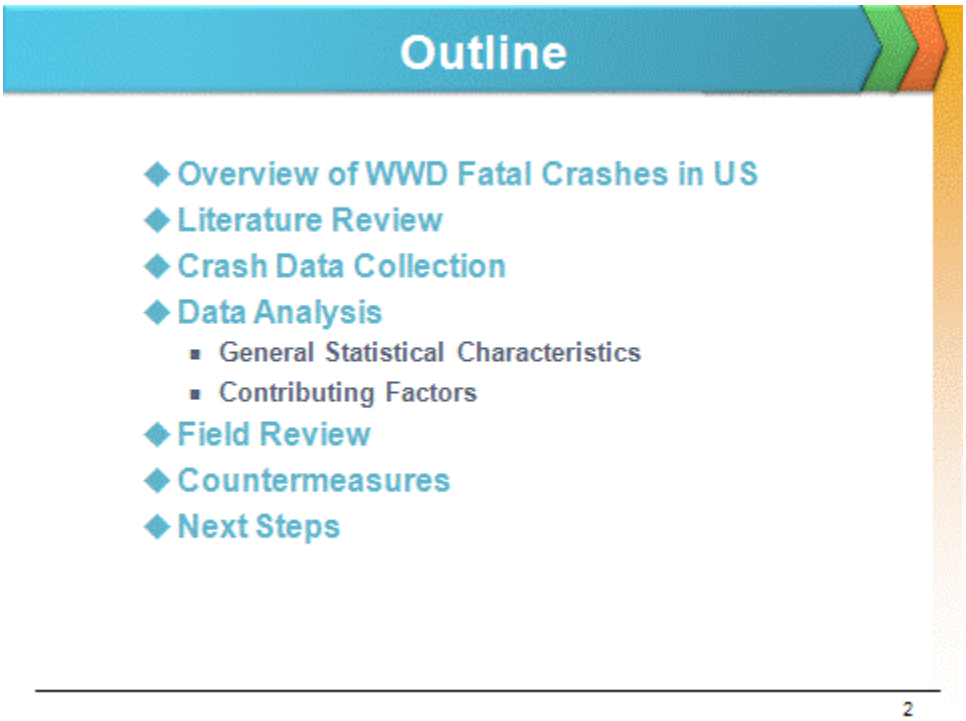
Jeffrey Shaw, P.E.
Intersections Program Manager
Email: jeffrey.shaw@dot.gov
Phone: (708) 283-3524

Investigation of Contributing Factors Regarding Wrong-Way Driving on Freeways

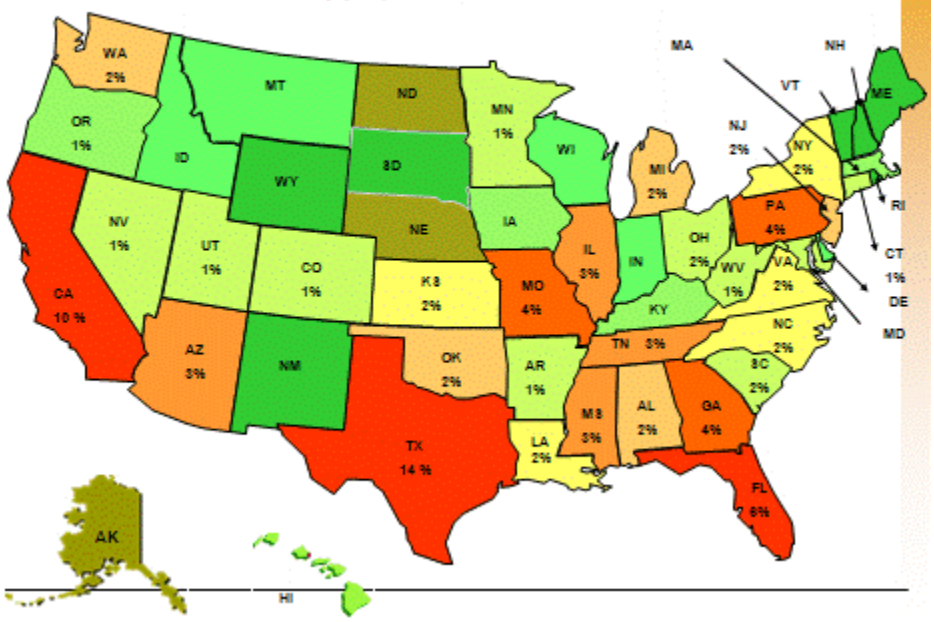
Huaguo Zhou, Southern Illinois University



At the 2013 National Wrong-Way Driving Summit
Edwardsville, IL.
July 18-19, 2013



WWD Fatal CRASH! per Year (2004-2011)



WWD Fatalities per Year (2004-2011)

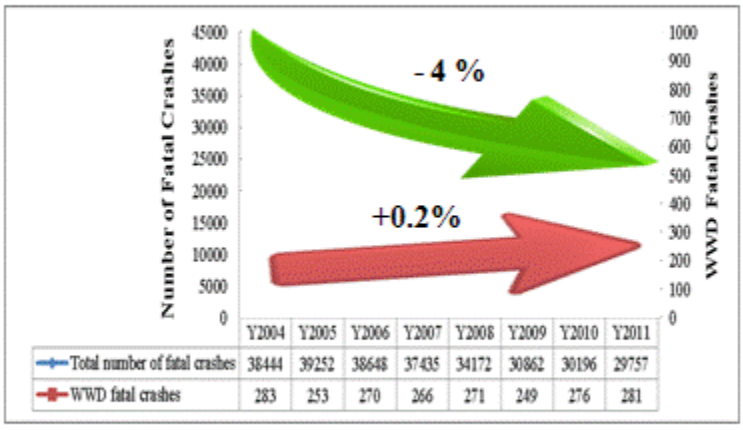
1	Texas	52 (14%)	18	New York	7 (2%)	35	Indiana	3 (1%)
2	California	35 (10%)	19	Virginia	7 (2%)	36	Wisconsin	3 (1%)
3	Florida	24 (7%)	20	Kansas	6 (2%)	37	New Mexico	3 (1%)
4	Georgia	14 (4%)	21	Ohio	6 (2%)	38	Idaho	3 (1%)
5	Pennsylvania	14 (4%)	22	West Virginia	5 (2%)	39	Delaware	2 (1%)
6	Missouri	13 (4%)	23	Arkansas	5 (1%)	40	Montana	2 (0%)
7	Illinois	12 (3%)	24	Colorado	5 (1%)	41	Rhode Island	1 (0%)
8	Tennessee	11 (3%)	25	Nevada	5 (1%)	42	Hawaii	1 (0%)
9	Mississippi	11 (3%)	26	Minnesota	5 (1%)	43	Wyoming	1 (0%)
10	Arizona	11 (3%)	27	South Carolina	5 (1%)	44	Maine	1 (0%)
11	Alabama	9 (2%)	28	Maryland	5 (1%)	45	New Hampshire	1 (0%)
12	Michigan	8 (2%)	29	Massachusetts	5 (1%)	46	South Dakota	1 (0%)
13	Oklahoma	8 (2%)	30	Utah	5 (1%)	47	Vermont	1 (0%)
14	Louisiana	7 (2%)	31	Connecticut	4 (1%)	48	North Dakota	0 (0%)
15	New Jersey	7 (2%)	32	Iowa	4 (1%)	49	Alaska	0 (0%)
16	North Carolina	7 (2%)	33	Kentucky	4 (1%)	50	Nebraska	0 (0%)
17	Washington	7 (2%)	34	Oregon	4 (1%)	51	District of Columbia	0 (0%)

Average 269 Fatal WWD Crashes and 358 people Killed Per Year

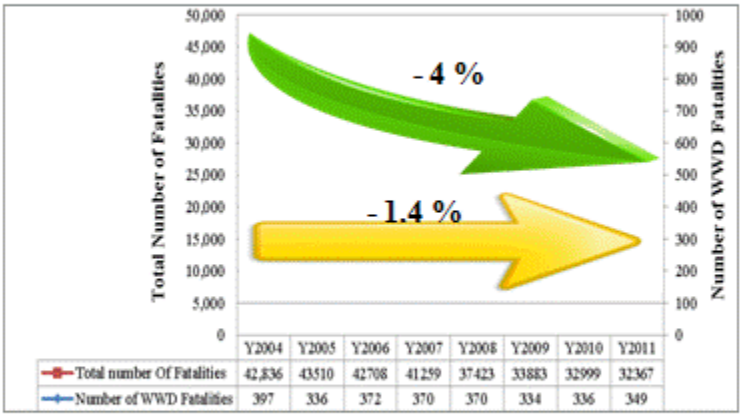
WWD Fatality Rate (2004-2011)

1	Delaware	1.9	19	Tennessee	1.0	37	New Mexico	0.7
2	Rhode Island	1.8	20	Colorado	1.0	38	New Hampshire	0.7
3	Utah	1.7	21	Pennsylvania	1.0	39	Wyoming	0.6
4	Connecticut	1.6	22	California	1.0	40	South Dakota	0.6
5	Nevada	1.6	23	Georgia	0.9	41	Maine	0.5
6	Texas	1.5	24	U.S	0.9	42	New York	0.5
7	West Virginia	1.4	25	Iowa	0.9	43	North Carolina	0.5
8	Kansas	1.4	26	Hawaii	0.9	44	South Carolina	0.5
9	Mississippi	1.4	27	Oregon	0.9	45	Ohio	0.5
10	Washington	1.4	28	Alabama	0.8	46	Wisconsin	0.5
11	Missouri	1.3	29	Arkansas	0.8	47	Kentucky	0.4
12	Idaho	1.2	30	Louisiana	0.8	48	Indiana	0.4
13	Massachusetts	1.1	31	Vermont	0.8	49	North Dakota	0.2
14	New Jersey	1.1	32	Michigan	0.8	50	Alaska	0.2
15	Oklahoma	1.1	33	Florida	0.8	51	Nebraska	0.1
16	Illinois	1.1	34	Maryland	0.8	52	District of Columbia	0.0
17	Arizona	1.0	35	Virginia	0.8			
18	Minnesota	1.0	36	Montana	0.7			

WWD Fatal Crash Trend



WWD Fatality Trend

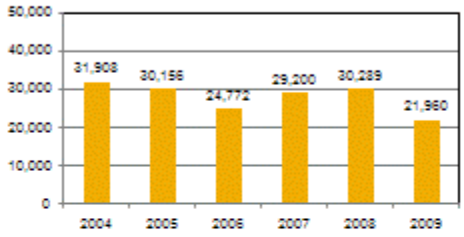


	Y2004	Y2005	Y2006	Y2007	Y2008	Y2009	Y2010	Y2011
Total number Of Fatalities	42,836	43510	42708	41259	37423	33883	32999	32367
Number of WWD Fatalities	397	336	372	370	370	334	336	349

About One Percent of Traffic Fatalities Caused by WWD

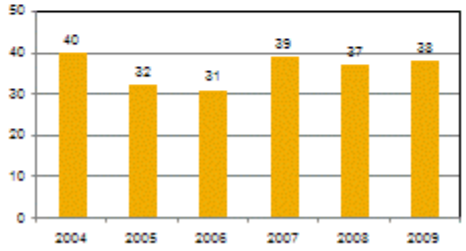
WW Crashes in IL

Freeway Crashes



About 1.3 Percent of Freeway Crashes Caused by WWD

W-W Crashes



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WW Crashes in IL

Category	Year						
	2004	2005	2006	2007	2008	2009	Total
Freeway Crashes	31,908	30,156	24,772	29,200	30,289	21,960	168,285
WW Crashes	40	32	31	39	37	38	217
%	1.3%	1.1%	1.3%	1.3%	1.2%	1.7%	1.3%

Severity	2004	2005	2006	2007	2008	2009	Sum
Killed	12	3	8	10	4	7	44
A-Injury	27	9	18	14	21	17	106
B-Injury	14	14	15	24	25	23	115
C-Injury	6	6	5	6	3	1	27
PDO	14	11	12	13	16	20	86

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Wrong-Way Crashes in Illinois

Crash Type	2004	2005	2006	2007	2008	2009	Sum	%of Total
Killed	$64.7	$16.2	$43.1	$53.9	$21.6	$37.7	$237.1	84.7%
A-Injury	$7.8	$2.6	$5.2	$4.1	$6.1	$4.9	$30.8	11.0%
B-Injury	$1.5	$1.5	$1.6	$2.5	$2.7	$2.4	$12.2	4.4%
Total	$74.0	$20.3	$49.9	$60.5	$30.3	$45.1	$280.0	100.0%

(in Millions Dollars)

Average Annual Economic Loss Due to Wrong-Way Crashes is $56 Million in Illinois

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Literature Review

http://www.ce.siue.edu/faculty/hzhou/ww/report.html?I

Including: 22 Reports, 14 Papers, and 9 Others

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Literature Review Results

- **Caltrans, 1970-1980**
  - Low Mounted DO NOT ENTER and WRONG WAY Signs
  - A Wrong-Way Crash Monitor Program
- **TxDOT and Tollway In Dallas and Houston, 2004-2009**
  - A Comprehensive 4 E's Approach
  - Application of Advanced Intelligent Transportation System (ITS) Technologies

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Literature Review Results

- No National Level Effort to Reduce WW Crashes
- Difficult to Identify WW Entry Points
- No Statistical Significance Test on Contributing Factors
- Few Studies on Countermeasures Effectiveness

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WW Crash Data Collection

- 632 Possible WW Crashes from the IDOT Crash Database
- After Reviewing the Hardcopy of 632 Crash Reports, 217 Real WW Crashes Identified.

Year	Total Crash	Freeway Crash	Possible WW Crash	True WW Crash
2004	433,259	31,908	125	40
2005	421,757	30,156	137	32
2006	408,858	24,772	103	31
2007	423,090	29,200	106	39
2008	408,487	30,289	88	37
2009	292,426	21,960	73	38
Total	2,387,877	168,285	632	217

1.3% of Freeway Crashes

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Data Analysis

- General Statistical Characteristics
  - Where
  - When
  - Who
  - How
- Contributing Factors
  - Haddon Matrix
  - Significance Test

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Top 10 WW Counties

Ranking	County Name	Amount	Percent (%)
1	Cook	82	37.8%
2	St Clair	21	9.7%
3	Madison	20	9.2%
4	Will	14	6.5%
5	Champaign	6	2.8%
6	Mclean	6	2.8%
7	Tazewell	6	2.8%
8	Winnebago	5	2.3%
9	6 Counties	3	1.4%
10	10 Counties	2	0.9%
Sum	-	165 (217)	76.0% (100%)

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Top 10 Routes

Ranking	Route Number	Total WW Crashes	Percent (%)	Length (Mile)
1	I-55	42	19.4%	294
2	I-94	32	14.8%	77.4
3	I-57	21	9.7%	359
4	I-74	17	7.8%	220
5	I-64	16	7.4%	130
6	I-290	12	5.5%	30.4
7	US 41	11	5.1%	5.2
8	I-80	9	4.2%	163
9	I-270	7	3.2%	15.2
10	I-90	6	2.8%	108
Sum	-	173 (217)	79.7% (100%)	1402.2

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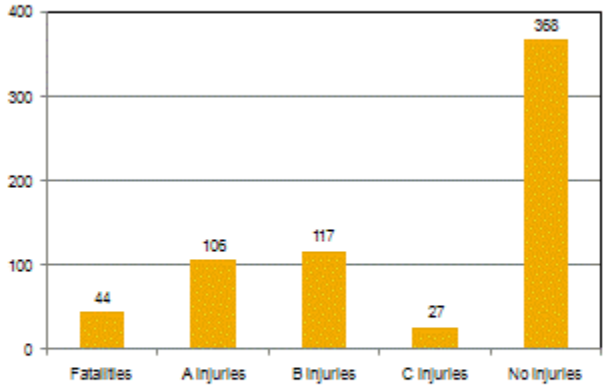
WW Crash Severities



Total WW Crashes: 217
Total People Involved: 912
4.2 People per Crash
1.3 Fatalities per Fatal Crash

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WW Crash Severity

	Freeway crash	Wrong way crash
average	1.10	1.33
Low	1.10	1.13
High	1.11	1.53

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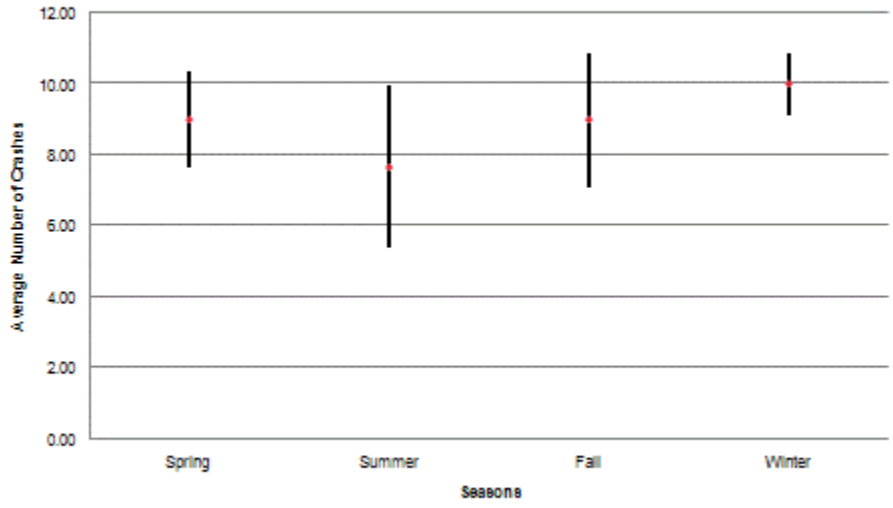
When: Season



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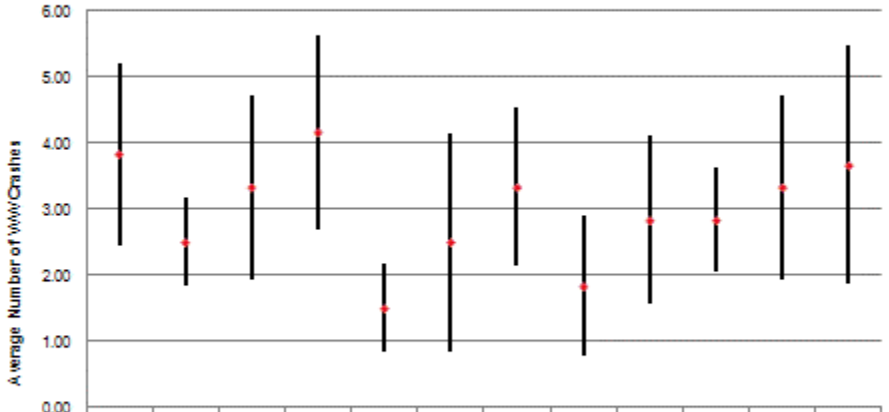
When: Month



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	5.21	3.17	4.73	5.63	2.17	4.16	4.54	2.90	4.12	3.62	4.73	5.47
Low	2.46	1.83	1.93	2.70	0.83	0.84	2.13	0.77	1.55	2.05	1.93	1.87
Average	3.83	2.50	3.33	4.17	1.50	2.50	3.33	1.83	2.83	2.83	3.33	3.67

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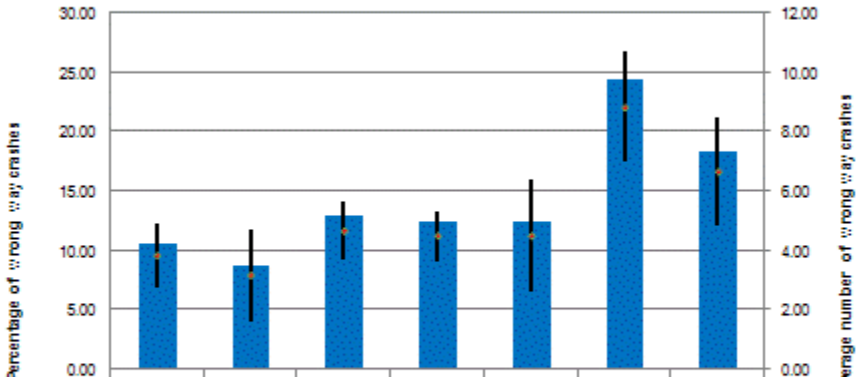
When: Day



	Monday	Tuesday	Wendnesday	Thursday	Friday	Saturday	Sunday
Percentage	10.60	8.76	12.90	12.44	12.44	24.42	18.43
High	4.90	4.72	5.64	5.34	6.38	10.69	8.47
Low	2.77	1.61	3.70	3.66	2.62	6.98	4.87
Average	3.83	3.17	4.67	4.50	4.50	8.83	6.67

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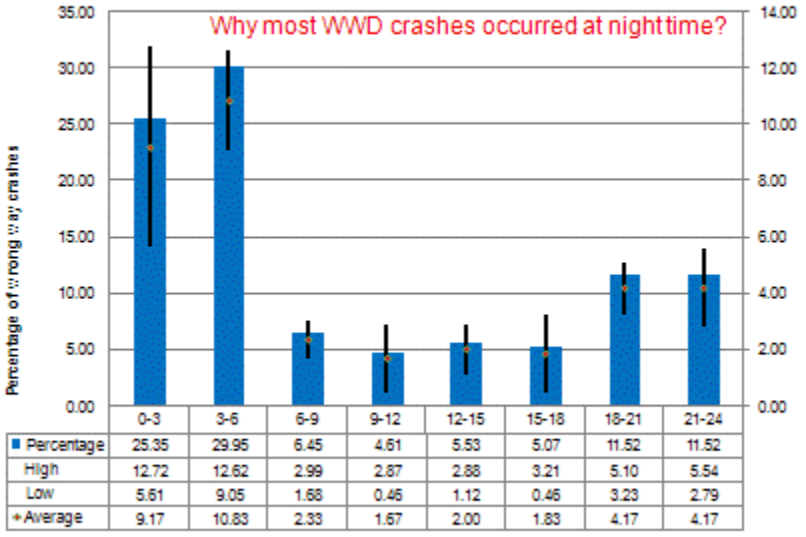
When: Hour



	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Percentage	25.35	29.95	6.45	4.61	5.53	5.07	11.52	11.52
High	12.72	12.62	2.99	2.87	2.88	3.21	5.10	5.54
Low	5.61	9.05	1.68	0.46	1.12	0.46	3.23	2.79
Average	9.17	10.83	2.33	1.67	2.00	1.83	4.17	4.17

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WW Driver Characteristics

Age Group	Number of drivers	Percentage of total
16-24	41	18.9%
25-34	54	24.9%
35-44	28	12.9%
45-54	23	10.6%
55-64	10	4.6%
Over 65	29	13.4%
Unknown	32	14.7%
Total	217	100%

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WW Driver: Age

	16-25	25-34	34-50	50-65	>65
High	1.07	1.28	1.11	1.02	4.24
Low	0.73	0.92	0.65	0.28	1.54
Average	0.90	1.10	0.88	0.65	2.89

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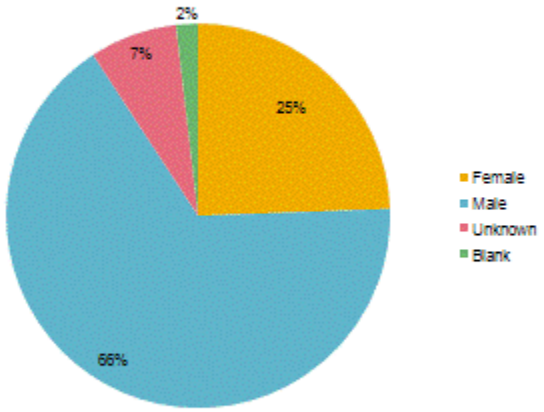
WW Driver Characteristics



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WW Driver: Gender

	Male	Femail
High	1.17	0.96
Low	1.02	0.66
Average	1.10	0.81

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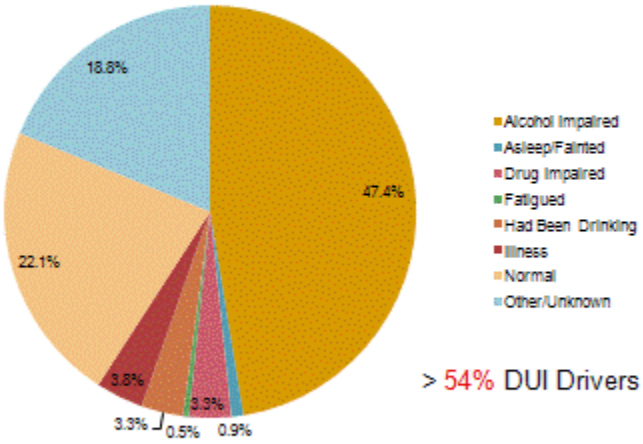
WW Driver Characteristics



> 54% DUI Drivers

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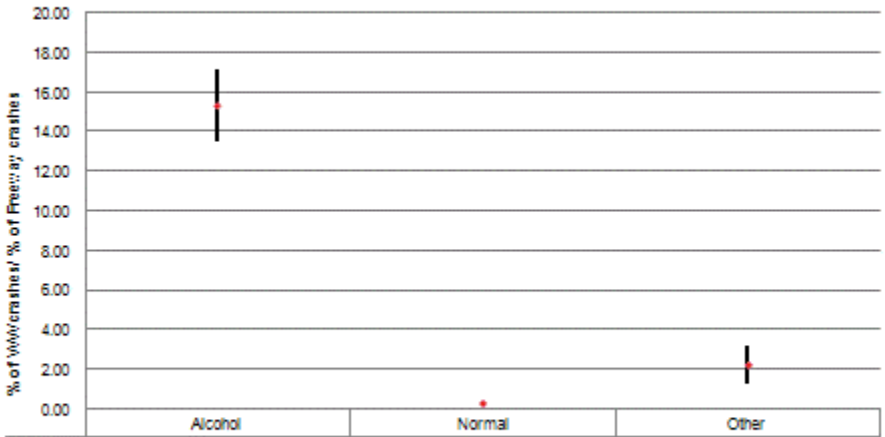
WW Driver: Condition



	Alcohol	Normal	Other
High	17.18	0.36	3.24
Low	13.53	0.25	1.24
* Average	15.36	0.30	2.24

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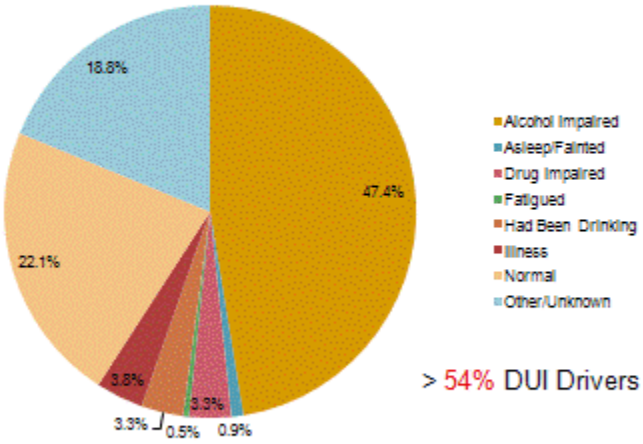
WW Driver Characteristics



> 54% DUI Drivers

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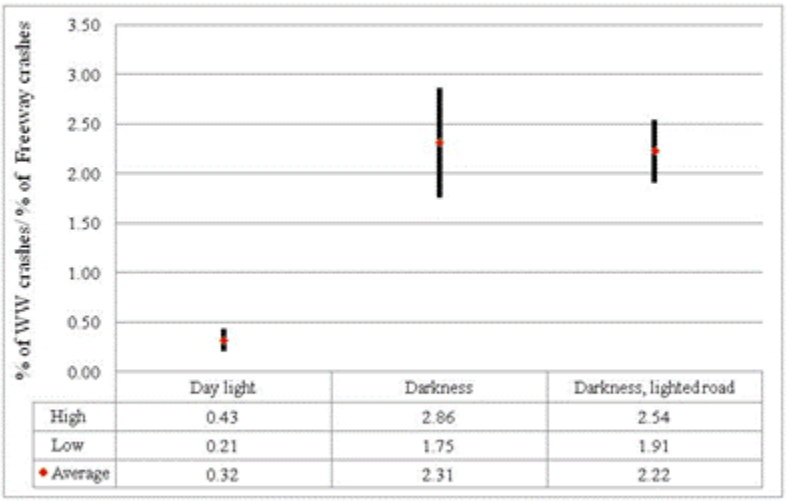
Darkness/Lighting



	Day light	Darkness	Darkness, lighted road
High	0.43	2.86	2.54
Low	0.21	1.75	1.91
Average	0.32	2.31	2.22

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How: Causal Table

◆Contributing Factors Percentage and Weight

Contributing Factor	Crash Severity by Percentage						
	Fatal	A-Injury	B-injury	C-Injury	No-injury	All Crashes	Weight*
Darkness	12.44	16.13	13.36	4.61	33.18	79.72	3.79
Under Influence of Alcohol/Drugs	11.06	10.14	8.76	2.30	15.67	47.93	2.66
Physical Condition of Driver	1.38	3.69	2.30	0.46	3.69	11.52	0.63
Operating Vehicle in Reckless Manner	0.92	2.76	0.46	0.92	2.30	7.37	0.41
Driving Skills/Knowledge/Experience	1.38	0.46	1.84	0.46	5.07	9.22	0.33

*Weight = (Fatal*10+A-injury*9+B-Injury*5+C-Injury*2+No-Injury*1)/100

Based on Cause 1 and Cause 2 in the Crash Reports

7/25/2013 33

How: Correlation Analysis

◆Correlation (1= Strongly Correlated)

	Young Drivers	Older Drivers	DUI Drivers	Night Crashes	Male Drivers	Weekend Crashes	Fatal/Injury Crashes
Young Drivers	1.00						
Older Drivers	-0.11	1.00					
DUI Drivers	0.07	-0.45	1.00				
Nighttime Crashes	0.06	-0.32	0.60	1.00			
Male Drivers	0.27	-0.11	0.59	0.35	1.00		
Weekend Crashes	0.12	-0.16	0.54	0.30	0.50	1.00	
Fatal/injury Crashes	-0.08	-0.15	0.46	0.19	0.27	0.07	1.00

- DUI drivers are in correlation with male drivers/nighttime/weekend/F/I.

Significant Factors

Factors	Significantly Contribute	Factors	Significantly Contribute
Location	√	Driver Gender	√
Season	×	Driver Age	√
Month	×	Driver Condition	√
Day	√	Darkness	√
Time	√	Lighting	×

Contributing Factors for F/I WW Crashes

Human	Vehicle	Environment
• **Pre-crash:** Young driver-Age of 16-24; Old driver-Age Above 65; Under Influence of Alcohol /Alcohol Impaired; Drug Impaired • **During Crash:** Driving on wrong side/wrong way; Improper Lane Usage; Physical Condition of Driver; Driving Skills/Knowledge/Experience	• **Pre-crash:** Vehicle 1 driving wrong way; Vehicle 2 straight ahead or avoiding vehicle/objects • **During Crash:** Seat belts not used	• **Pre-crash:** Higher frequency in urban area than in rural area; Higher frequency in Madison, Cook, St. Clair, and Will; Mostly happened during 12am-4am. • **During Crash:** Road lighting-Darkness; Lighted Road or Darkness; • Roadway Layout

Based on Haddon Matrix Analysis Results

Ranking Analysis-Overall

◆Assumption:

- In each crash case, all contributing factors are weighted equally. Each factor is assigned a weight of 1/total number of contributing factors in a case. Factors are then ranked by their average weights.

◆Total Crashes (Fatal/A Injury/B Injury)

Rank	Top Contributing Factors	%
1	Under Influence of Alcohol/Alcohol Impaired	11.5%
2	Road Lighting-Darkness, Lighted Road	9.4%
3	Road Lighting-Darkness	6.6%
4	Young Driver-Age of 16-24	4.1%
5	Vehicle 2 Maneuver-Avoiding Vehicle/Objects	3.9%
6	Old Driver-Above 65	3.4%
7	Improper Lane Usage	3.0%
8	Physical Condition of Driver	2.8%
	Total Percentage	80.3%

Ranking Analysis-Fatal

- **Specially Important Factors: Old Driver, Seat Belts Not Used.**

Rank	Top Contributing Factors	%
1	Under Influence of Alcohol/Alcohol Impaired	19.7%
2	Road Lighting-Darkness, Lighted Road	13.1%
3	Road Lighting-Darkness	12.8%
4	Old Driver- Above 65	6.1%
5	Seat Belts Not Used	5.9%
6	Vehicle 2 Maneuver-Avoiding Vehicle/Objects	5.8%
7	Young Driver-Age of 16-24	5.6%
8	Drug Impaired	4.6%
9	Driving Skills/Knowledge/Experience	4.3%
10	Improper Lane Usage	4.0%
	Total Percentage	81.8%

Ranking Analysis-A Injury

- **Specially Important Factors: Young Driver, Seat Belts Not Used, Rain**

Rank	Top Contributing Factors	%
1	Under Influence of Alcohol/Alcohol Impaired	17.1%
2	Road Lighting-Darkness, Lighted Road	15%
3	Young Driver-Age of 16-24	8.3%
4	Improper Lane Usage	8.2%
5	Road Lighting-Darkness	7.7%
6	Vehicle 2 Maneuver-Avoiding Vehicle/Objects	6.2%
7	Seat Belts Not Used	4.9%
8	Physical Condition of Driver	4.5%
9	Operating Vehicle in Reckless Manner	3.1%
10	Rain	3.0%
	Total Percentage	78.0%

Ranking Analysis-B Injury

- Specially Important Factors: Old driver, Physical Condition, Rain

Rank	Top contributing factors	%
1	Under Influence of Alcohol/Alcohol Impaired	20.0%
2	Road Lighting-Darkness, Lighted Road	16.8%
3	Road Lighting-Darkness	11.5%
4	Old Driver-Age Above 65	8.5%
5	Physical Condition of Driver	5.2%
6	Rain	3.9%
7	Vehicle 2 Maneuver-Avoiding Vehicle/Objects	3.5%
8	Driving Skills/Knowledge/Experience	3.2%
9	Young driver-Age of 16-24	2.9%
10	Drug Impaired	2.7%
	Total Percentage	78.2%

Limitations of Crash Data Analysis

- Mainly focus on the human factors: drivers' error;
- Little information about the roadway environment, geometric conditions, traffic sign and pavement markings;
- Only a small percentage (less than 1%) of WWD incidents end up with a crash. So it is difficult to identify high WW entry locations if using WWD crash data only.

Field Review

- **How to Select High Crash Locations?**
  - New Method to Identify WWD Entry Points
  - New Method to Rank WWD Crash Locations
- **How to Conduct Field Reviews?**
  - Field Review Checklist
  - RSA Approach
  - Site Specific Countermeasures

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WW Entry Points

- **Typical Entry Locations**
  - Exit Ramps
  - No Entry Points
    - U-Turn on Freeway
- **Availability**
  - Recorded in Crash Reports
  - Not Recorded

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General Information on Entry Points

Category		Number
W-W Crashes with Known Entry Points	Recorded Entry Points	44
	U-Turn on Freeways	14
	Cross Median	7
W-W Crashes with Unknown Entry Points	1st Possible Entry Point	127
	2nd Possible Entry Point	134

Method to Rank the High Crash Locations:

- A weight of 1.0 was assigned for the recorded entry point,
- 0.5 was assigned for the 1st entry point, and
- 0.25 was assigned to the 2nd entry point.

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Top 10 Locations

County	Route	Longitude	Latitude	Type of Interchange	WW Entry Points	Weighted Points
Cook	I55/S Damon Ave	87°40'31.60"W	41°50'13.89"N	Single Point Urban	4	2
Cook	I94/87th St	87°37'29.50"W	41°44'9.52"N	Compressed Diamond	4	1.5
Cook	I94/ W Peterson Ave	87°45'1.36"W	41°59'24.79"N	Partial Clover	4	1.5
Cook	41/W Belmont Ave	87°38'17.10"W	41°56'25.90"N	Compressed Diamond	4	1.5
St Clair	I64/N Illinois St	89°59'5.80"W	38°35'57.05"N	Diamond	3	2.25
Cook	I94/W Foster Ave	87°44'45.24"W	41°58'31.93"N	Partial Clover	3	2
St Clair	I64/S Bluff Rd	90° 2'45.89"W	38°36'50.80"N	Partial Clover	3	1.75
St Clair	I64/3	90° 8'42.63"W	38°37'58.74"N	Directional	3	1.75
Cook	I90/35th St	87°37'50.10"W	41°49'51.52"N	Compressed Diamond	3	1.25
Cook	I57/S Halsted St	87°38'35.08"W	41°42'53.41"N	Compressed Diamond	3	1.25
Madison	I70/ 111	90° 5'33.93"W	38°39'46.20"N	Diamond	3	1.25

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Interchange Type

Interchange Type	Recorded	1st Possible	2nd Possible
Compressed Diamond	12(25.0%)	45(30.4%)	44(29.9%)
Diamond	16(33.3%)	39(26.4%)	38(25.9%)
Partial Cloverleaf	5(10.4%)	27(18.2%)	23(15.6%)
Cloverleaf	3(6.3%)	12(8.1%)	12(8.2%)
Rest Area	1(2.1%)	9(6.1%)	6(4.1%)
Freeway Feeder	5(10.4%)	4(2.7%)	6(4.1%)
Modified Diamond	3(6.3%)	4(2.7%)	4(2.7%)
Semi-directional	0	3(2.0%)	5(3.4%)
Trumpet	0	2(1.4%)	4(2.7%)
SPUI	1(2.1%)	2(1.4%)	3(2.0%)
Directional	2(4.2%)	1(0.7%)	2(1.4%)
Total	48 (100%)	148 (100%)	147 (100%)

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I-64/S Bluff Road

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I-64/S Bluff Road

Crash History

Date	Time	Type of Injury	Alcohol Results	Crash ID	WW Entry Point
9/23/2005	9 AM	C injury	96	53628657	I 64 off ramp South on IL 157
3/9/2006	2 AM	B injury	96	61360285	I 64 off ramp north on IL 157
4/21/2007	5 AM	PDO	Drug impaired	70797980	I 64 off ramp South on IL 157

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A Check List

Route Information:	I-64/S bluff road			Date: 11/08/11
Ramp Description:				Time:
SIGN	CHECK IF	YES	NO	COMMENTS
DO NOT ENTER	At least one present	√		3 entry points confusing for left turns
	In good condition	√		
WRONG WAY	At least one present	√		For right turns if 4 miss the right turn only lane may
	In good condition	√		
ONE WAY	Present at location for cross under/over traffic		x	
	NO RIGHT TURN		x	
	NO LEFT TURN		x	
	NO U-TURN		x	

PAVEMENT MARKING	CHECK IF	YES	NO	COMMENTS
WRONG-WAY ARROWS	Present		x	They don't use a through arrows
	Pieces in good condition		x	Include pavement markings
Other Markings	Elephant tracks/turning guide line		x	Stop bars & arrows
	Stopping lines at end of exit ramp	√		Use the reflective tape for pavement markings

GEOMETRIC DESIGN FEATURES	CHECK IF	YES	NO	COMMENTS
Raised Curb Median on the crossroad	Present			
	Present			
	Present	√		
Design to Discourage Wrong-Way Entry	Present			

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I-64/S Bluff Road

- Site Specific Countermeasures
  - Signage:
    - DO NOT ENTER sign followed by WRONG WAY shall be both sides of the road way clearly demarcating the wrong way for the drivers
    - WRONG WAY sign and DO NOT ENTER provided on the left hand side of the wrong way shall be adjusted such that the drivers making left turn on to the on-ramp from S Bluff road should clearly identify it.
    - DO NOT ENTER sign mounted on red post as adopted by Texas DOT.
    - Low mounted WRONG WAY signs with DO NOT ENTER post
    - Provide overhead DO NOT ENTER signs
  - Pavement Marking:
    - Elephant tracks need to be provided on both WB and EB on-ramps (MUTCD 2009 2B-41 & fig 3B-13)
  - Geometric Design
    - **Remove the raised medians for right, through and left turn lanes of I 64 on Bluff south exit ramp**

12 Field Reviewed Sites

- Diamond Interchange
  - I-70/IL-111
- Compress Diamond Interchange
  - I-94/ 87th St., 35 St.; and I-57/Halsted St., 41/Belmont Ave
- Partial Cloverleaf Interchange
  - I-64/Bluff Rd., I-94/Peterson, Touchy, W Foster Ave, I-94/Ohio, Cermak (Chinatown)
- SPUI
  - I-55/S Damon Ave

Countermeasures

- **General Countermeasures**
  - Signage
  - Pavement Marking
  - Geometric Design
- **Site Specific Countermeasures**
  - Compressed Diamond
  - Diamond
  - Partial Cloverleaf
  - SPUI

Short Term Low Cost Countermeasures

- **Maintenance of Existing Signage**
  - Do-Not-Enter
  - Wrong-Way Sign
  - One-Way Sign
  - No Right and Left Turn Sign
  - Signal
- **Maintenance of Pavement Marking**
  - Stop Bar
  - Directional Arrow
  - Elephant Track Marking

Long Term and System Approaches

- **Advanced Signage and Pavement Marking**
  - Oversize and LED Wrong-Way Sign
  - Solid Arrow Signal
  - Qwick Curb Application
- **Advanced Detection and Warning System**
  - Blinker Sign Wrong Way and Do Not Enter LED Warning System
- **Geometric Design**
  - Raised Curb Median
  - Sharp Turning radius
  - Median Extensions
- **A Comprehensive 4 E's Approach**

General Issues with Existing Signage

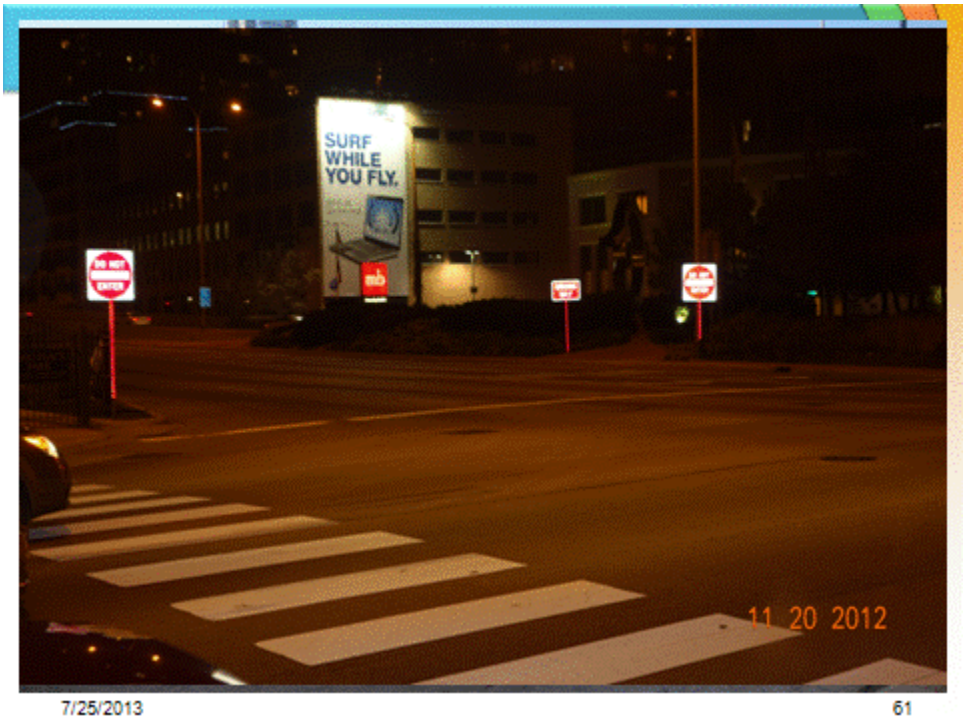
- **Some Do-Not-Enter signs do not face the potential wrong-way drivers**
- The sizes of some signs on the multi-lane off-ramps are not proportional to the width of cross section
- No Do-Not-Enter/Wrong-Way signs were placed at some one-way streets

I-70/IL 111

California DO NOT ENTER Sign

DO NOT ENTER SIGNS in LA

No Do-Not-Enter Sign

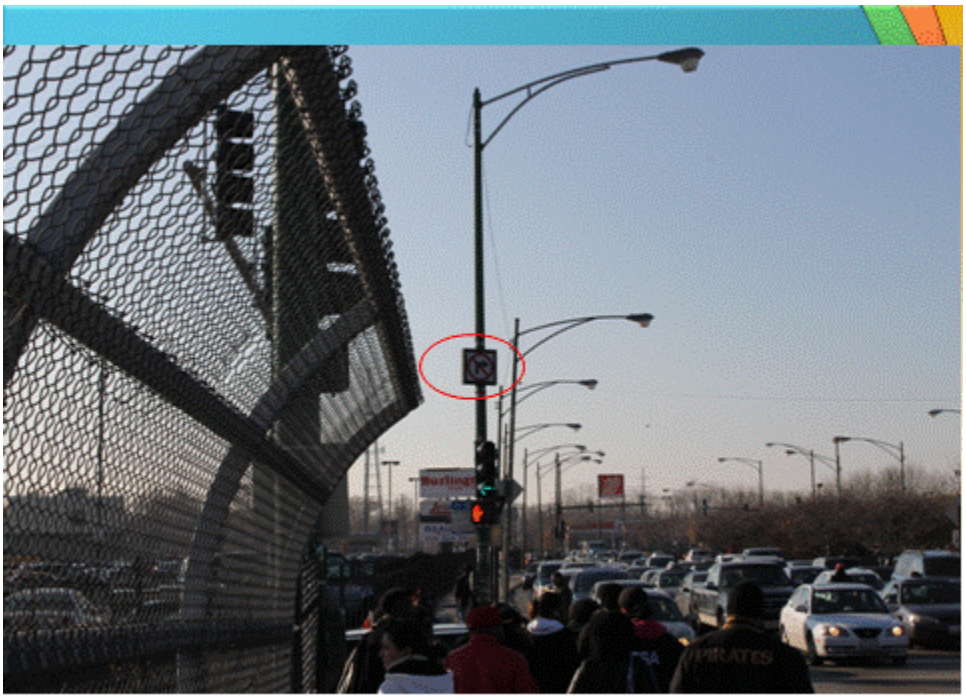


General Issues with Existing One-Way Sign

- The sizes of one-way signs on the multi-lane off-ramps are too small.

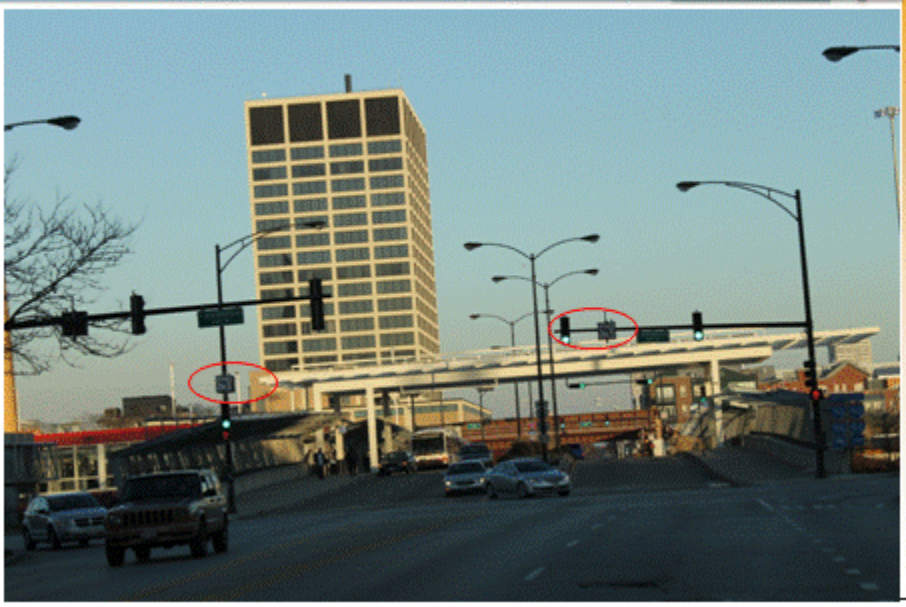

ONE WAY
STOP


General Issues with Existing No Turn Sign
12-10'



7/25/2013 68

Correct Placement of No-Left Turn Sign



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General Issues of Pavement Marking

- Lack of elephant track marking to guide the large turning radii
- Absence of stop bar at the end of the off-ramps
- Absence of directional arrow at the end of the off-ramps

Advanced Signage and Pavement Marking

- Oversize LED WW Sign
- Solid Arrow Signal

Dallas Tollway

74

Wrong-Way LED Sign

Dallas Tollway

75

LED No Left Turn Sign (Chicago)

76

Advanced Detection and Warning System

- BlinkerSign Wrong Way and Do Not Enter LED Warning System
  - (I would suggest to be only activated at nighttime when traffic volume is low)

77

Wrong-Way Go Back Sign

Advanced Geometric Design

- Raised Curb Median
- Sharp Turning Radius
- Median Extensions

Raised Curb Median

- Full-Diamond Interchange:

80

Application of QK by MDOT

81

4 E's Approach-Engineering

- Engineering
  - Implemented the site-specific countermeasures at 12 locations
  - Adopted the checklist for wrong-way field review
  - Established a RSA team for recent WW crashes
- Enforcement
- Emergency Response
- Education

Enforcement Countermeasures

- Enforcement
  - **A standard procedure to report the wrong-way crashes**
  - **Data Driven ISP patrol-DUI check points**
    - **Weekend, 12-6 AM**
    - **Locations**
  - **A standard procedure to respond a WW driver**
    - **Portable spike barriers to stop WW drivers**
    - **Confinement, to close toll barriers, tunnel and motorway access the area**
    - **Radio and DMS Warning to Right-way drivers**

Emergency Response

WW Driving Distance

Items	Recorded Entry Point
Total Amount	48
Mean	1.2 miles
Maximum	6.4 miles
Minimum	0.1 miles
Standard Deviation	1.6 miles
Variance	2.6 miles
Median	0.4 miles

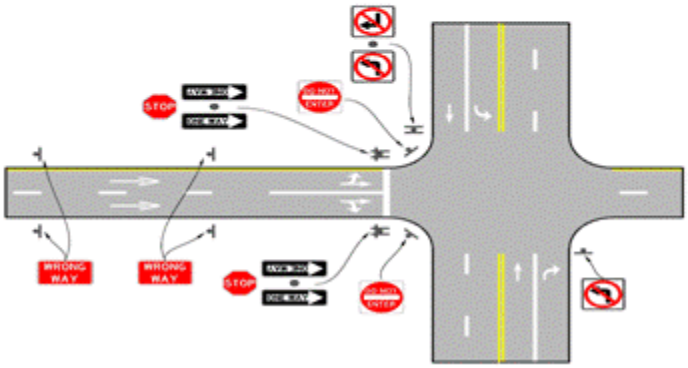
Most WW drivers stayed at left lanes before crashes

Education Countermeasures

- Education
  - Public awareness and understanding of
    - Basics of road designs and Interchange types
    - Acts to do (witnessing a wrong way driver)
    - Possible damages to society or a family
  - Focus Group
    - Young drivers
    - Older drivers
    - DUI drivers

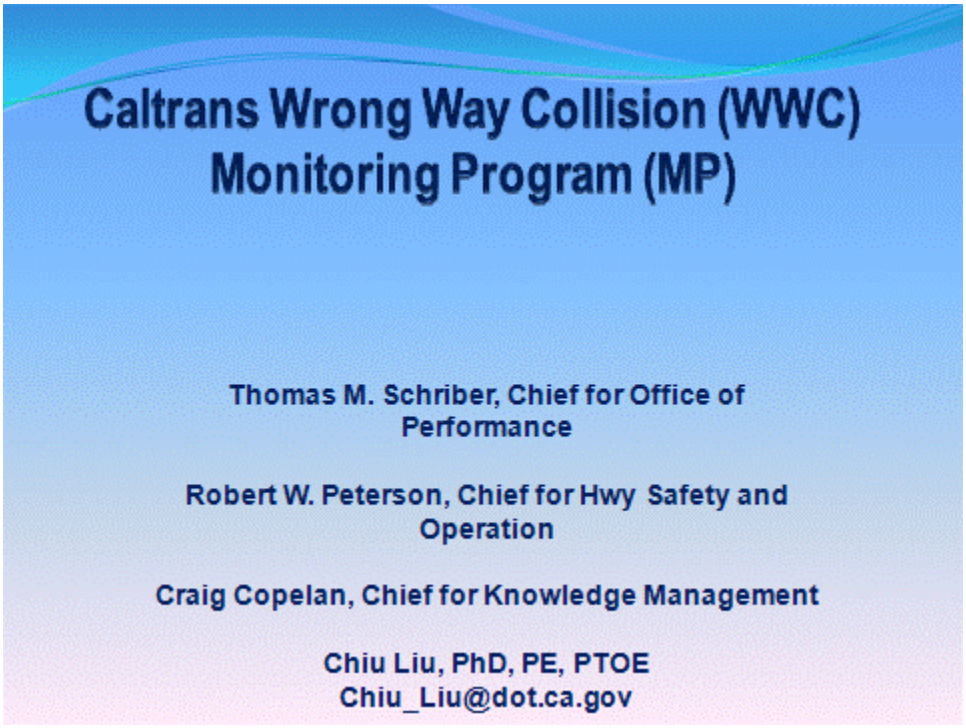
Next Steps

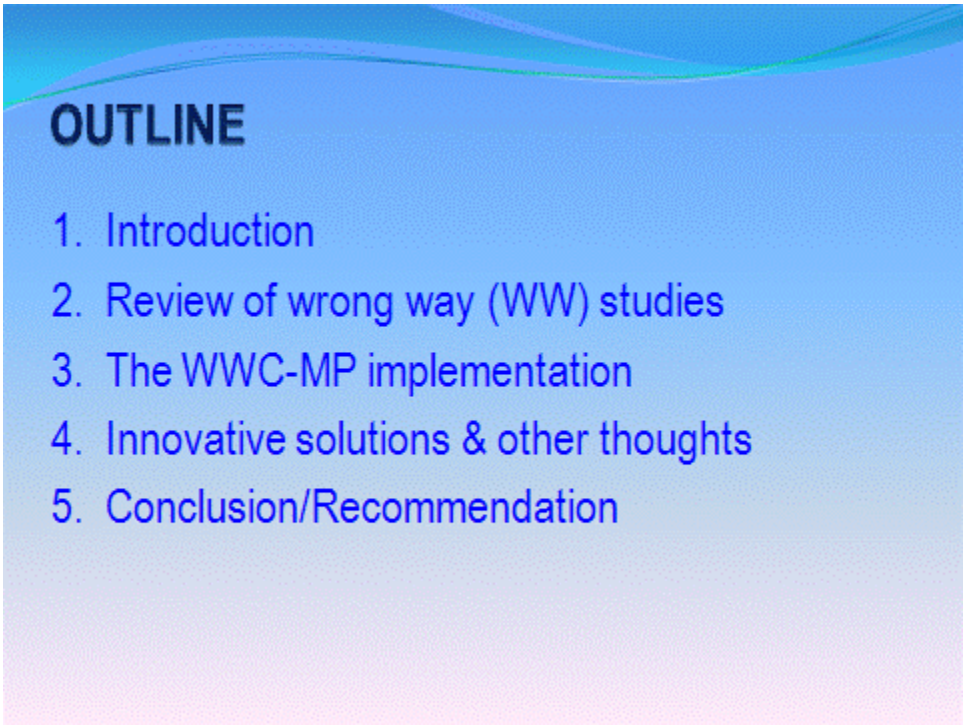
- Develop a Guideline for WW Driving Countermeasures
- Develop Methods to Evaluate the Recently Implemented Countermeasures in IL



California Wrong-Way Driving Monitoring Program

Chiu Liu, California Department of Transportation





INTRODUCTION

1. What is wrong way driving (WWD)? Confused because of DUI, Poor Visibility (V), Age &V ….etc?
2. What can possibly be done for a given location?
3. What are the possible countermeasures?
4. Network Screening/Field Studies/Implementation

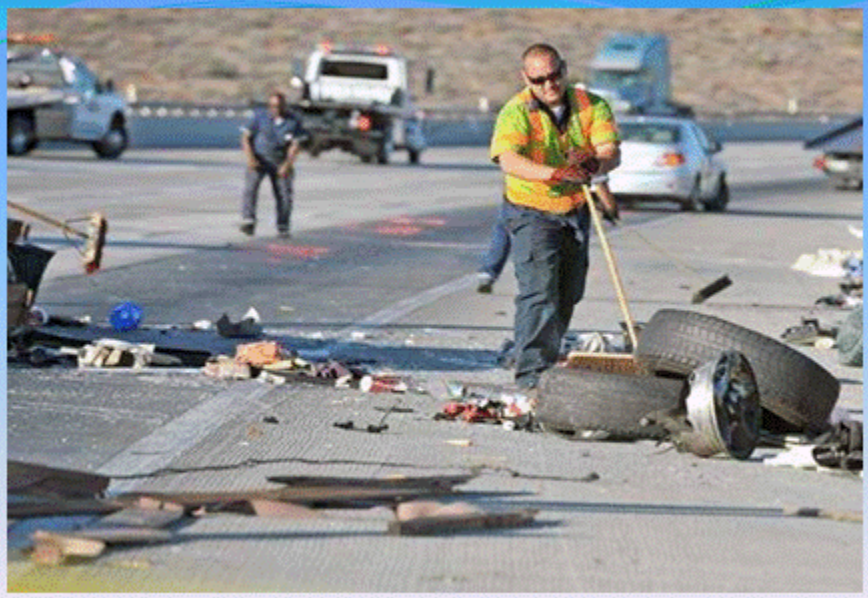
Why is WWD an Important Issue?

ALL E/F COLLISION Stat From 2006 to 2010:
FCs =0.6%, ICs =31.2%, PCs =68.2% for tot of 663,602 Cs

Statewide (SW) E/F WWC Stat From 2006 to 2010:
FCs=121 (12%), ICs=526 (52%), PCs=365 (36%)
% of FC = 2.83%; and % of IC = 0.25% over all E/F Cs
DUI among WWCs = 50%

Usually Multi-vehicles get involved and cause fwy congestion

E/F---Expressway/Freeway
FC---Fatal Collision
IC---Injury Collision
PC---Property Damage Only Collisions



9-car pileup on Highway14 after a WW crash, 6/10/13 in Agua Dulce, CA

California Highway Patrol (CHP) at the WW crash on Highway 14, 6/10/13, in Agua Dulce, CA

INTRODUCTION

Drivers/Passengers at the Highway 14 WW crash June 10 in Agua Dulce, CA

REVIEW of WW STUDIES

1. 1961-64 ITE WWD Study at UCLA

Signs, horns, activated lights, Spring loaded spikes

Recommendations:

(i) "Freeway Entrance" sign for all on ramps (ensure the right way)

(ii) Black on White "Do Not Enter" instead white on black plus underneath "Wrong Way" Sign (D-Neg)

(iii) Pavement Arrows on Traveled Ways/Reflective Arrows on Offramps

(iv) Double the size of the 'Keep Right" sign at transitions

REVIEW of WW STUDIES

2. 1968 Caltrans Interim Report

1. >1/3 WWD reduction
2. Interchange should allow all movements to and from freeway because most do but some don't
3. Making off-ramp junction difficult to enter
4. Provide sufficient SD at interchanges, further one can see, less Likely one gets onto the WW
5. Age factor……
6. A great deal more research…

REVIEW of WW STUDIES

3. 1971 ITTE Study

1. Lower minimum sign height for off-ramps (V)
2. Reduce cluster of signs and bundle them on posts where possible for off-ramps (V&I)
3. Fwy entrance sign should include Route No. and its direction.
4. Ramp terminal lighting is preferred (V)
5. Overhead and illuminated fwy entrance sign (V) is preferred

4. 1971 Caltrans Final Report on WWD

1. Trumpet, full Diamond, partial diamond, tend to attract substantially more WWD.
2. The additional sign "GO BACK - YOU ARE GOING - WRONG WAY" helps reduce 60% Fwy and 70% Expwy WWDs.
3. Install physical dividers on the cross street
4. Offramps from the left side of the traveled way should be avoided
5. Age factor for WWCs, Driving and HBD -77% up till age 69, and 46% in group 60-69 (DMV)

5. 1975 Caltrans

Implementing "Do not enter" Package for WW locations

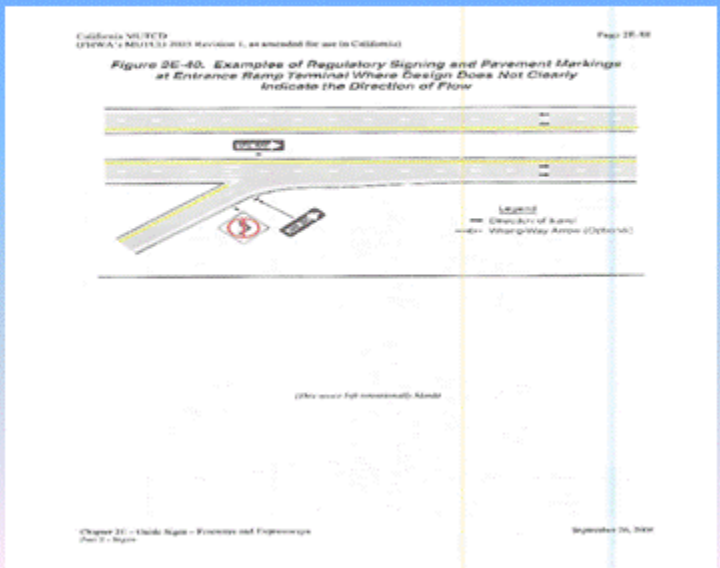
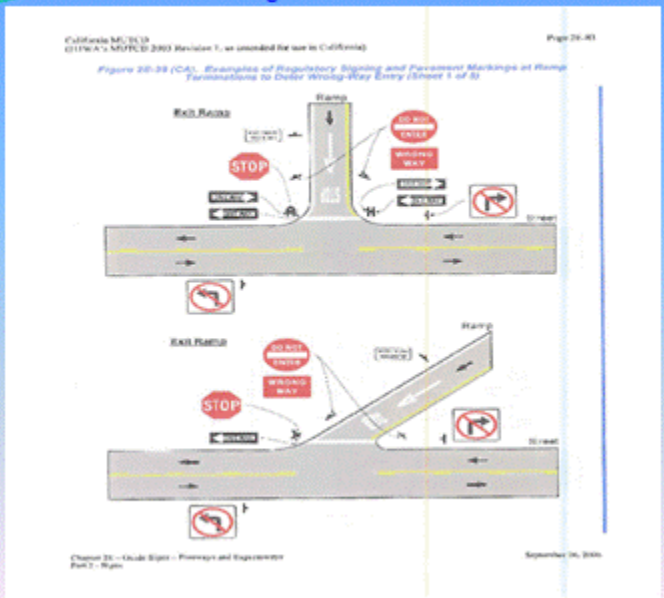


Figure 2E-40. Examples of Regulatory Signing and Pavement Markings at Entrance Ramp Terminal Where Design Does Not Clearly Indicate the Direction of Flow

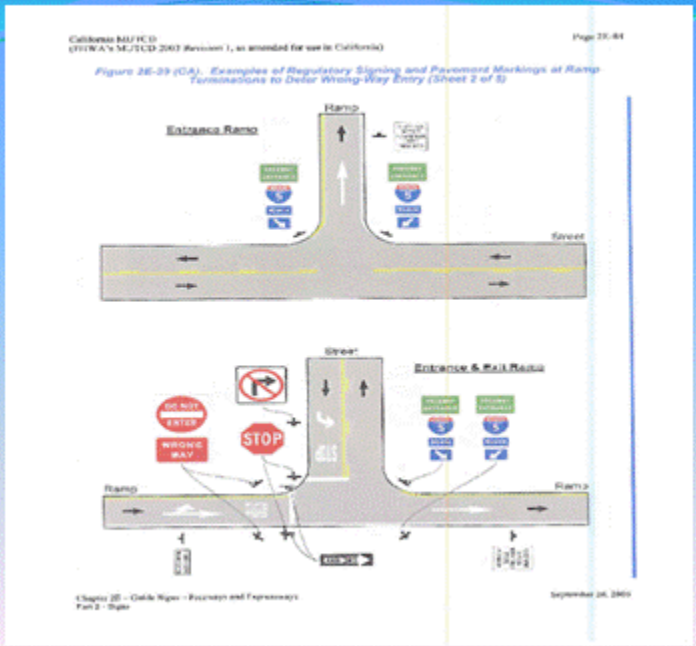
REVIEW of WW STUDIES

"Do not enter" Package for WW locations



"Do not enter" Package for WW locations

REVIEW of WW STUDIES



Check List for Wrong-Way Entry Review

1. Review pertinent collision reports. Using aerial photographs or other mapping websites, review ramps, cross roads, and median openings 3 miles upstream (less in urban, more in rural areas), from the collision location. Field investigation of ramps located within these 3 miles of the wrong-way collision site may reveal needed improvements in signing, striping or lighting. Bring appropriate figures from the CA MUTCD, starting from 2B-12(page 215-227) and , figure 3B-24(Pages 752 - 758) with you.
2. Inspect off-ramps during both daylight and dark conditions, especially if the collision occurred at night. It is desirable to check the general visibility close to the same time of day and weather condition as when the collision occurred (sunrise, sunset, dark, fog, rain, etc.) Choose a safe observation location near entry points to the off-ramp where a wrong-way driver may have driven. Get out of your vehicle and view the scene from the wrong-way driver's perspective.
3. Check if Do Not Enter sign packages (R5 over R5-1a) are:
   - ___ present in the minimum quantities (See CA MUTCD figures),
   - ___ visibility from the entry decision point; not too far back,
   - ___ mounted at the recommended height (about 2' above the edge of the traveled way pavement but visible to headlights),
   - ___ not faded,
   - ___ not hidden by other objects or bushes,
   - ___ oriented at the best possible viewing angle,
   - ___ in good repair (riveted or bolted connection, etc.),
   - ___ and free from graffiti
   - ___ specify replacement and added signs made of high intensity sheeting.
4. Check if the 24' wrong-way pavement arrows (figure 3B-24) are:
   - ___ in the proper locations starting at about 20' from the limit line,
   - ___ present in the minimum quantity (at least 2 per lane),
   - ___ visible, with a reflective freshly painted look,
   - ___ not faded, not covered with grease, not chipped away,
   - ___ not embedded between directional arrows in left/right only lanes.
   - ___ highly reflective thermoplastic material may be specified for replacement and added wrong-way arrows.
5. Check if other pavement directional arrows (figure 3B-24) are:
   - ___ visible,
   - ___ not faded, not covered with grease, not chipped away.

"Do not enter" Package for WW locations REVIEW of WW STUDIES

Check List for Wrong-Way Entry Review

6. Check for the presence of other signs which discourage wrong-way movements:
   - ___ One Way (R6) about 1 ½' above the edge of traveled way pavement, but visible to headlights;
   - ___ No Right/Left Turn (R16B, R17B);
   - ___ No U-Turn (R3-4);
   - ___ Keep Right (R4-7);
   - ___ Divided Highway (R6-3, R6-3a, W6-1, W6-2);
   - ___ Two Way Traffic (W6-3).
7. Off-ramp openings should discourage wrong-way entry from the cross street. The opening should:
   - ___ be narrow, and
   - ___ have an island or painted median dividing parallel, adjacent on and off-ramps,
   - ___ have small radius corners on either side of the throat and be aligned towards local street travel.
   - ___ Also, red-clear markers may be used on the freeway mainline approaching exit ramps (Figure 3A-102, detail 14 and 14A; Figure 3A-111, detail 37; Figure 3B-14).
8. Freeway entrances must be obvious and accessible.
   - ___ Check that pathfinder-trailblazing signs are adequate for motorists to find the freeway entrances,
   - ___ entrance packages are in place and in good condition,
   - ___ one 18' entrance arrow per lane exists, in good repair (Figure. 3B-24),
   - ___ freeway entrances are better lit than exits (Traffic Manual figure 9-15, 9-16),
   - ___ interchanges are complete so motorists never have to enter a freeway using an off-ramp.
9. When left turning movements may be confusing in an intersection adjacent to an off-ramp, recommend:
   - ___ turning guide lines, either solid or broken,
   - ___ pavement markers to aid the turning movement,
   - ___ pavement markers on guide lines (good wear for high ADT),
   - ___ directional pavement arrows.

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Check List for Wrong-Way Entry Review

10. Consider eliminating factors which contribute to wrong way moves on adjacent right of way by:
    - ___ recommending removal of guide signs or privately owned directional signs located close to the off-ramp which may encourage wrong way entry,
    - ___ locating guide signs for frontage roads paralleling off-ramps far from the off-ramp opening,
    - ___ removing bushes and structures which decrease visibility,
    - ___ During the planning process, discourage the location of business driveways next to off-ramps in original right-of-way agreements,
    - ___ deny permission for bar permits near freeway ramps.
11. Any recommendations which result from the field investigation should be approved by a supervisor with Traffic Engineering experience before filling out the Traffic Investigation Report (TIR) form. Recommendations shown on the TIR form must be accomplished in a timely manner to prevent tort liability. Do not editorialize. Never write suggestions on the TIR form which will not be accomplished. Recommendation for the installation of wrong way preventive treatments such as wrong-way packages and pavement arrows do not require a safety index > 200, but do require engineering judgment; Minor B funding is at the discretion of the District.
12. In locations where sign theft is a problem, try:
    - ___ replacing any missing signs with those made of synthetic material,
    - ___ coating the backs of existing signs with a thick layer of grease.
13. For recurring problem, try:
    - ___ reviewing through another pair of eyes,
    - ___ installing more Do Not Enter sign packages, larger Do Not Enter sign packages, illuminating the signs, or increasing the number of pavement arrows,
    - ___ monitoring with camera or video to isolate the sources and patterns of the problem,
    - ___ observing traffic flow during different time of day,
    - ___ increasing traffic flow on low ADT off-ramps (reroute),
    - ___ closing the ramp or a road to the intersection,
    - ___ re-grading or realigning ramps with limited sight distances,
    - ___ re-grading or realigning portions of freeways where sight distances are < 1200 feet,
    - ___ constructing wrong-way, vehicle activated red pavement lights,

1985 CALTRANS Annual WWC-MP

1. Why 1985? the highway network inventory data base becomes available.
2. Purpose is to identify WWC locations on Expwy/Fwy and to implement routine investigations with recommended improvements (signs/markings/lighting etc).
3. 1985, right time to impose a statewide (SW) implementation on reducing WWCs based on a broader data base with persistent effort, uniform accident recording, and consistent countermeasures.

How is the Annual WWC-MR Prepared

1. Statewide (SW) highway network data base
2. All WWCs in the network are identified for the most recent 5 years
3. Identify locations meeting the following criterion: Rate for WWCs >=0.12=3/(5M*5Y) collisions PMPY with the requirement that # of WWCs >=3?

Continued Annual WWMR

4. Tabulate these locations for each district in a table
5. Send out both WW Checklist package and the TABLE with the WWC List to all 12 district investigation groups
6. District traffic investigators review the listed locations, proposes countermeasures; they when needed would discuss with the CHP concerning some WWCs
7. What about the 50% DUI WWCs? The CHP?

CHP EFFORT on Reducing DUI

1. CHP must be empowered with… – California Sup. Court in Oct 1987 declared that the sobriety check point operations are constitutional….
2. Hundreds of Sobriety checkpoints have been set up in CA
3. CHP runs (1) sober graduation program in May and June- targeting HS seniors (Young) and (2) National Drunk and Drugged Driving Week (All) to raise the public awareness of DUI via media announcements and participation in local activities

How effective is this WWC-MP?

1. Currently this program is operating by keeping WWCs at a minimal acceptable level.
2. Most of the fixes applied to identified locations cost less than $3K, indicating that the B/C ratio for a severe collision that is avoided would be very high, e.g. B/C ratio > (0.12*5500+0.52*68+0.36*3)K/3K = 232.
3. California's WWC-MP along with additional 4 MPs make up a comprehensive safety monitoring system

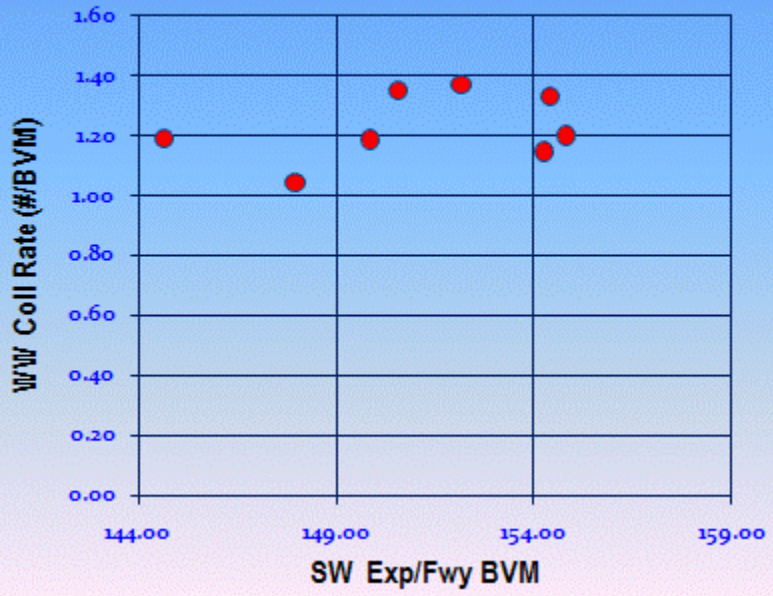
Effectiveness of the WWMP?

Wrong Way Collision Statistics							
Year	DUI	Fatigue	HBD	HNBD	Unknown	Tot Coll	SW E/F BVM
2002	70	0	9	55	38	172	144.64
2003	89	1	9	32	24	155	147.96
2004	80	1	3	80	44	208	152.18
2005	94	3	7	36	37	177	154.29
2006	118	1	3	39	44	205	154.44
2007	90	0	5	61	30	186	154.83
2008	94	0	7	37	40	178	149.85
2009	85	0	7	75	36	203	150.58

BVM--- billion vehicle miles traveled

WWC-MP Implementation

Effectiveness of the WWC MP?



INNOVATIVE SOLUTIONS...

'New' Devices for Reducing WWCs

1. Yellow/Red Pavement markers for off-ramps
2. Signs/Markings with higher retro-reflectivity Sheeting
3. GPS in Vehicle with built-in 'WW' warning /verbiage/ noise

INNOVATIVE SOLUTIONS...

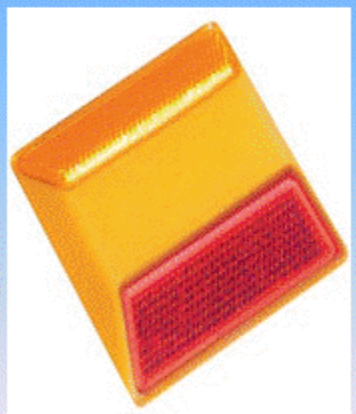
Other Research Efforts

3. TxDOT/FHWA/TAMU did a WW study with countermeasures in 2003
4. ICT did a WW contributing factor study in 2012
5. NTSB did Special Investigation Report in late 2012
6. More to come and to be done.....

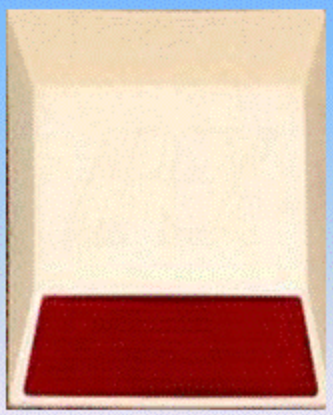
INNOVATIVE SOLUTIONS...

Ramp Pavement Markers

Yellow/Red Ramp Markers



Yellow/White Ramp Markers



INNOVATIVE SOLUTIONS...

2011 Traffic Sign Retroreflective Sheeting Identification Guide

U.S. Department of Transportation Federal Highway Administration

This document is intended to help identify sign sheeting materials for rigid signs and their common specification designations. It is not a qualified product list. FHWA does not endorse or approve sign sheeting materials. Many other sheeting materials not listed here are available for delineation and construction/work zone uses.

Retroreflective Sheeting Materials Made with Glass Beads

Example of Sheeting (Shown to scale)								
ASTM D4956-04	I	II	II	III	III	III	III	III
ASTM D4956-09	I	II	II	III	III	III	III	III
AASHTO M268-10	(1)	(1)	(1)	A	A	A	A	A
Manufacturer	Several companies	Avery Dennison®	Nippon Carbide	3M™	ATSM, Inc.	Avery Dennison®	Nippon Carbide	Oracal
Brand Name	Engineer Grade	Super Engr Grade	Super Engr Grade	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity
Series	Several	T-2000	15000	2800 3800	ATSM HI	T-5500	N500	5800
NOTES:	(2)	(3) (4)	(4)	(3) (4)	(4)	(4)	(4)	(4)

(1) – Sheeting material does not meet minimum AASHTO classification criteria.
(2) – Glass Bead Engineer Grade sheeting is uniform without any patterns or identifying marks. Section 2A.08 of the 2009 MUTCD (http://mutcd.fhwa.dot.gov) does not allow this sheeting type to be used for new yellow or orange signs, or new legends on green signs.
(3) – Material no longer sold in the United States as of the date of this publication.
(4) – Section 2A.08 of the 2009 MUTCD (http://mutcd.fhwa.dot.gov) does not allow this sheeting type to be used for new legends on green overhead signs.

- ASTM D4956-04 is referenced in Table 2A-3 of the 2009 MUTCD.
- ASTM D4956-09 is the most current ASTM sign sheeting specification (the 2009 version is designated by "-09").
- AASHTO M268-10 Types for this Guide are based only on retroreflective properties and not other unique AASHTO requirements such as color.

Manufacturer Contact Information

3M - http://www.3M.com/tss
Avery Dennison - http://www.reflectives.averydennison.com
Oracal - http://www.oracal.com
ATSM, Inc. - http://www.atsminc.com
Nippon Carbide - http://www.nikkalite.com
Reflexite - http://www.reflexite.com

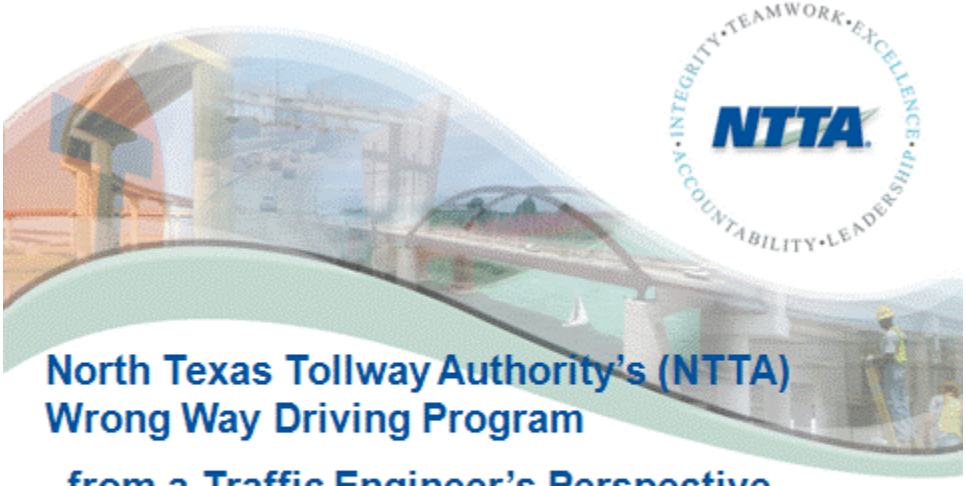
FHWA Publication Number: FHWA-SA-11-14. For additional copies of this document, please send request to [email]

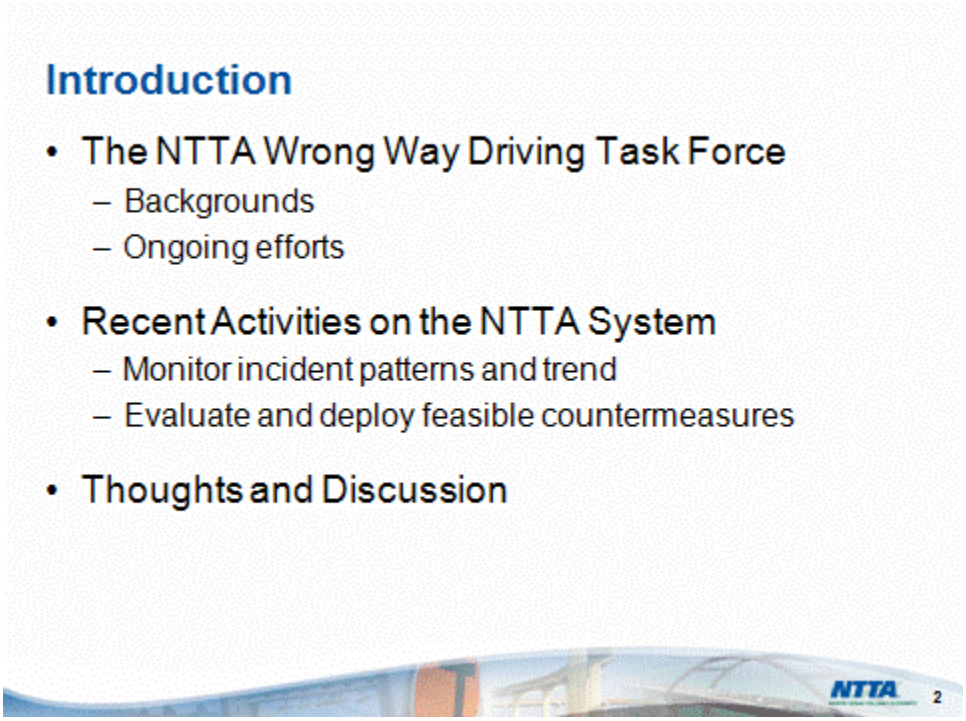
Conclusion/Recommendation

1. CA's WWD Studies have been effective in mitigating wrong way driving on California freeways.
2. WWD research is continued to be monitored for possible inclusion into the our WWC mitigation efforts.
3. Some solutions are proposed in view of the advancement of technology
4. New tools from Safety Analyst to conduct network screening are being prepared for identifying WWC concentrations
5. The future is bright for further improvements and reductions in the number and severity of WWCs

North Texas Tollway Authority Wrong-Way Driving Program

Yang Ouyang, North Texas Tollway Authority

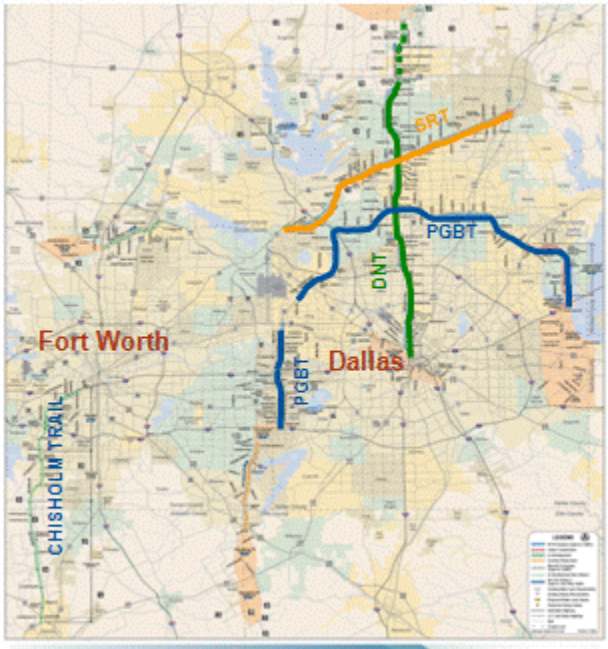




NTTA Toll Road System

Key Features:

- Expanding throughout Dallas/Ft Worth metro
- All Electronic Toll Collection (ETC) – cashless operation
- High-speed commuter routes to major destinations



NTTA System Map

NTTA

3

NTTA Wrong Way Driving Task Force

- Task Force was formed in June 2009
- Initial Analysis of the WWD Incidents:
  - There was a high frequency of Wrong Way crashes during the first half of 2009 (5 WWD in 6 crashes including 4 fatalities)
  - There were 2 more WWD crashes (non-life threatening) during the 2nd half of 2009
  - Crashes caused by Wrong Way Drivers account for a very small percentage of the overall accidents (0.6%) but with severe impact

NTTA

4

NTTA WWD Task Force Key Findings

- Driver impairment is the overriding factor
- 94% of crashes from 2007 to 2009 occurred between 11:00 PM & 4:00 AM
- No consistent correlation between incident and a particular roadway section or configuration
- All countermeasures evaluated have limitations
- Worldwide long term problem

NTTA WWD Task Force Recommendations

- 17 Countermeasures evaluated in 2009:
  - 6 deployed immediately
  - 4 rejected at the time of study
  - 3 for pilot testing
  - 3 for further study
  - 1 emerging technology to be monitored
- Three-pronged approach
  - Engineering
  - Enforcement
  - Education

Implemented Countermeasures

- Process enhancements
- Reflective tape on sign post
- RPM Wrong Way arrows
- LED enhanced signs
- Modified pavement markings and lane use signs on cross streets
- Modified roadway median configuration
- Loop detection and notification software
- Law Enforcement and MADD Partnerships

Reflective Tape and RPMs

Reflective Tape and RPMs

LED Enhanced Signs

NTIA 10

Modified Pavement Markings

NTTA 11

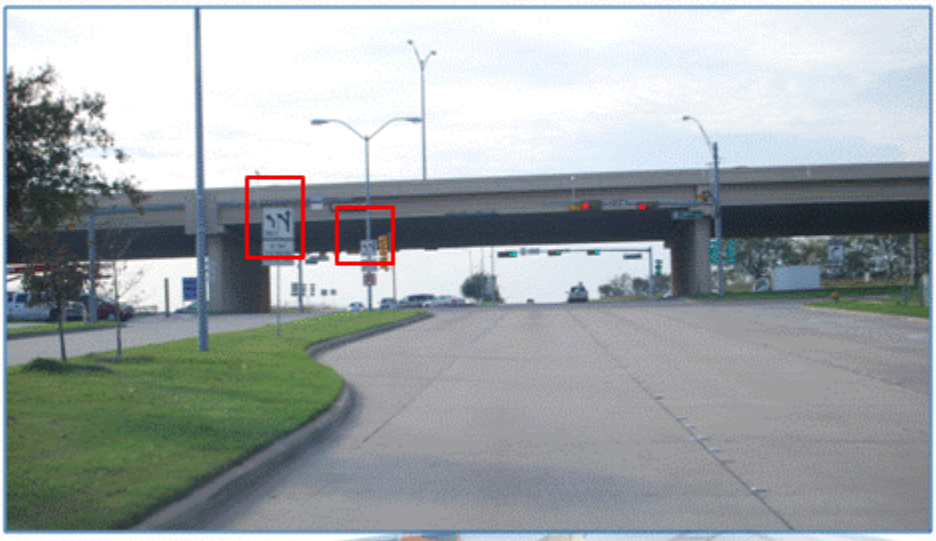
Modified Pavement Markings

NTTA 12

Modified Pavement Markings

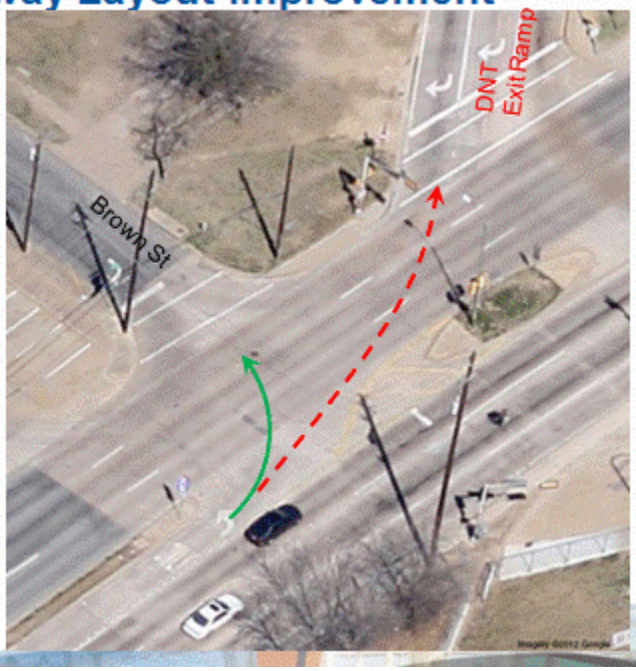
NTTA 13

Signage Modification



NTTA 14

Roadway Layout Improvement



NTTA 15

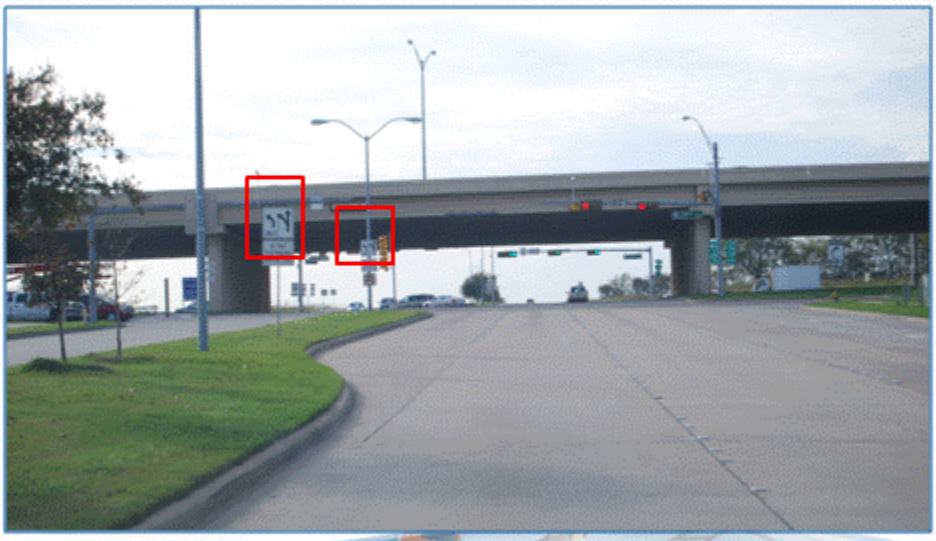
Modified Pavement Markings

NTTA 12

Modified Pavement Markings

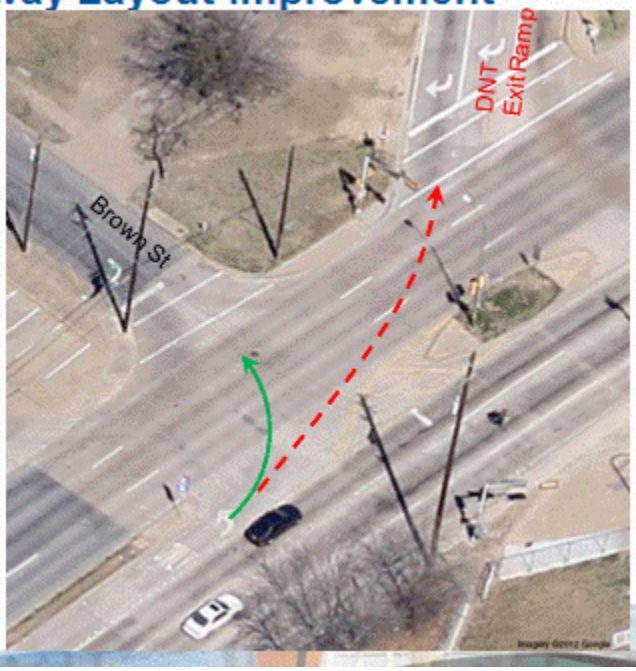
NTTA 13

Signage Modification



NTTA 14

Roadway Layout Improvement



NTTA 15

Roadway Layout Improvement – cont'd

NTTA 16

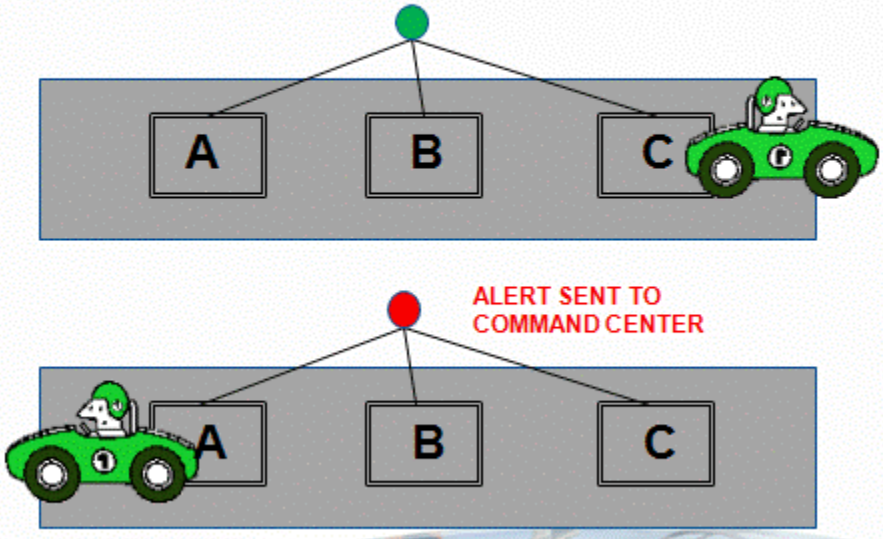
Roadway Layout Improvement – cont'd

NTTA 17

Roadway Layout Improvement – cont'd

NTTA 18

Loop Detection



Enforcement

- DPS Enforcement
  - Immediate response to detections or reported incident
  - Quarterly DUI Task Force
- Command Center
  - Constant monitoring
  - Prompt dispatching
  - Video verification
  - Agency coordination

Pilot Test Countermeasures

- Lower Mounted Signs
  - Crash-tested by the Texas A&M Transportation Institute (TTI)
  - Installed at 28 locations in July 2011
- Continuous monitoring and data analysis

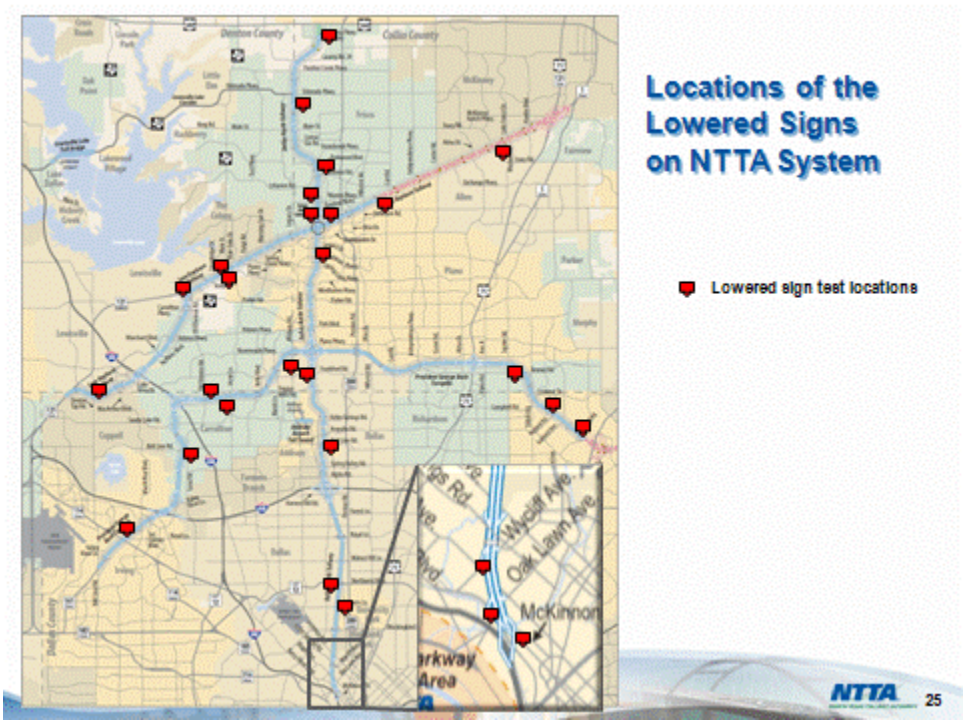
Lowered Signs

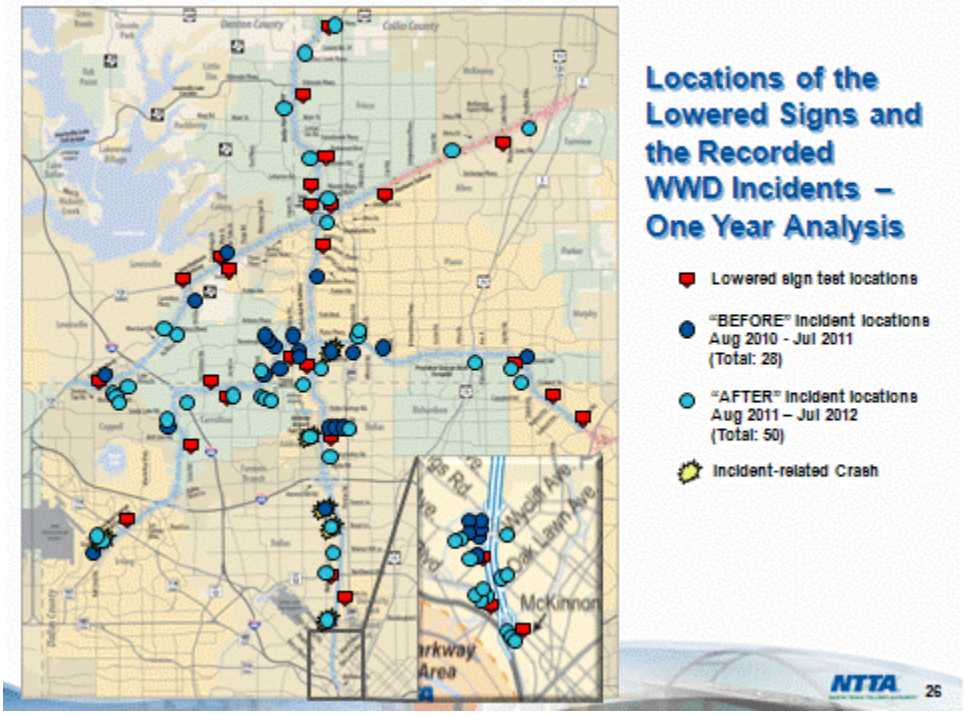
Lowered Signs

NTTA 23

Lowered Signs

NTTA 24


Locations of the Lowered Signs on NTTA System
Lowered sign test locations
Denton County
Collin County
Dallas County
Wycliff Ave
Oak Lawn Ave
McKinnon
NTTA
25

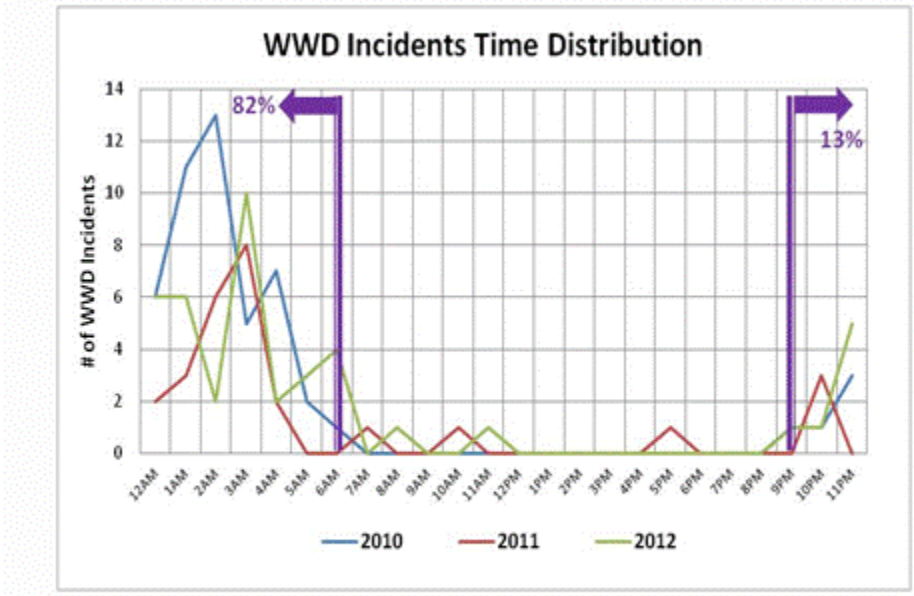

Locations of the Lowered Signs and the Recorded WWD Incidents – One Year Analysis
Lowered sign test locations
"BEFORE" Incident locations Aug 2010 - Jul 2011 (Total: 28)
"AFTER" Incident locations Aug 2011 – Jul 2012 (Total: 50)
Incident-related Crash
Denton County
Collin County
Dallas County
Wycliff Ave
Oak Lawn Ave
McKinnon
NTTA
26

Lower Mounted Signs Effectiveness Analysis – August 2012

- Incidents are reported at various locations throughout the system before and after the sign installation
- Some test locations have fewer but repeated incidents despite the presence of lower signs
- It is recommended that the test program be expanded to include more locations

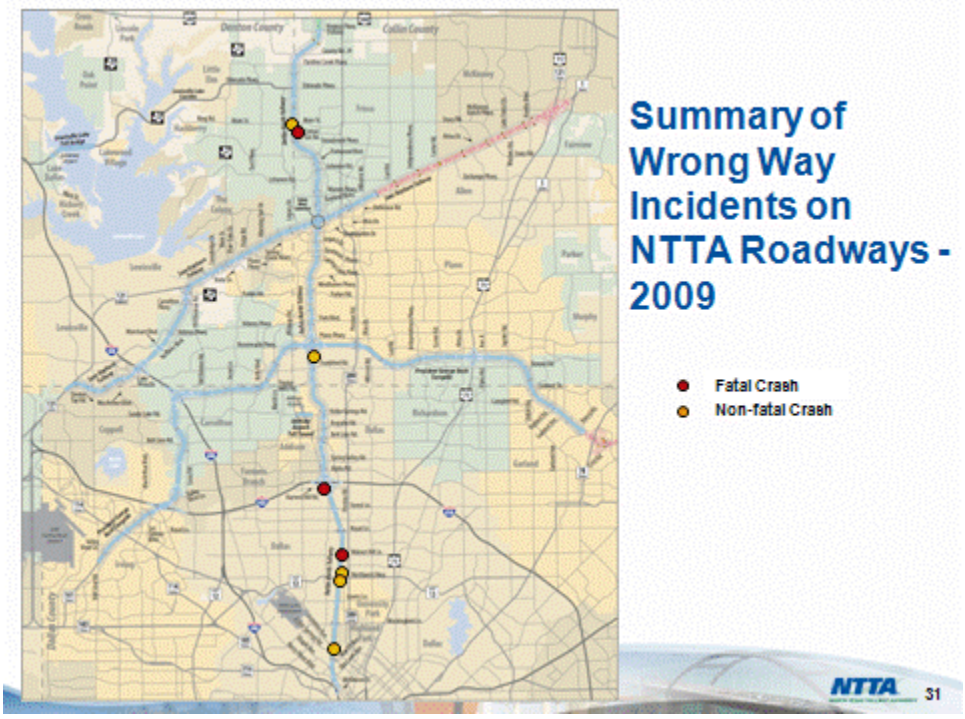
WWD Incident Patterns and Trend

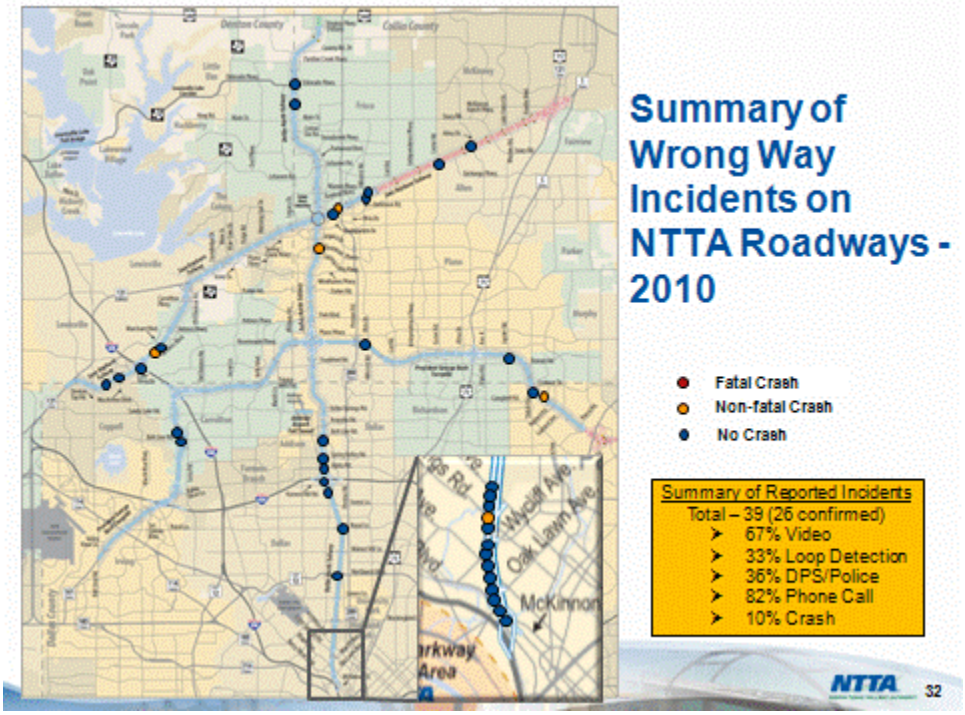
- Previous finding:
  - 94% of crashes from 2007 to 2009 occurred between 11:00 PM & 4:00 AM
- Update:
  - 95% of incidents (and all crashes) from 2010 to present occurred between 9PM and 6AM

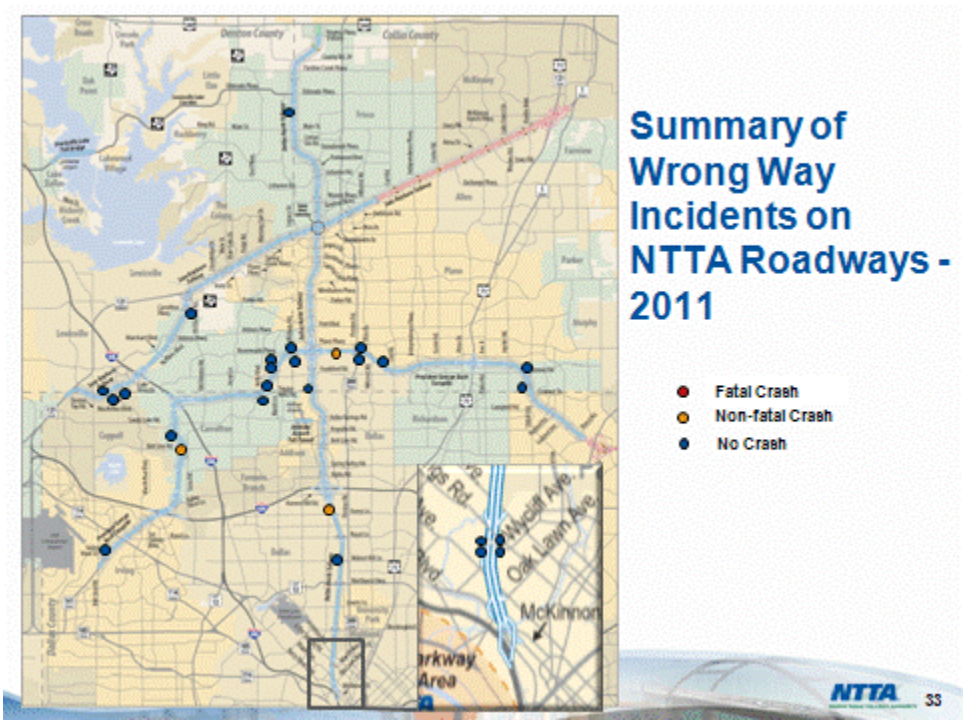


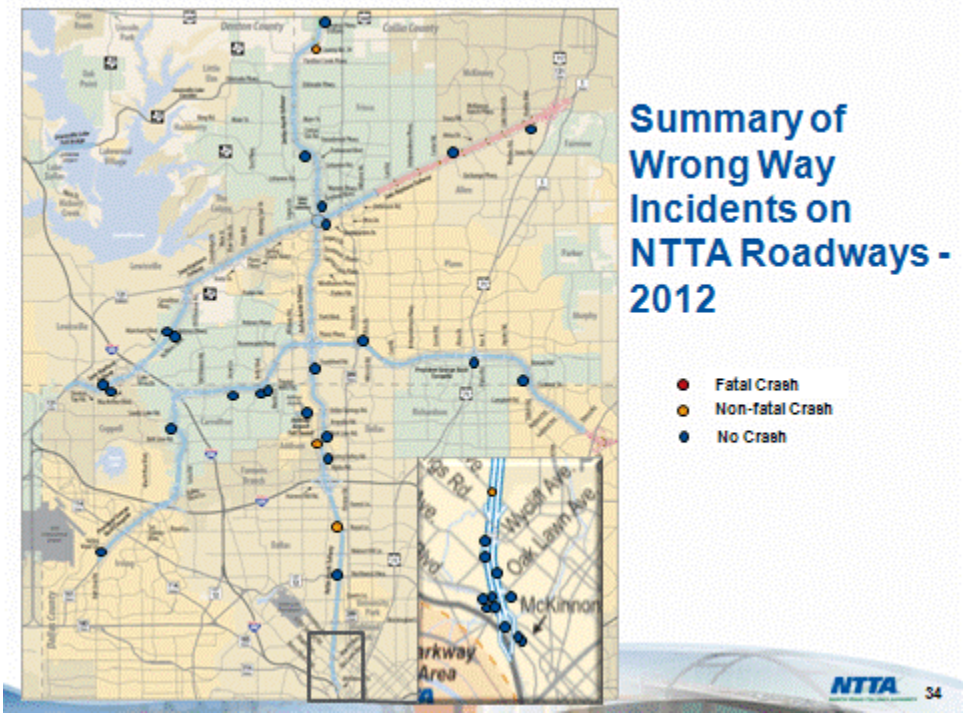
WWD Incident Patterns and Trend

- Time Distribution
  - 94% of crashes from 2007 to 2009 occurred between 11:00 PM & 4:00 AM
  - 95% of incidents (and all crashes) from 2010 to present occurred between 9PM and 6AM
- Spatial Distribution
  - Incidents occurred on all corridors
  - Some locations have higher concentration

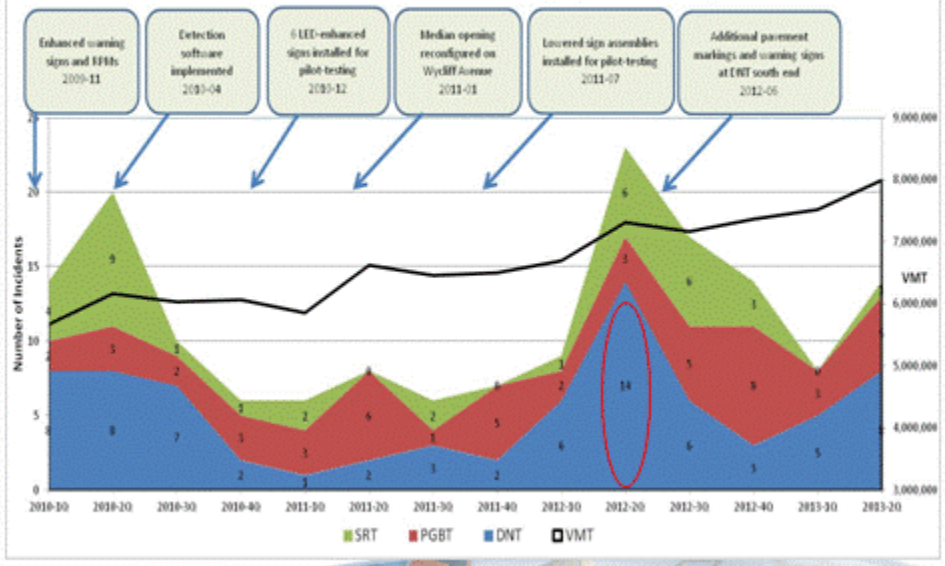

Denton County
Collin County
Dallas County
Summary of Wrong Way Incidents on NTTA Roadways - 2009
Fatal Crash
Non-fatal Crash
NTTA
31


Denton County
Collin County
Dallas County
Summary of Wrong Way Incidents on NTTA Roadways - 2010
Fatal Crash
Non-fatal Crash
No Crash
Summary of Reported Incidents
Total – 39 (26 confirmed)
67% Video
33% Loop Detection
36% DPS/Police
82% Phone Call
10% Crash
Wycliff Ave
Oak Lawn Ave
McKinnon
NTTA
32


Summary of Wrong Way Incidents on NTTA Roadways - 2011
Fatal Crash
Non-fatal Crash
No Crash
Wycliff Ave
Oak Lawn Ave
McKinnon
NTTA
33

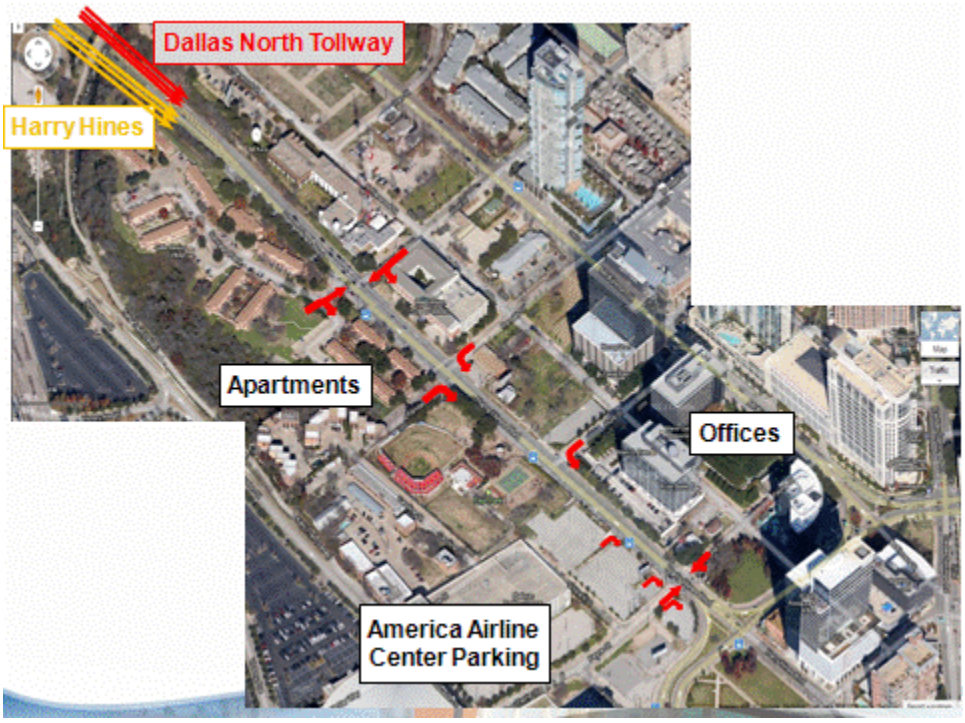

Summary of Wrong Way Incidents on NTTA Roadways - 2012
Fatal Crash
Non-fatal Crash
No Crash
Wycliff Ave
Oak Lawn Ave
McKinnon
NTTA
34

Wrong Way Driving – Incident Trend Analysis



DNT Southend – Harry Hines area

- Increased number of incidents during the first half of 2012
- Unique roadway configurations and adjacent land uses
- Multiple countermeasures are already in place
- Partner with City of Dallas for solutions



DNT Southend – Harry Hines area

- Increased number of incidents during the first half of 2012
- Unique roadway configurations and adjacent land uses
- Partner with City of Dallas for solutions
- Improvements
  - Stripings (22 lane use legends and center lines on cross streets)
  - Signs (15 additional regulatory signs including 4 Wrong Way signs on signal mast arms)

Before condition at Wolf St

After the Striping Additions at Wolf St

Before condition at Payne St

After the Striping Additions at Payne St

After condition at Payne St - WB

After condition at Wolf St - EB

After condition at Randall and Hunt - WB

After condition at AAC parking lot driveways - EB

NTTA 41

Before condition of Harry Hines at Payne St

After the Striping Additions on Harry Hines at Payne St

NTTA 42

Wrong Way Signs on Signal Mast Arms (at two locations)

DNT Southend – Harry Hines area

- Number of incidents has decreased significantly after the sign & pavement marking improvements
- Recurring incidents with higher frequency than other locations within the NTTA toll road system
- Multiple countermeasures have been deployed at the same location – making it difficult to attribute the results to a specific measure

Observation and Points for Discussion

- Murphy's Law – Anything that can go wrong, will go wrong
- Drivers vs. Facility Operator's responsibility
- A balance approach within the constraint of available resources
- Maximize the benefits of technology advancement
- Data vs. Information
- Every small improvement counts

Summary

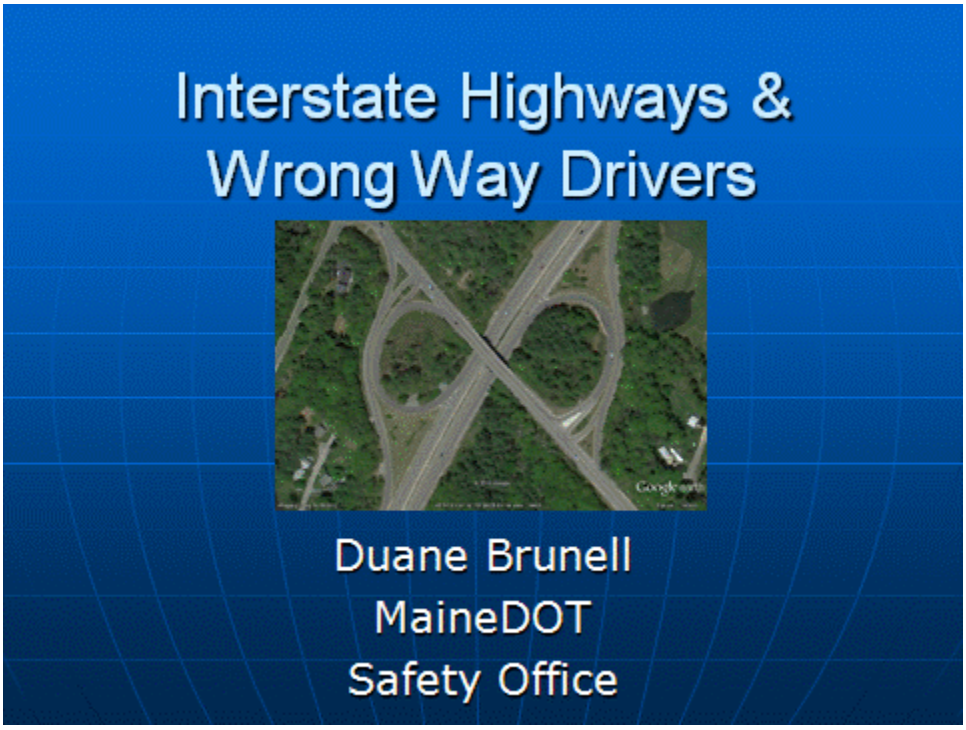
- Wrong Way Driving is a world wide long-term challenge to the transportation community
- NTTA is proactively working to reduce incidents with a three-pronged approach:
  - Engineering
  - Enforcement
  - Education
- Partner with other entities for effective solutions

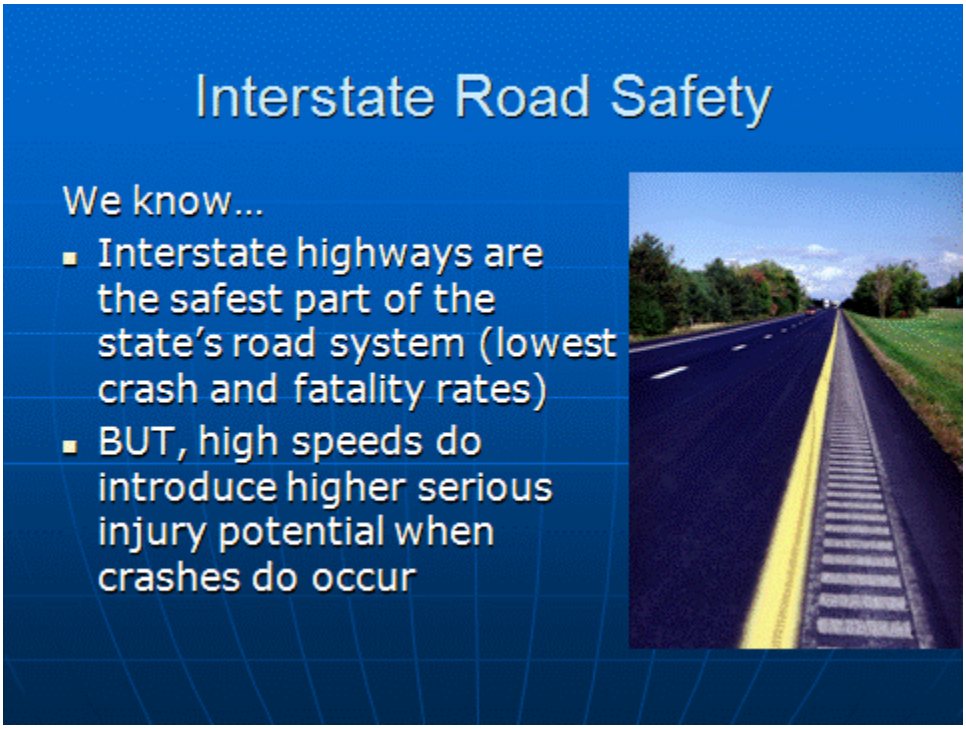
Questions?

• provide a safe and reliable toll road system • increase value and mobility options for our customers • operate the Authority in a businesslike manner • protect our bondholders • partner to meet our region's growing need for transportation infrastructure.

Older Drivers: Wrong-Way Driving Study and Countermeasures

Duane Brunell, Maine Department of Transportation





Two specific interstate crash scenario concerns:

- Cross-median crashes

- Wrong way crashes (more frequent)

Wrong way crash comments:

- Not frequent
- BUT…More frequent than the headline news stories
  - Most drivers quickly realize they made an error and self correct
  - Some go for miles….
- More than 20% of WW crashes result in a fatality

Maine – SHSP input

- Maine State Police input on leading on road safety concern…

Wrong Way Drivers

What are some of the crash factors?

- Alcohol, emotional/medical issues
- AGE:
  - In half of Maine fatal crashes driver age was 72+
  - In all other crashes, 26% of crashes involved mature drivers.
  - Locations trends? – not really

Ramp Type?

Story lines from various driver ages

- "…Police suspect he entered the interstate from Mallet Drive in Freeport and then drove north for about **two** miles in the southbound lane avoiding collisions with several other vehicles until the crash."
- "allegedly drove south for **five** miles in the northbound lanes of the turnpike near Ogunquit before crashing head-on with a limousine"
- "drove for almost **seven** miles — headed north in the southbound lane — before he collided with the other car."
- `…woman traveled north in the southbound lanes for **seven** miles …"It appears that she thought she was on a two-lane road," he said. The woman never exited the interstate but pulled over to clean off her windshield.`

Engineering and Design considerations…

Contemplate:

Driver Behaviors and Decision-making

(even when they are less than perfect)

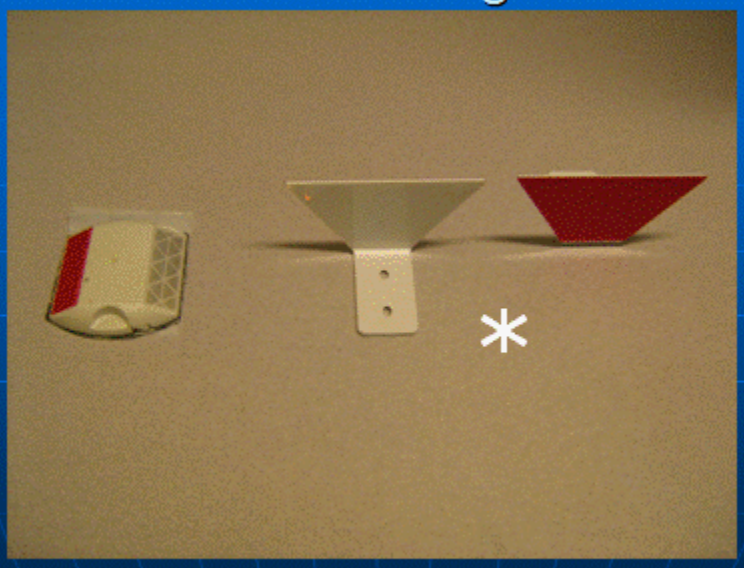
Difficult area to come up with a 100% solution

- If driver is disoriented – due to mind or physical issues, what can provide positive guidance?
- One suggestion: One way tire spikes – presents other safety problems?

Critically Evaluate what you have

- Placement of route directional signs
- Placement of turn arrow markings
- Clearly marked entrances
- One way/Do not enter sign placements/visibility
- Overall ramp design

Low Cost Mitigation



* Evaluating adhesive application rather than bolting

Solutions to consider

- Improved static signs
- Improved pavement markings – skips to show path of travel
- Improved exit design and on/off separation (But often you have to work with what you have)
- Dynamic Signs (due to unusual nature of worst case scenarios - looking for something more attention grabbing for the wayward driver)

Installing DO NOT ENTER and WRONG WAY BlinkerSign® LED signs can deter drivers from making wrong-way movements onto freeways and other restricted roads. By providing the extra visible warning cues standard traffic signs lack. The solar-powered BlinkerSign® is directional and activated only by vehicles traveling in the wrong direction (speed threshold is adjustable). Additional signs facing the opposite direction can be added to warn drivers of the wrong way traveling vehicle.

BlinkerBeam™ Wireless Communication

Wrong Way BlinkerSign warning systems typically consist of two Wrong Way signs, one on each side of the roadway. When activated, the signs communicate wirelessly with each other through the BlinkerBeam™ transmitter. Instantly both signs are flashing in unison.

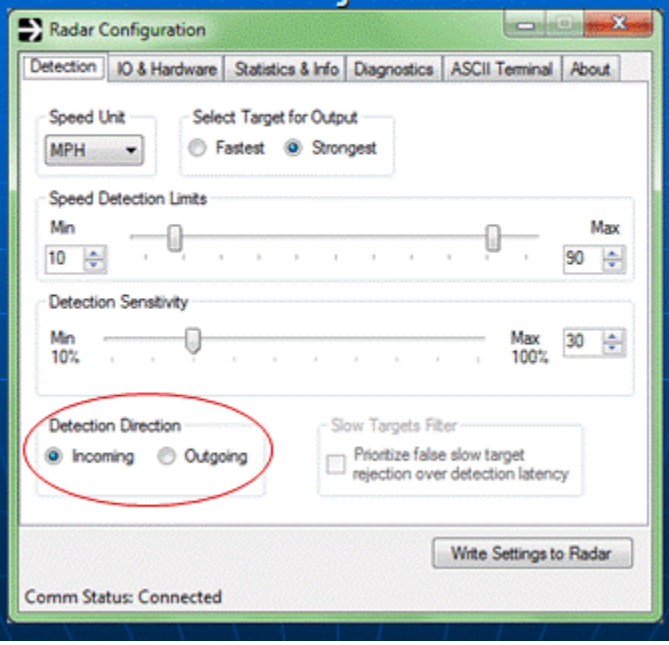
Maine's Pilot Project

- One location I-295 NB Mallet Drive, Freeport
- Keep state police in communication/progress loop
- If system performs favorably, could go to many key exit locations
- Location system installations may vary ($6,500 for base dynamic sign pair)


WRONG
WAY


© 2013 Google
Google earth

At site adjustments



Full system option

Alerts via:

- Cell phone
- e-mail

Questions or feedback, contact

Duane Brunell
MaineDOT
Safety Office
624-3278
duane.brunell@maine.gov

Law Enforcement Approach to Preventing Wrong-Way Driving Incidents

Lt. Brian Windle, Illinois State Police

WRONG WAY DRIVERS

LAW ENFORCEMENT RESPONSE

ILLINOIS STATE POLICE

OPS-074, TRAFFIC CRASH REDUCTION

I. POLICY
The Illinois State Police (ISP) will work to **reduce** motor vehicle traffic crashes by:
I.A. Identifying high traffic crash areas in conjunction with the Illinois Department of Transportation by evaluating geographic, temporal, and causative factors.
I.B. Applying selective assignment techniques for patrol personnel.
I.C. Monitoring and evaluating current enforcement data and significant incidents during Commanding Operational Policing Strategies (COPS) sessions.
I.D. Educating motorists, including teen drivers, on the benefits of practicing motor vehicle safety, the benefits of occupant restraint usage, and the dangers of alcohol usage for the purpose of impacting their driving behavior.

THE FOUR E'S

- ENFORCEMENT
- EDUCATION
- ENGINEERING
- EMS

Wrong-Way Driver Intersection Review

LOCATION OF EXIT RAMP: I94 West Exit Ramp to 111th

RAMP DESIGN: Straight

WARNING SIGNS: Visible for wrong-way drivers to view? Yes

SIGNS POSTED: Number of signs posted? 3 Wrong Way
3 Do Not Enter

Posted at different locations? Yes

If yes, approximately location posted: Approximately .20 of mile apart

APPROXIMATE HEIGHT OF SIGNS POSTED: 10'

STRUCTURE OF LOCAL ROADWAY: 111th Street has 2 lanes in each direction divided by 4 to 6 inch median curb near the Interstate Junction. Doty Road is a two lane road with no lane makings which runs parallel to I-94 with and entrance and exit ramp on the 111th Street Slip Ramp.

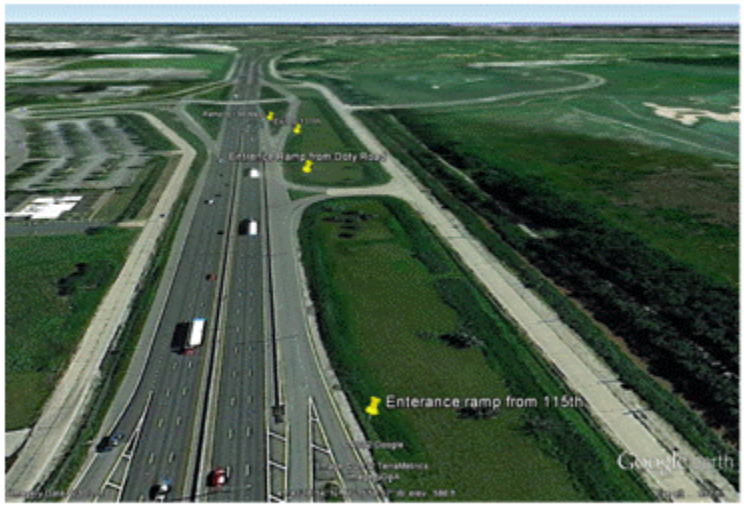
(What is the roadway structure of the local road that leads to the expressway ramp? Is is divided with a median barrier, 2-lanes each direction? Is it divided with yellow lines only?)

DIAGRAM OR NOTES:

Additional signage further down the ramp could assist in reducing incidents of wrong way drivers continuing onto the highway. The Doty Road junction could use additional signage.

Risk - Medium

I-94 at 111th

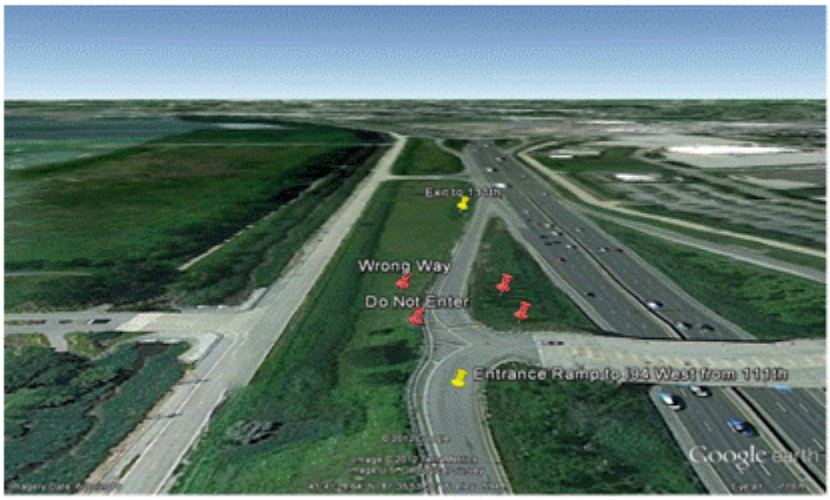


View above is looking from the south up the ramp to the north.

I-94 West Exit Ramp to Doty Road

View above is looking from the south up the ramp to the north.

I-94 West Exit Ramp to 111th



The view above is looking from the North down the ramp to the South.

Computer Aided Dispatch - Tracking

Report Printed: 11 July, 2013 09:42:43

Reply ID: 80437181
Date Received: 7/11/2013 09:40:48
Submitted from address:
Attachment(s):
Tag:

Notes:

Reply Text:

WRONG WAY DRIVING INCIDENTS District: 02 Month/Years 06/13 Run: 7 /11/2013

Total Number of I4610 Type Incidents = 0

Source	Incident	ID	Address	City	Opr	Disposit

Command Code: WWDI
District (2 digits/characters):
Month (2): 06
Year (2): 13

SIGNS


WRONG WAY
WRONG WAY GO BACK
YOU ARE GOING THE WRONG WAY
DO NOT ENTER
WRONG WAY
GO BACK YOU ARE GOING WRONG WAY
DANGER WRONG WAY TURN BACK
STOP! YOUR GPS IS WRONG NOT A THRU ROAD


There's a car going the wrong way down I-75?
Hell, there's hundreds of 'em!

WRONG WAY DRIVING CRASHES

CONTACT INFORMATION

LT. BRIAN WINDLE

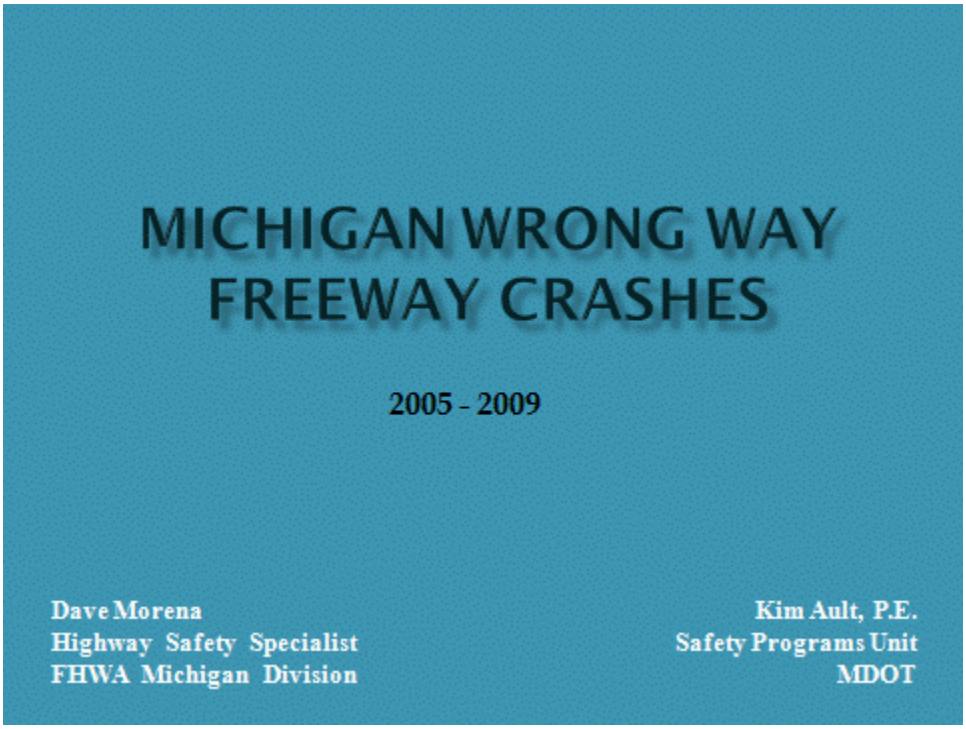
ILLINOIS STATE POLICE
DISTRICT 2

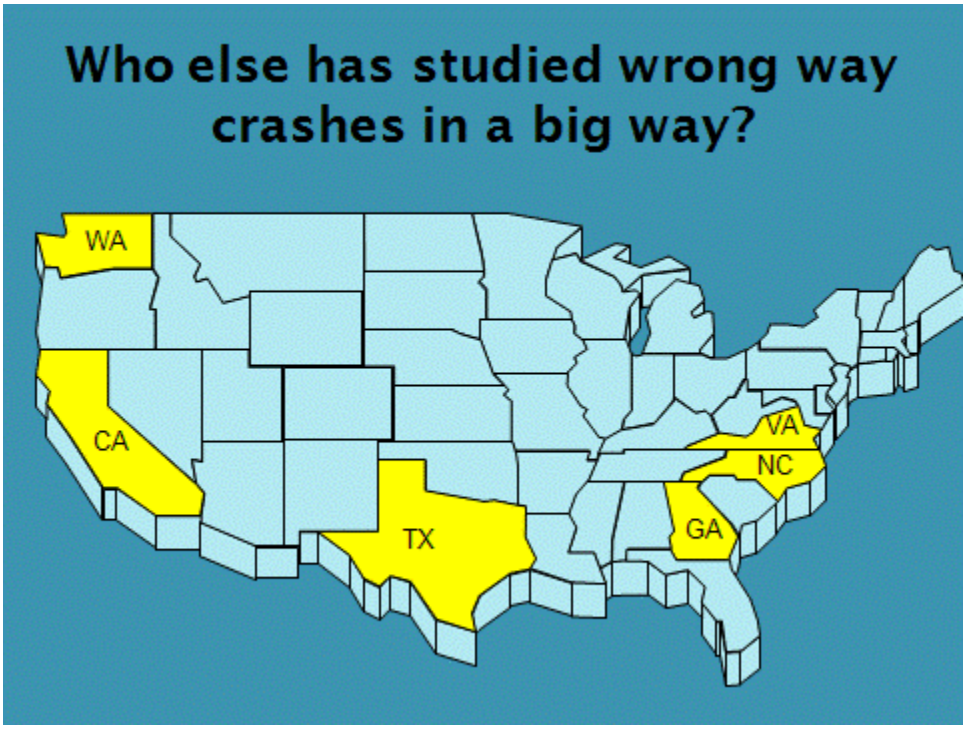
E-MAIL: BRIAN_WINDLE@ISP.STATE.IL.US

847-931-2415

Engineering Strategies for Reducing Wrong-Way Driving Crashes

David Morena, Federal Highway Administration, Michigan Division;
and Kim Ault, Michigan Department of Transportation





THIS STUDY: ONLY CRASHES CAUSED BY

WRONG WAY ENTRY

ONTO THE FREEWAY SYSTEM

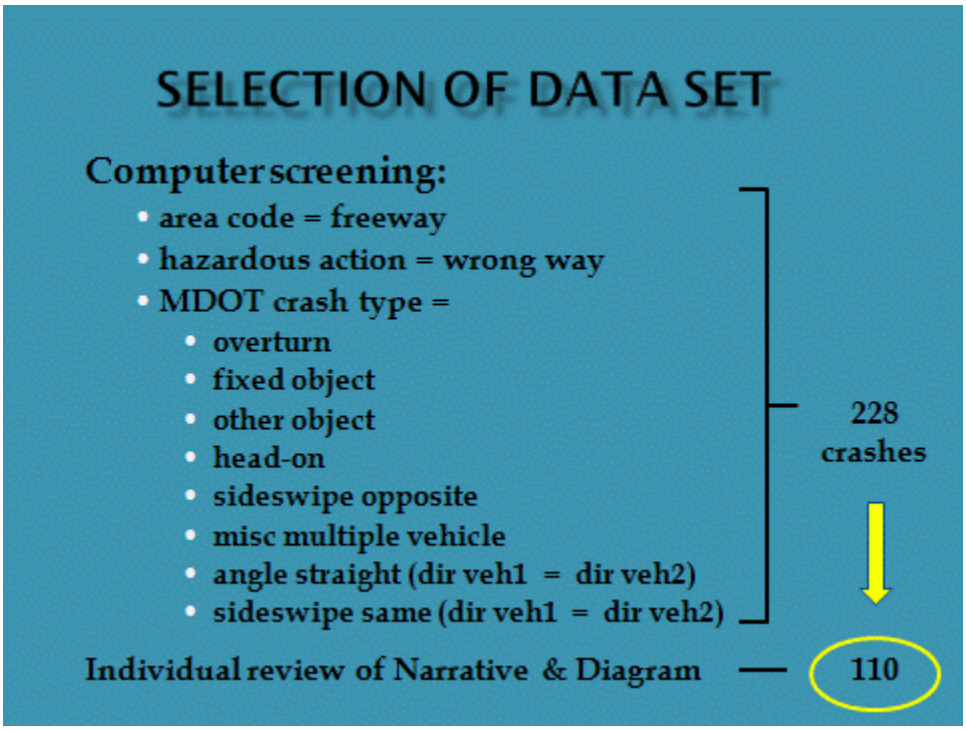
Not included:
loss of control, crossing the median

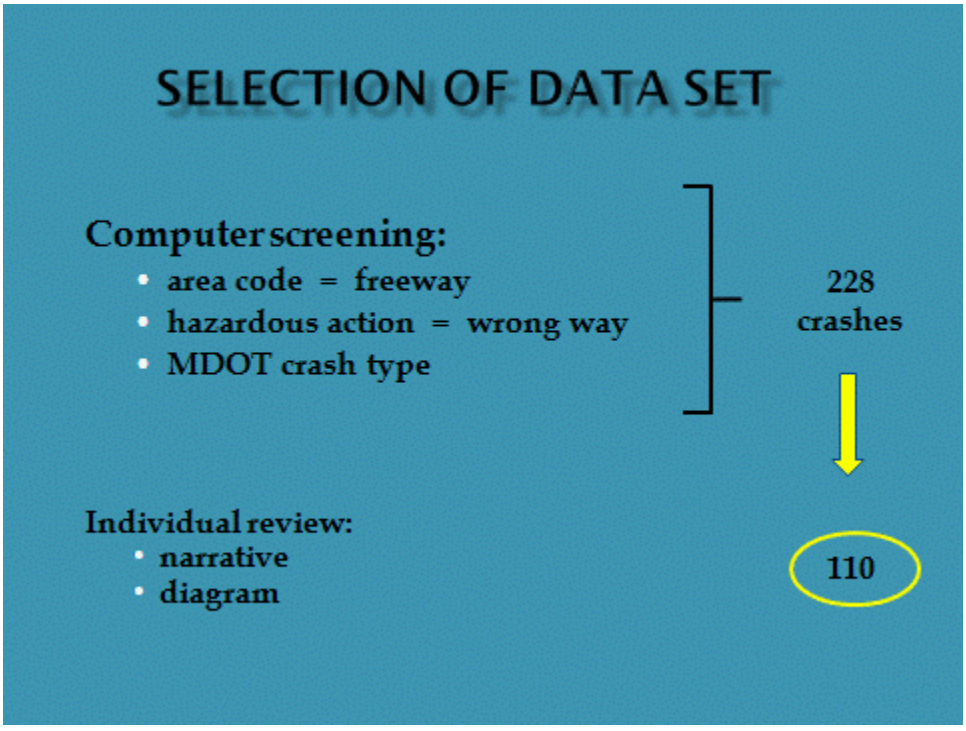
WRONG WAY ENTRY

ONTO THE FREEWAY SYSTEM

Not included:
loss of control, crossing the median

110 crashes


SELECTION OF DATA SET
Computer screening:
• area code = freeway
• hazardous action = wrong way
• MDOT crash type =
• overturn
• fixed object
• other object
• head-on
• sideswipe opposite
• misc multiple vehicle
• angle straight (dir veh1 = dir veh2)
• sideswipe same (dir veh1 = dir veh2)
228 crashes
Individual review of Narrative & Diagram
110


SELECTION OF DATA SET
Computer screening:
• area code = freeway
• hazardous action = wrong way
• MDOT crash type
228 crashes
Individual review:
• narrative
• diagram
110

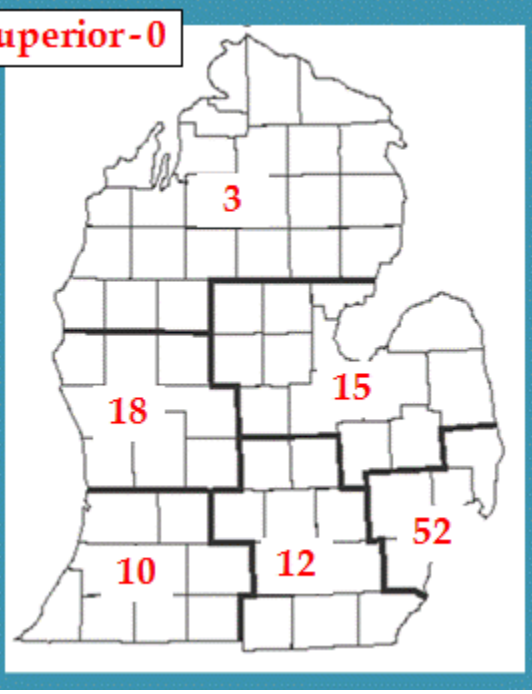
BY REGION:

2005 - 2009

110 wrong way crashes

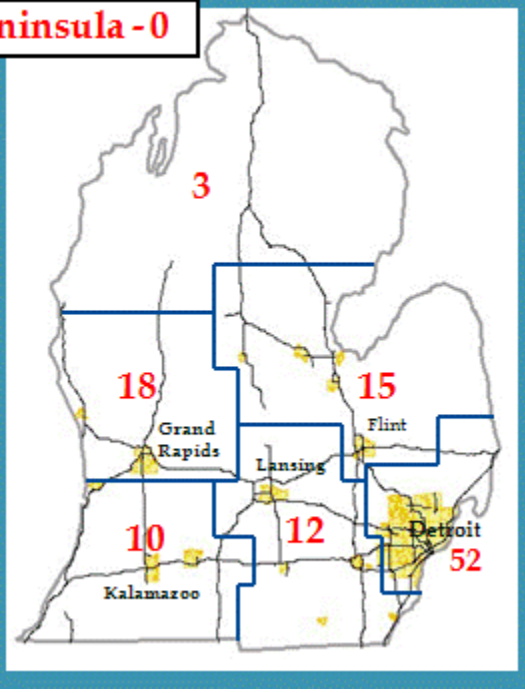
2000 miles of freeway

5 years



Michigan
2005 – 2009:

110 wrong way crashes
on
1957 miles of freeway



Upper Peninsula - 0

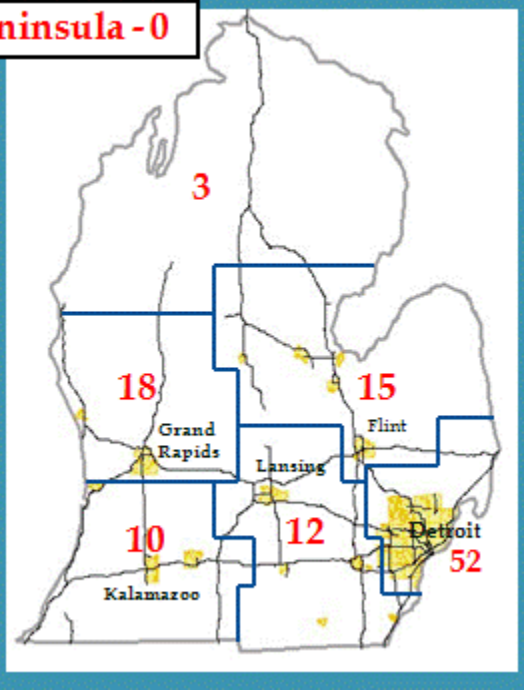
2005 – 2009:

110 wrong way crashes

1957 miles of freeway

10 M population

103 B vehicle miles / yr



LIGHT CONDITION

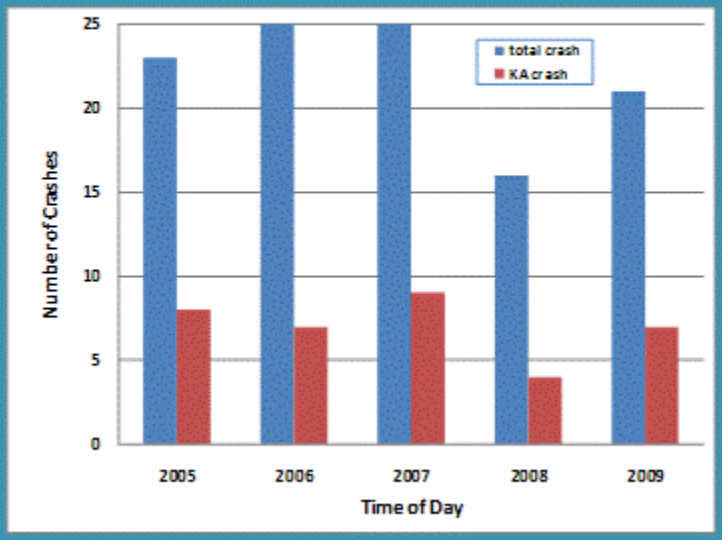
78% occurred under condition of darkness (86 crashes)

Q. Was there lighting at the ramps????

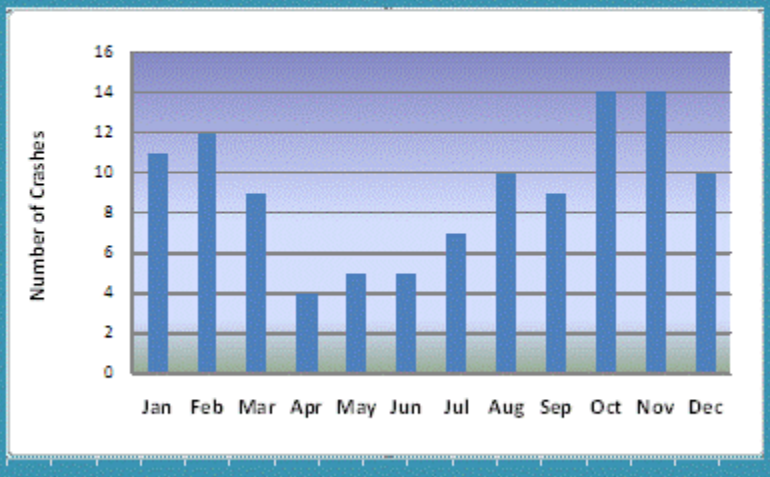
FOR 35 CRASHES WHERE ENTRY POINT IS KNOWN:

- 13 daytime
- 14 darkness – ramp lighted
- 8 darkness – ramp not lighted

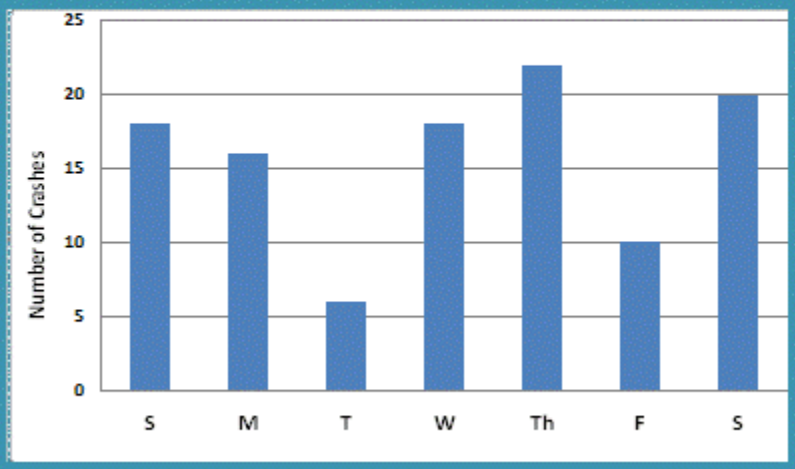
BY YEAR:



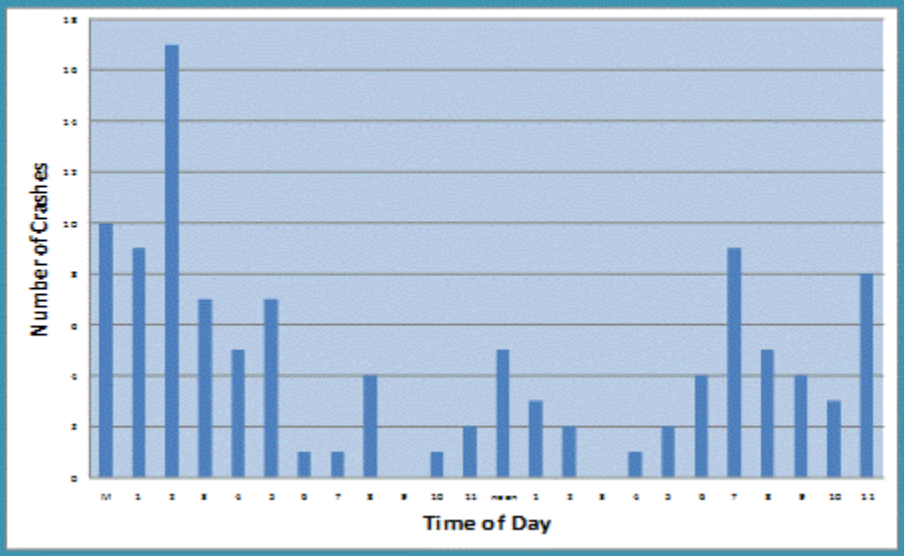
MONTH



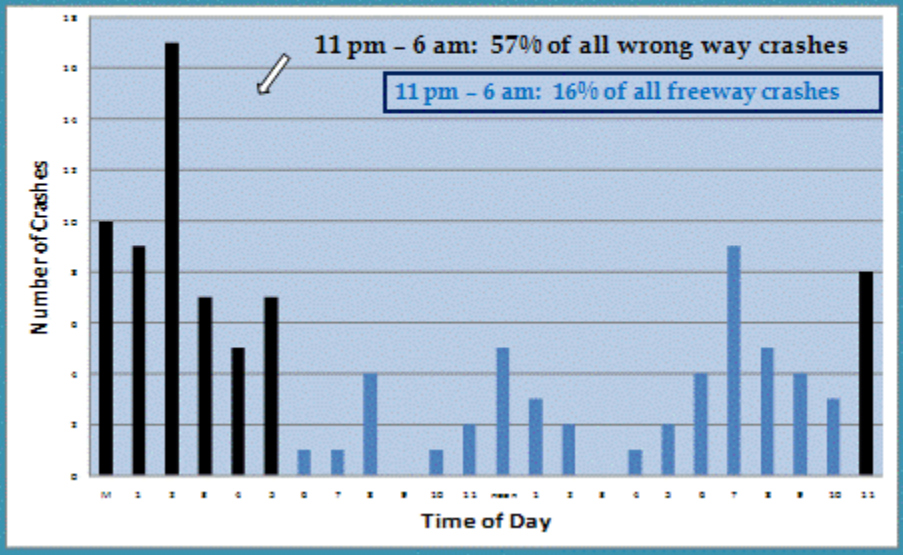
DAY OF WEEK



TIME OF DAY



TIME OF DAY



IMPAIRED DRIVING

(10 crashes drive-away – driver condition unknown)

⇩

59% of 100 crashes, driver was impaired:

- 55 under influence of alcohol
- 4 under influence of drugs

← 53 of 59 at night

LOCATION

Mainline freeway

69 crashes

LOCATION:

Crash occurred on:

- **exit ramp – 31**
- **mainline – 71**
  - **entry point unknown - 67**
  - **entry ramp known - 4**
- **freeway-to-freeway ramp – 6**
- **entrance ramp - 2**

LOCATION:

Crash occurred on:

- exit ramp – 31
- mainline – 71
  - entry point unknown - 67
  - entry ramp known - 4
- freeway-to-freeway ramp – 6
- entrance ramp - 2

35 known entry points

Michigan injury severity :

K - fatality
A - incapacitating injury
B - non-incapacitating injury
C - possible injury
O - no injury

"A" injury = *incapacitating*

- broken arm, leg
- bone exposed or dislocated
- severe lacerations
- severe bleeding

WRONG WAY CRASH SEVERITY

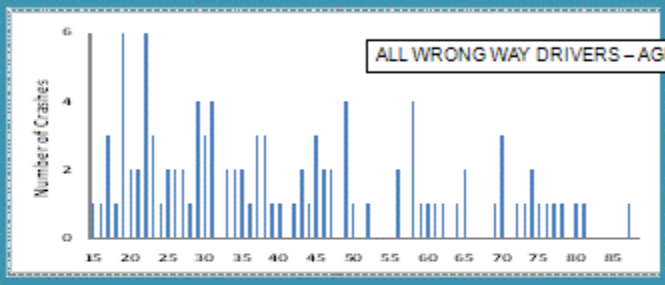
32% of crashes resulted in K or A-injury

Comparison: 2% of all freeway crashes result in K or A

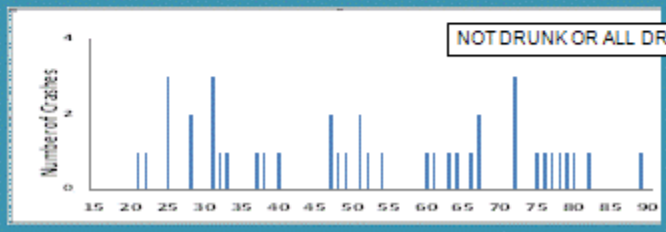
By location:

- exit ramp – 6% of crashes resulted in K or A
- mainline - 42% of crashes resulted in K or A

AGE OF WRONG WAY DRIVER



94



41

INTERCHANGE DESIGN

And could that affect wrong way crashes?

INTERCHANGE TYPES

INTERCHANGE TYPES

MDOT INTERCHANGE TYPES

708 Interchanges	35 KNOWN WRONG WAY ENTRIES
Diamond - 427	6
Partial cloverleaf – 135	21
Directional – 89	2
Trumpet – 17	4
Full cloverleaf – 20	1
Other – 20	1

MDOT INTERCHANGE TYPES

791 Interchanges		35 Wrong Way Entries
Directional (206)	26%	6%
Partial cloverleaf (163)	21%	→ 60%
Tight/Mod Diamond (154)	19%	9%
Diamond (136)	17%	0%
Urban Diamond (50)	6%	9%
Trumpet (23)	3%	→ 11%
Full cloverleaf (20)	3%	3%
Other (39)	5%	3%

Partial Cloverleafs:

I-94 @ GRATIOT AVE.

Alcohol	No Alc
3	7

Dark	Daylight
5	5

I-94 @ GRATIOT AVE.

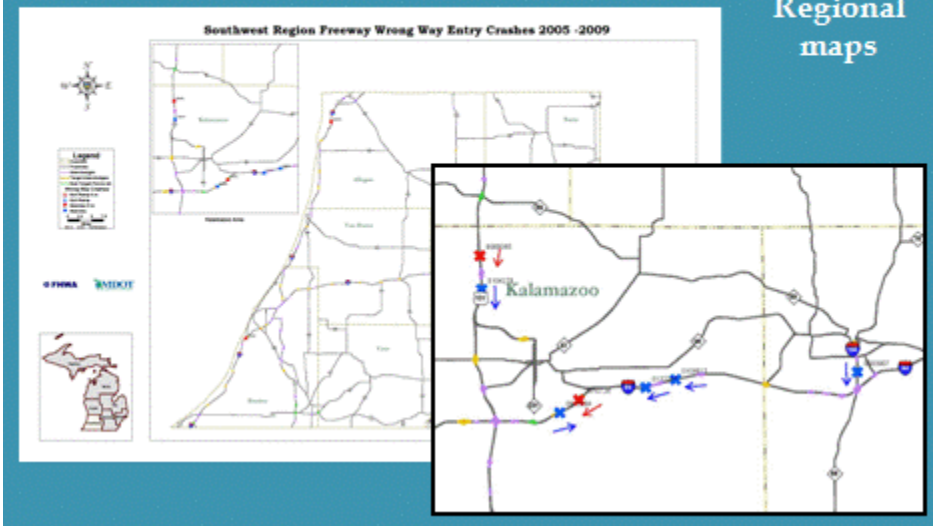
"Video taken at the interchange indicates that drivers may be staying to the left of the barrier because they cannot see the on-ramp on the barrier's other side."

Wash DOT, 2001

Public Roads, Sep/Oct 2002

PACKAGE
FOR MDOT REGIONS

Regional maps

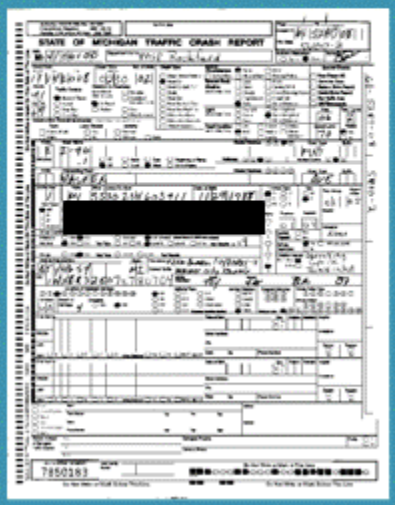


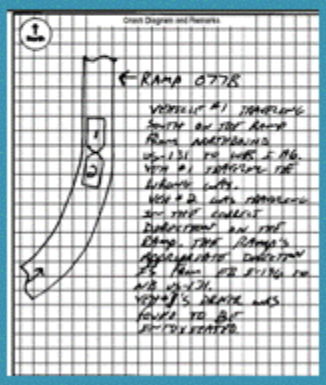
PACKAGE
FOR MDOT REGIONS

Individual maps

PACKAGE
FOR MDOT REGIONS

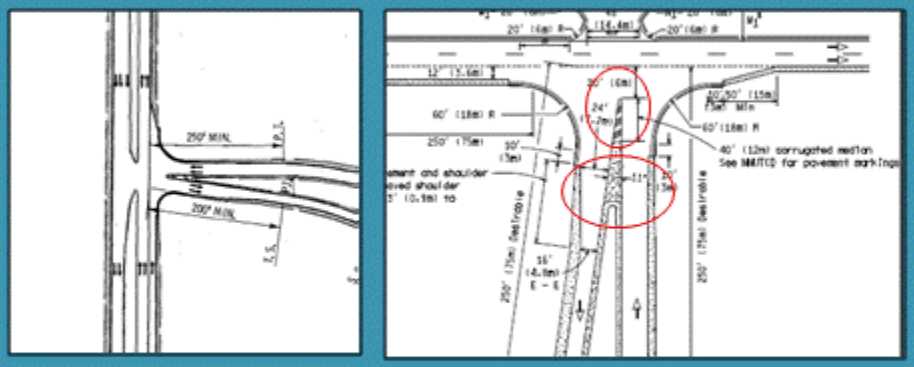
Individual Crash Reports





MDOT's Plan

What do we already do?



From 8° angle between ramps to 11° angle.

From 30′ setback to 20′ setback for the corrugated island.

1. Lower Sign Height

2. Reflective Signpost Sheeting

3. Stop Bars & Placement

4. Off Ramp Wrong Way Arrow

5. Pavement Marking Extensions

6. Painted Island


7. Wrong-Way Delineation


Potential Countermeasures
• Lowering Signs to 4' Bottom Height
• Reflective Sheeting on Sign Posts
• Wrong Way Pavement Markings
• Turning Guidelines
• Painted Island
• Stop Bars
• Two-sided Delineation on Ramp
Where Feasible

Estimated Cost

161 Interchanges with parallel ramp features

$1,161,300

What about the rest?

- 161 interchanges targeted immediately
- 29% remaining known entries not at paired ramps
- Potential danger at ALL ramps
- 1st 2 countermeasures to use at all exit ramps

Lower Bottom Height & Reflective Sheeting

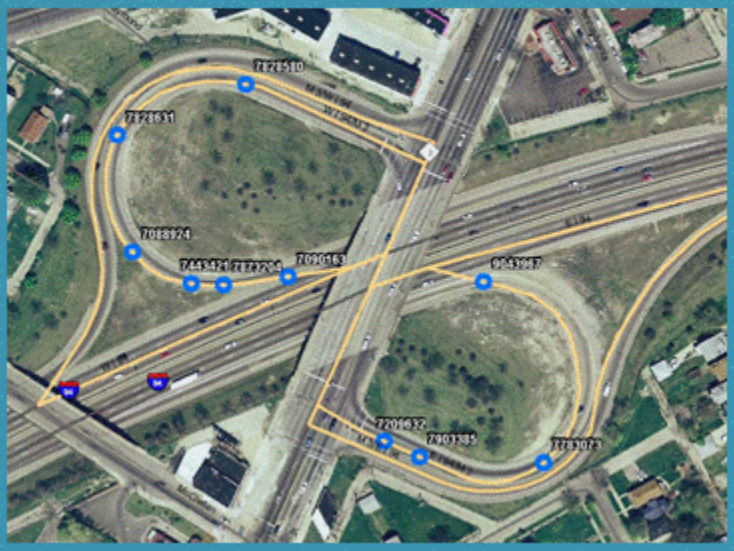
MDOT's Standards Changes

- Signing Standards
  - At all exit ramps:
    - 4 foot bottom height with 3 foot reflective sheeting for WRONG WAY and DO NOT ENTER signs
- Pavement Marking Standards (in approval process)
  - At side-by-side ramps:
    - Wrong Way arrow REQUIRED
    - Stop bar, turning arrows, painted gore/island, turning guide lines and red delineation OPTIONAL

MDOT's Status

- 117 out of 161 interchanges treated or programmed
- Total Cost so far: $765,500

Gratiot @ I-94



Gratiot @ I-94 Improvements

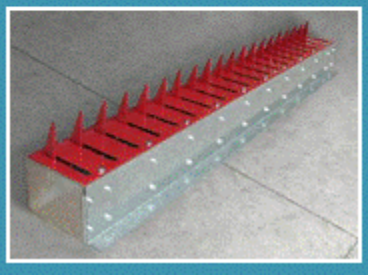
Gratiot @ I-94 Improvements

Gratiot @ I-94 Improvements

Gratiot @ I-94 Improvements

Other Countermeasures Considered Statewide

- ITS Deployments
- Tire Deflation Devices
- Interchange Lighting
- Raised Pavement Markers

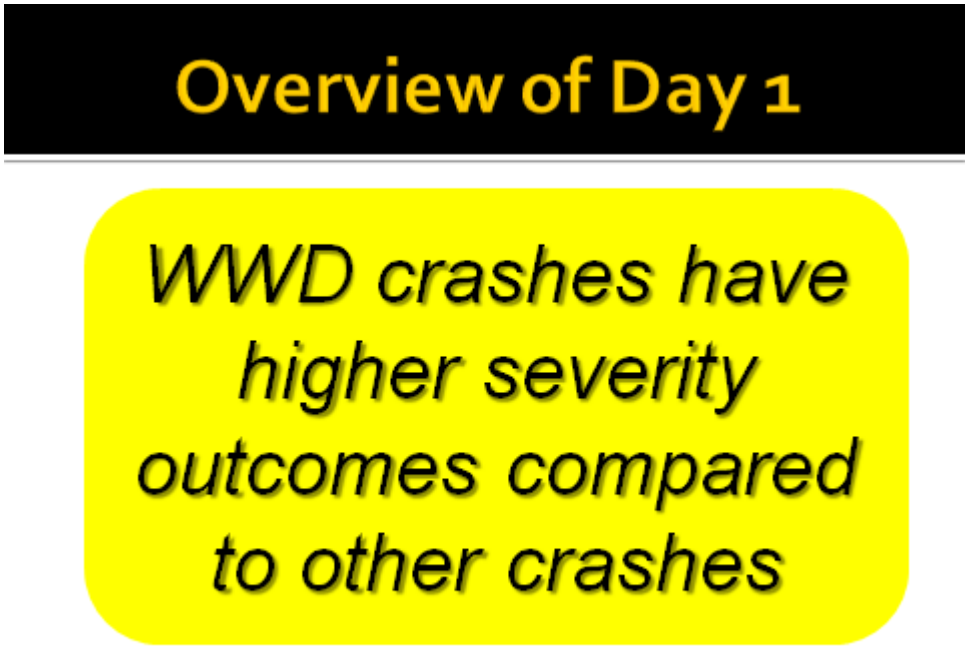


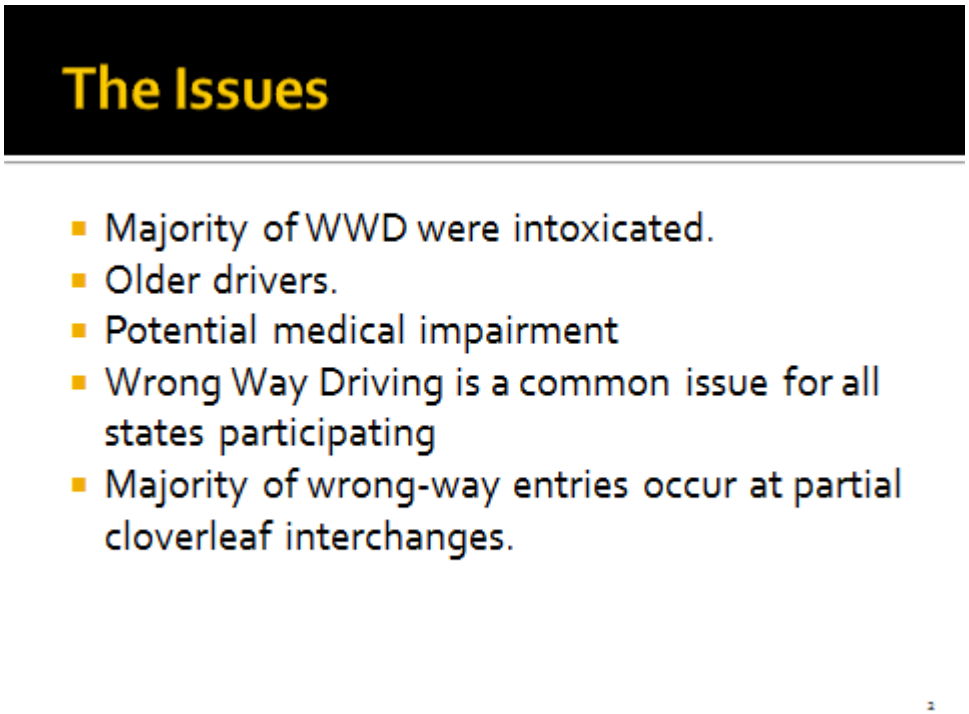
Any Questions?

Dave Morena
David.morena@dot.gov
(517) 702-1836

Kimberly Ault, P.E.
AultK@Michigan.gov
(517) 335-2859

Overview of Highlights of Day 1





A comprehensive strategy is key for a successful National Campaign!

3

Engineering

Signing

- Implementing standard wrong-way sign package
- Improved static signs
- Lowering sign height (Crashworthiness is a concern)
- Using oversized signs
- Mounting multiple signs on the same post
- Applying red retro-reflective tape to the vertical posts
- "Freeway Entrance" sign for all on ramps (ensure the right way)

4

Engineering

Pavement Marking

- Stop Bar
- Wrong-Way Arrow
- Turn/Through Lane-Use Arrow
- Raised Pavement Markers
- Short dash lane delineation through turns

5

Engineering

Geometric Improvement

- Entrance/Exit Ramp Separation
- Median layout to discourage Wrong Way Movement
- Change ramp geometrics
  - Obtuse angle
  - Sharp corner radii

6

Engineering

ITS Technologies

- BlinkerSign® LED illuminated signs.
- Dynamic Signs – warn other drivers
- Use existing GPS navigation technologies to provide wrong-way movement alerts
- Provide consistent messages or alerts that are intuitive to the driver

7

Enforcement

- Alert Law Enforcement Agency
- DUI Enforcement
- DMS Warning to Right-way drivers
- Portable spike barriers to stop WW drivers - Often suggested but has many problems with implementation

8

Enforcement

Alcohol Ignition Interlocks

- Prevent engine start until breath sample is analyzed
- Running retests ensure driver remains unimpaired
- Reduce recidivism; use by all offenders estimated to save over 1,000 lives/year
- 17 states and 4 California counties require interlocks for all offenders

Education

- Public awareness and understanding of
  - Basics of road designs and Interchange types
  - Acts to do (witnessing a wrong way driver)
- Focus Groups
  - Young drivers
  - Older drivers
  - DUI drivers

10

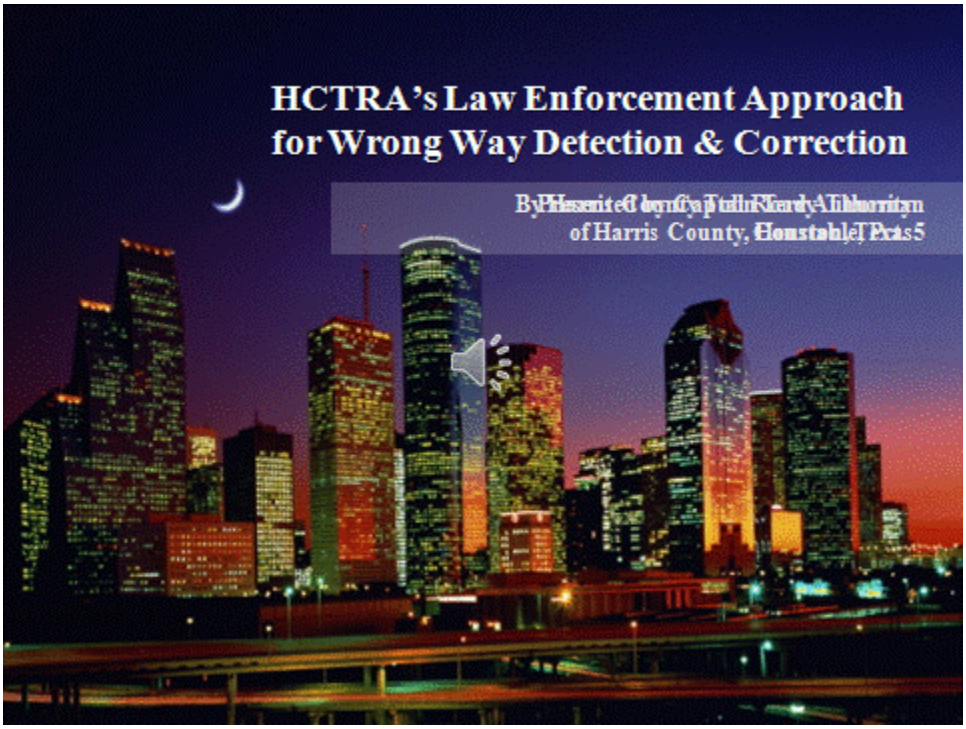
Wrong-Way Monitoring Programs

- States that have conducted projects to monitor wrong-way drivers on freeways
  - California
  - Texas
  - Arizona
- Provide an effective means of identifying wrong-way accident trends
  - Identifying entry points
  - Determining which crashes in the database are caused by wrong way entry

All the states participating have found that Wrong Way Driving is a serious issue to be addressed with cooperation between engineering and law enforcement agencies

Law Enforcement Approach for Wrong-Way Detection and Correction

Captain Terry Thurman, Harris County Toll Road Authority, Texas



Identified Need...

- Reports from the public and law enforcement of a higher frequency of wrong-way drivers on the Westpark Toll Road.
- One (1) fatality in August 2006 and three (3) deaths on January 1, 2007 due to wrong-way incidents.

Why on the Westpark...

- No toll collectors?

  The Westpark Toll Road was the first all electronic toll road designed and built in the United States.

- Limited ramps and exits?

  Fewer entrance and exit ramps due to right-of-way constraints; also, there are no in-bound exits for 8 miles.

Why on the Westpark...

- Design issue?

  Signage and striping.

  Roadway Geometry.

Technology Investigated

- In early January 2007, the Toll Road Authority held discussions with potential vendors regarding available wrong-way detection technologies.
- It was determined that the technology should be field-proven and tested in similar traffic detection applications.

Technology Investigated

- Detection devices should be monitored/controlled from the Harris County Toll Road Authority Incident Management Center (IMC) since all law enforcement dispatching and monitoring functions were performed at this facility.

Pilot Site Implementation

- HCTRA requested that *TransCore* submit a proposal to supply, install, and test a wrong-way detection system based upon radar detection technology.
- This proposal was submitted on January 17, 2007 and included the provision of a total of twenty (20) wrong-way detection sites to be located at the exit ramps and mainline of the Westpark Tollway.

Pilot Site Implementation

- The pilot site was implemented in March 2007 and evaluated/tested in April over a 30-day period. The test results and feedback from IMC personnel indicated the unit produced numerous false detections during the test period, especially during rainy weather.
- The second test-unit was installed in May 2007 and evaluated/tested in May/June over a 30-day period, subjecting the second unit to the same test procedures.

Project Implementation

- The contract was awarded to *TransCore* in July of 2007 and construction began in August.
- The initial overall cost was $337,000.
- The remaining 19 sites came online over the next 11 months.

Project Implementation

- Due to Hurricane Ike in September of 2008, many of the radar sites were out of alignment and needed to be repaired.
- The system became fully functional in October of 2008.

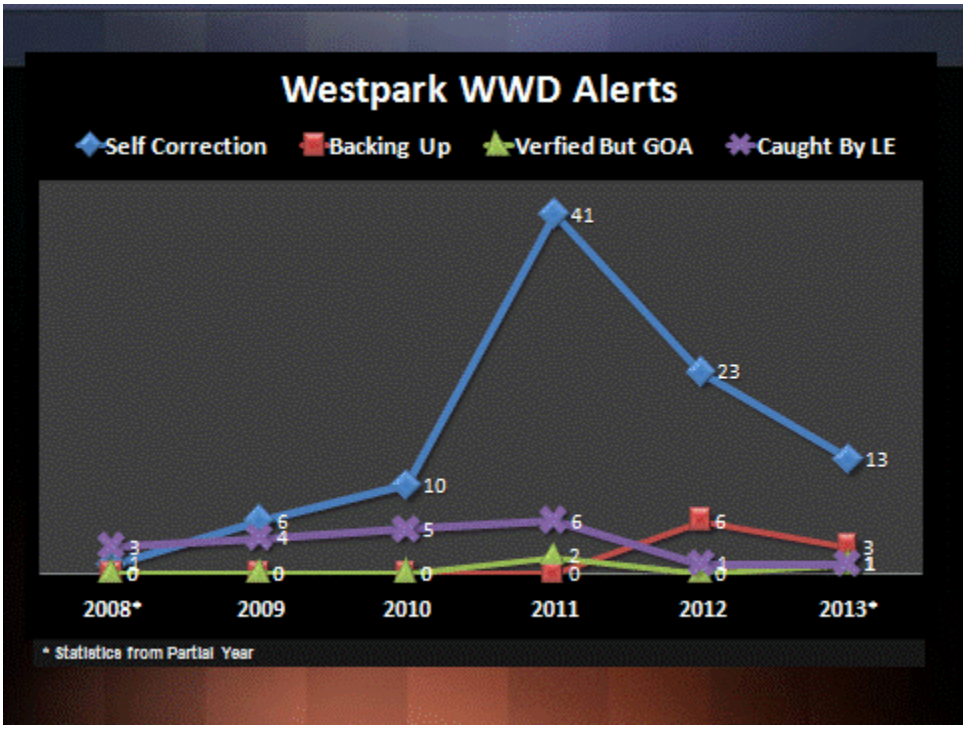
System Enhancements in 2011

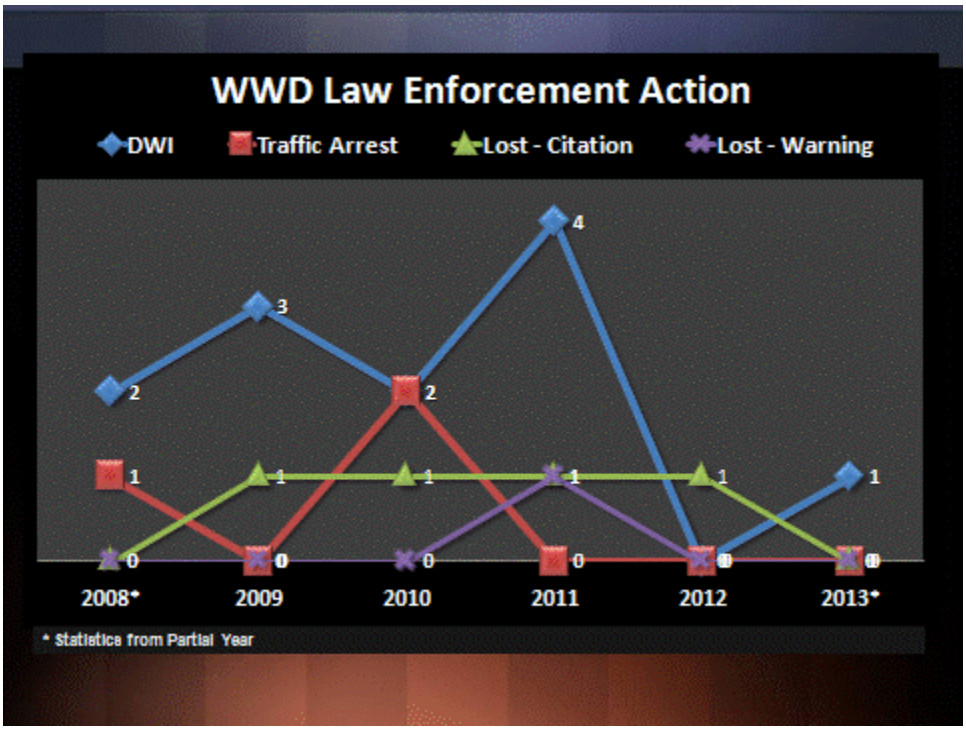
- LED in-ground lighting to warn motorists at Post Oak and Richmond Avenue.
- Flashing LED wrong-way signs installed at locations which have a higher rate of incidents.
- Through attrition, *Sensys* puck sensors are replacing radars devices.

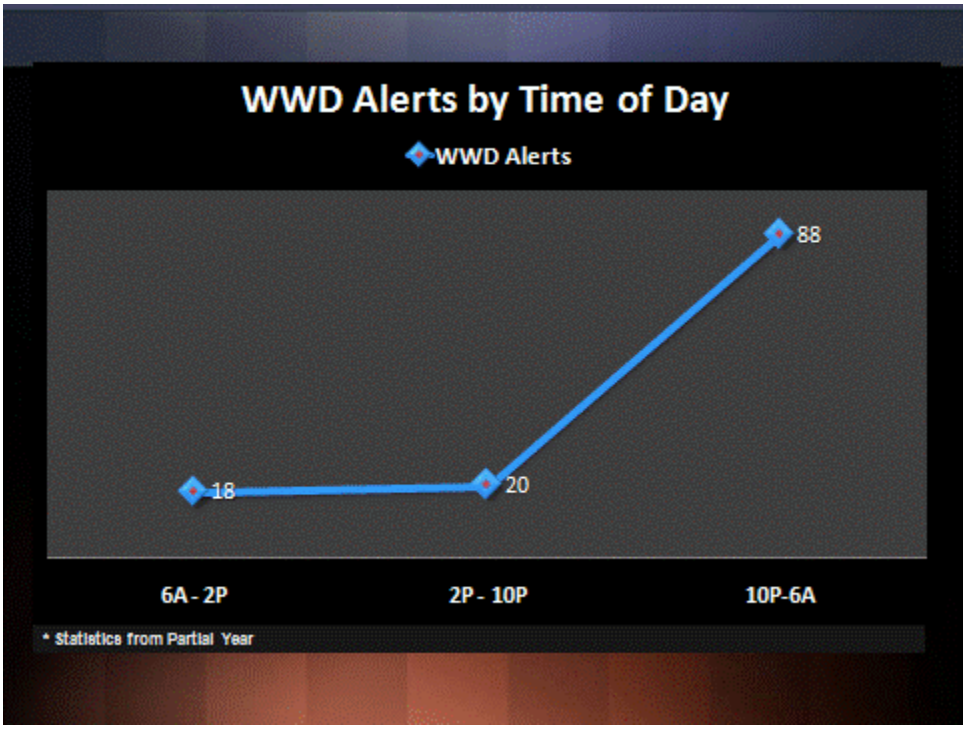
Possible Future Enhancements

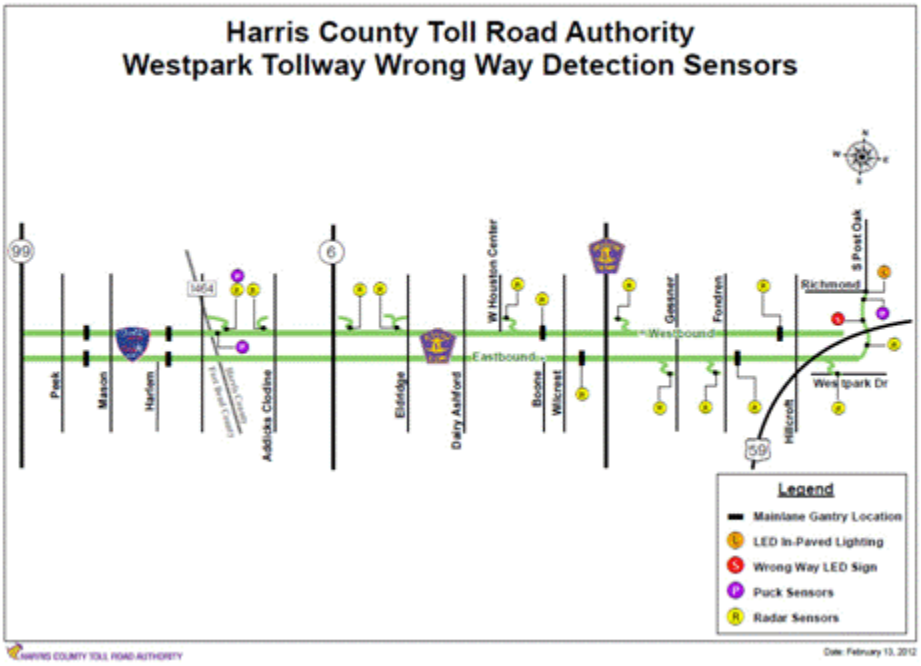
- HCTRA has requested *TransCore* to research and develop a proposal for use of a laser powered water curtain to alert wrong-way drivers.
- The technology is currently being used in Sydney, Australia to stop oversized trucks from entering a tunnel.


STOP
STOP


Westpark WWD Alerts
Self Correction
Backing Up
Verfied But GOA
Caught By LE
41
23
13
10
6
4
3
5
6
6
3
2
1
0
0
0
0
0
0
2008*
2009
2010
2011
2012
2013*
* Statistics from Partial Year


WWD Law Enforcement Action
DWI
Traffic Arrest
Lost - Citation
Lost - Warning
2
3
2
4
1
1
1
1
1
1
0
0
0
0
0
0
2008*
2009
2010
2011
2012
2013*
* Statistics from Partial Year


WWD Alerts by Time of Day
WWD Alerts
18
20
88
6A - 2P
2P - 10P
10P-6A
* Statistics from Partial Year



How the System Works..

- The system detects a vehicle traveling the wrong-way.
- An alert is generated in the Incident Management Center.
- The alert automatically generates a call slip and a audio alarm is heard by the dispatchers.

How the System Works..

- The GIS Wrong-Way Detection Map zooms into the alert location and displays the location and direction of travel.
- Using GPS, the closest patrol unit is dispatched.
- Six downstream roadway cameras automatically pan, tilt and zoom to presets and the video feeds are displayed on the video wall.

How the System Works..

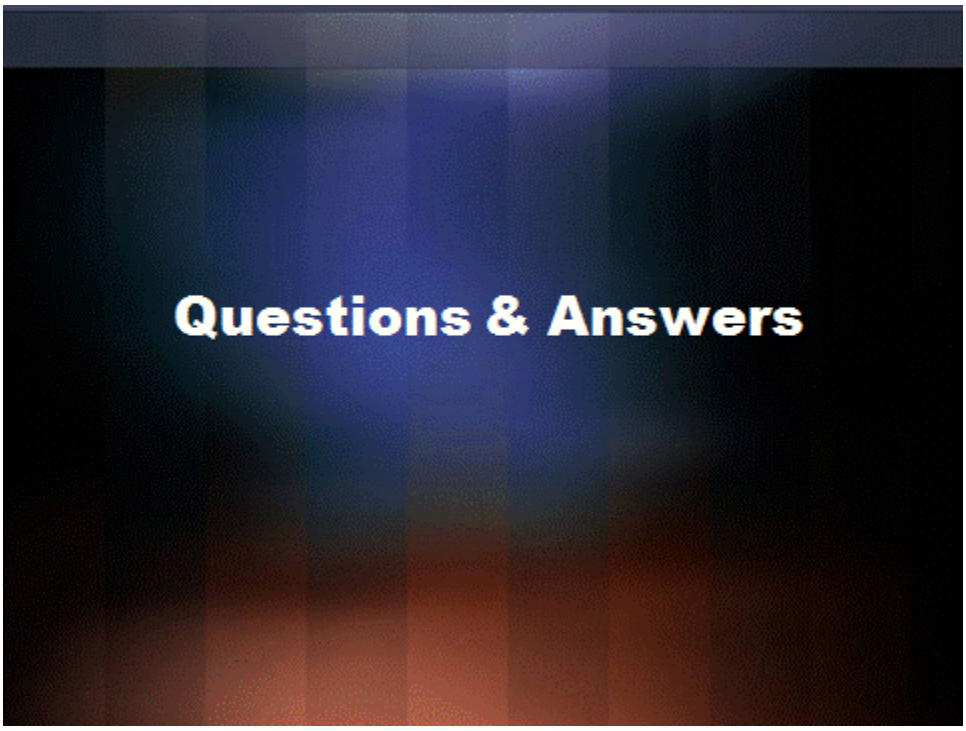
- The dispatchers attempt to visually verify the wrong-way driver using the real-time video feed on the large wall monitors.
- If a wrong-way driver is visually verified, the dispatchers then immediately post a message on the full color dynamic message signs (DMS) and begin recording the incident.

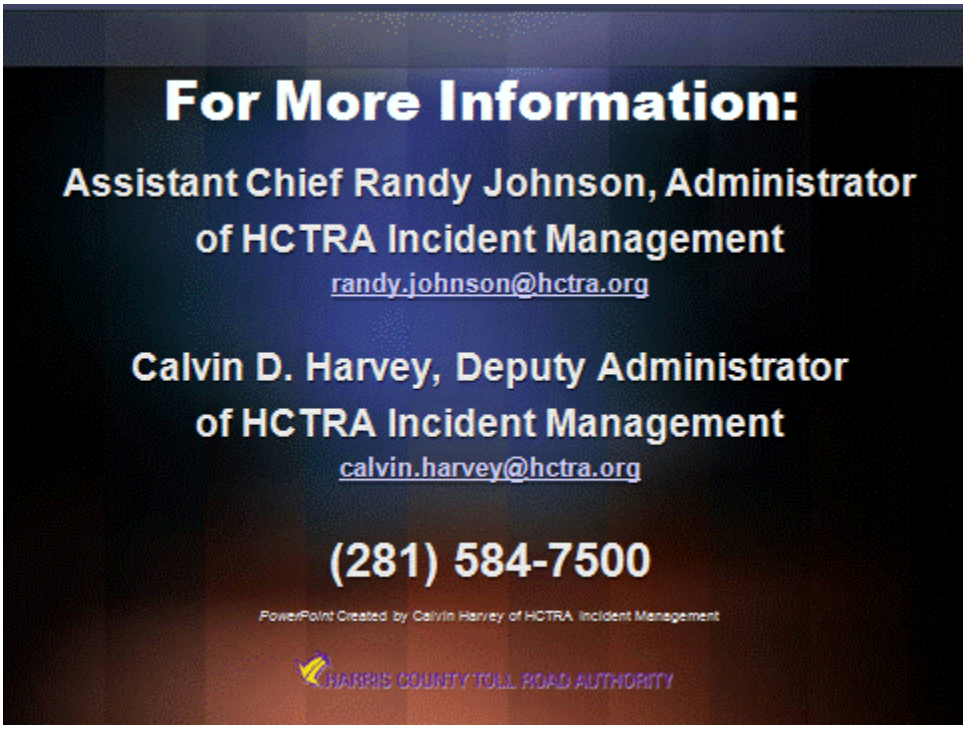
How the System Works..

- The dispatchers then advise the responding units that a wrong-way driver has been verified by CCTV.
- Dispatchers then manually pan, tilt and zoom the cameras to maintain a constant visual and provide law enforcement continuous updates.

Law Enforcement Response

- Responding units attempt to intercept the vehicle to deploy tire deflation devices.
- Units are not allowed to respond by driving in the wrong direction.
- Units may barricade the road with their patrol vehicle if needed or if the spike strips are unsuccessful.


Questions & Answers


For More Information:
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of HCTRA Incident Management
randy.johnson@hctra.org
Calvin D. Harvey, Deputy Administrator
of HCTRA Incident Management
calvin.harvey@hctra.org
(281) 584-7500
PowerPoint Created by Calvin Harvey of HCTRA Incident Management
HARRIS COUNTY TOLL ROAD AUTHORITY

Wrong-Way Driving Mitigation Through Intelligent Transportation Systems and Traffic Engineering

Brian Fariello and Michael Chacon, Texas Department of Transportation

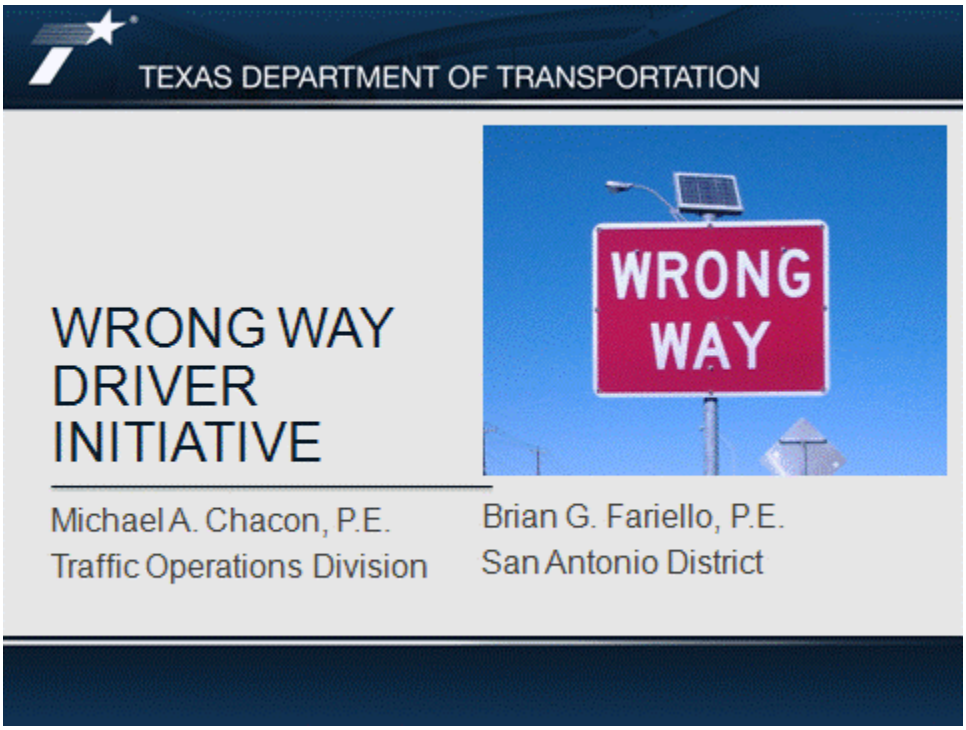


Table of Contents

San Antonio Wrong Way Driver Task Force

- Organized in the spring of 2011 to examine factors contributing to wrong way driving in San Antonio, and to identify methods of addressing wrong way drivers.

- Agencies Participating:
  - Texas Department of Transportation
  - The San Antonio Police Department
  - City of San Antonio Department of Public Works
  - The Bexar County Sheriff's Department
  - The Federal Highway Administration
  - The Texas Transportation Institute

TxDOT Operator Logs WWD Reports 2011 - 2013

	2011 (Mar - Dec)	2012 (Jan - Dec)	2013 (Jan - Jun)
Number of Reports	185	274	118
No Accident/Not Apprehended	150	235	105
Accident (Fatal)	4	5	3
-Number of Fatalities	7	7	6
Accident (Non-Fatal)	17	17	4
Medical Conditon/Elderly Driver	4	2	2
No Accident/WWD Apprehended	10	15	2
WWD Observed with Camera	14	12	2
WWD reports 10 PM to 6 AM	80%	72%	85%
WWD Repoprts 2 AM to 4 AM	45%	32%	41%

DMS Wrong Way Driver Warning Message

- No lane instructions given
- Displayed Until:
  1) WWD stopped, **2)** Accident found, *or* **3)** SAPD cancels Alert
- Message displayed first, then operator searches for vehicle using cameras

Countermeasures Identified

- Enhanced Static Signing & Pavement Markings
- On-Site Driveway Channelization
- Detection Technologies (Radar Sensors)
- Active/Illuminated Signing

Enhanced Static Signing & Pavement Markings

- Increased visibility of "WRONG WAY" and "DO NOT ENTER" signs shown to reduce wrong way driving
- TxDOT implemented measures recommended in a prior study:
  "Countermeasures for Wrong-Way Movement on Freeways: Overview of Project Activities and Findings", TTI 2003/2004"
  - Field Inspection of all ramps using 2004 TTI Study Checklist
  - Ensure all required signs, pavement markings and RPM's are in place and visible

Enhanced Static Signing & Pavement Markings

- Recommend additional (supplemental) measures:
  - Add reflective tape on sign posts
  - Increased size of ONE WAY signs
  - Additional WRONG WAY & DO NOT ENTER signs at critical locations
  - Lowered sign heights*

* Note: TxDOT is not implementing lowered sign heights at this time

Active/Illuminated Signing : LED Wrong Way Signs

- 72% of the wrong way driver events occur at night
- The flashing LED lights will be visible from a greater distance
- As the driver gets closer to the sign, the vehicle headlights will illuminate the retroreflective WRONG WAY message (greater visibility than LEDs)

Active/Illuminated Signing : LED Wrong Way Signs

Blank Out Sign is an LED DMS panel capable of displaying a single message when activated, otherwise message panel is "blank"

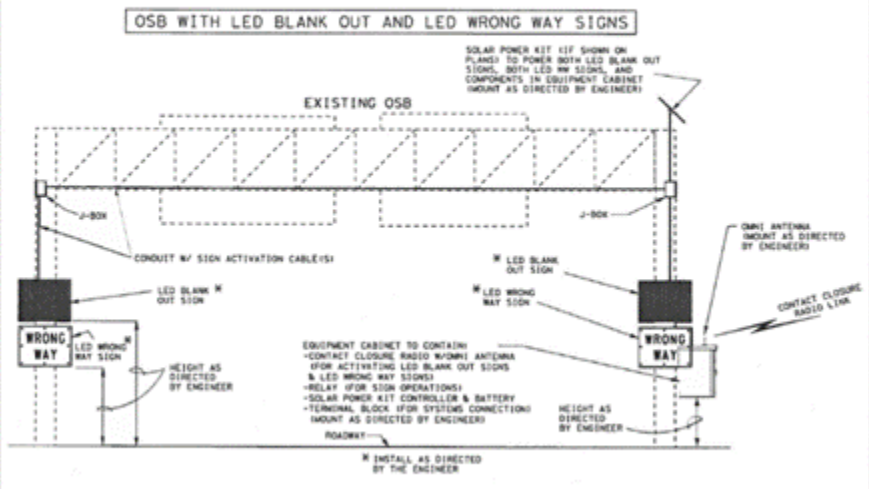
Countermeasures Identified

WWD Active Countermeasures

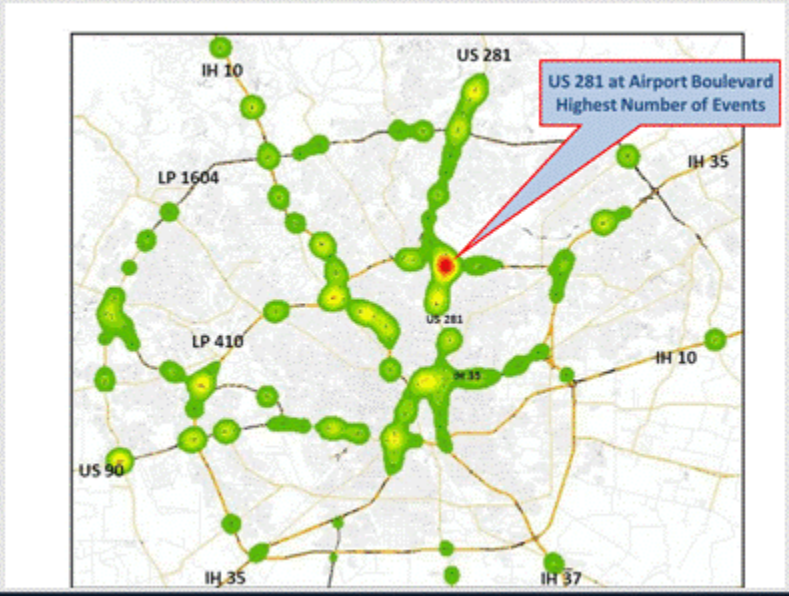
- Exit Ramps
  - Installing 2 TAPCO LED Illuminated Wrong Way Signs
    - Photocell activated for night and low visibility operation
  - Installing 1 TAPCO Radar Detector
  - Radar unit will provide notification of wrong way detection using TxDOT communication network connection to the TMC
- Mainlanes Systems
  - Installing 1 TAPCO LED Illuminated Wrong Way Sign & 1 SES Blank Out Sign on each shoulder
  - Installing 1 Wavetronix HD Radar Detector in advance of sign location
  - MAINLANE SYSTEMS WILL BE RADAR DETECTOR ACTIVATED due to visibility of illuminated signs to drivers on the other side of the median
  - Radar unit will provide notification of wrong way detection using TxDOT communication network connection to the TMC

Countermeasures Identified

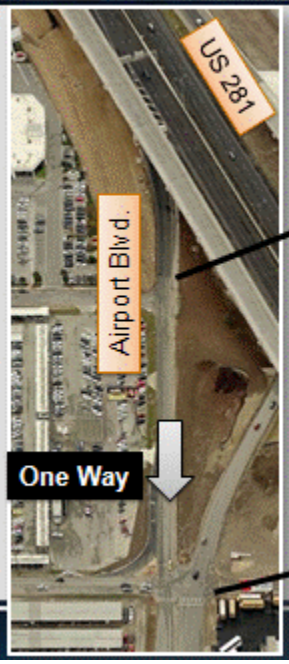
Mainlane System



US 281 at Airport Blvd



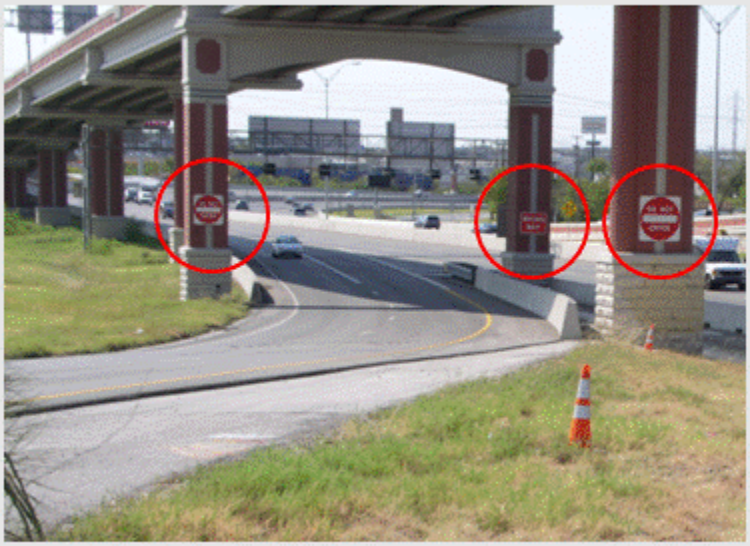
US 281 at Airport Blvd



US 281 NB Exit to Airport Blvd.

CoSA Signalized Intersection

US 281 at Airport Blvd



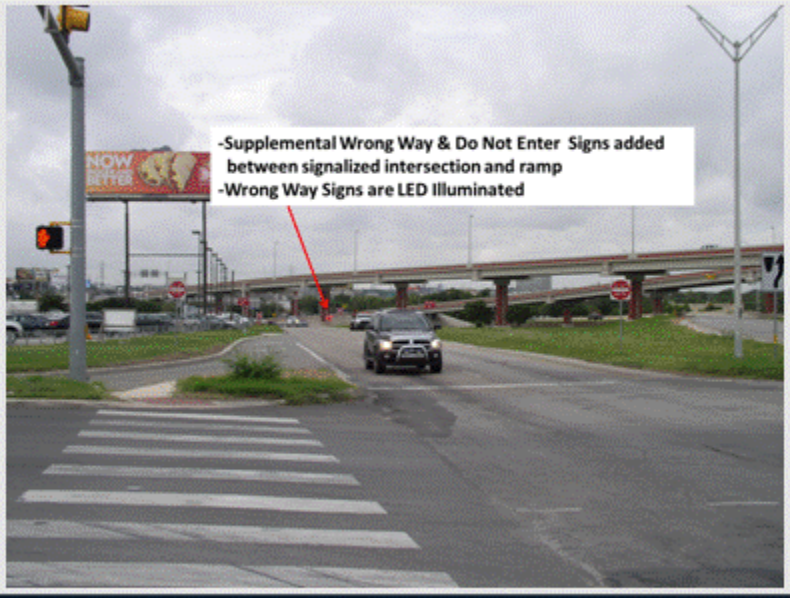
US 281 at Airport Blvd

Footer Text

US 281 at Airport Blvd

Footer Text

US 281 at Airport Blvd



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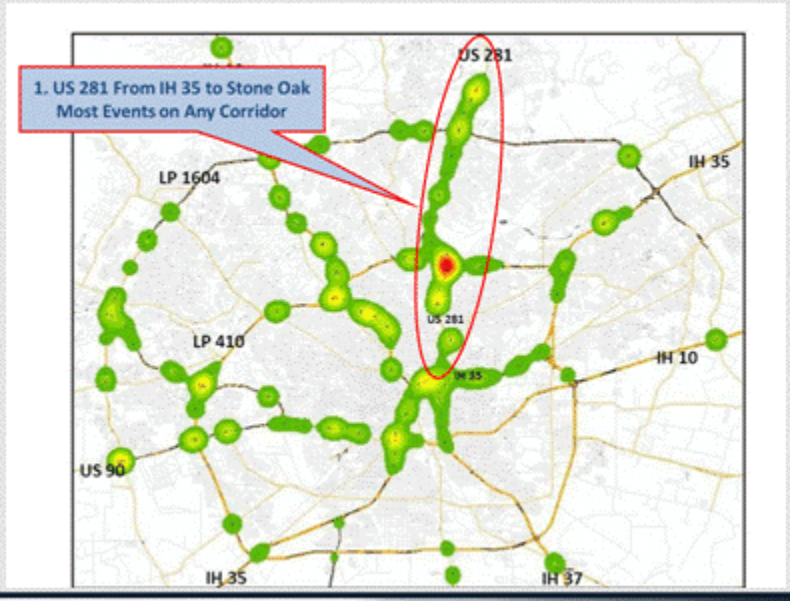
US 281 Pilot Project



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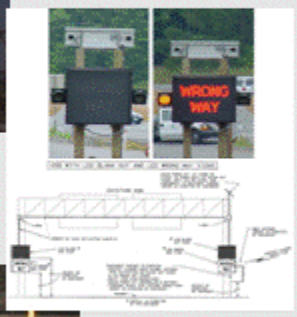
US 281 Pilot Project



15 Miles

29 Exit Ramps
- 2 LED Illuminated Wrong Way Signs
- 1 Radar Detection Unit

1 Mainlane Location
- LED Illuminated Wrong Way & LED Blank Out Sign installed on both shoulders
- 1 Radar Detection Unit

-Installation began Jan 2012
-LED Illuminated Wrong Way Sign Installed
-Radar Unit Installed
-Mainlane System Installed
-Budget $500,000

Footer Text

US 281 Pilot Project - 12 Month Results

	July 2012 - June 2013 (12 Months)
Reduction in Average Rate of WWD Events/Month TransGuide Operator Logs US 281- IH 35 to LP 1604	-29.03%
Reduction in Average Rate WWD Events/Month SAPD 911 Call Logs US 281- IH 35 to LP 1604	-28.99%
Project Cost- Installation of LED Illuminated Wrong Way Signs on US 281 from IH 35 to LP 1604	$377,605
Calculated Annual Cost Savings (Average of SAPD and TransGuide Data)	$247,104
Benefit - Cost Ratio	13.1 to 1
Cost Recovery Time (Years)	1.5

Footer Text

TxDOT Research Project 0-6769

WWD Countermeasures

- Evaluate the effectiveness of WWD countermeasures implemented in San Antonio, elsewhere in Texas and around the country
- Evaluate detection methods used to detect wrong way drivers in San Antonio, Dallas (NTTA), Houston (HCTRA) and elsewhere
- Review MUTCD guidelines for Illuminated Signing applications for WWD countermeasures and make best practice recommendations
- Began fall of 2012 (2 year project)

TxDOT Research Project 0-6769

WWD Countermeasures

- Research Plan
  - **Task 1**: Assess State-of-Knowledge in the US and Texas
  - **Task 2**: Evaluate Countermeasures in a Closed-Course Environment
    - Monitored, intoxicated test subjects on a closed course at night in an instrumented vehicle
  - **Task 3**: Evaluate countermeasures and detection systems in an operational environment
    - Utilize data from San Antonio, Dallas and Houston WWD countermeasure deployments to assess their impacts
  - **Task 4**: Develop and assess wrong-way driver warning messages
    - Determine what message(s) to deliver to right-way drivers
  - **Task 5**: Develop recommendations and report

Summary – WWD Task Force Lessons Learned

- Adopted lessons learned from prior research and countermeasure deployment projects
  - TTI Study 2003/2004
  - NTTA Project- Task Force Summary Report
  - HCTRA Detection Project
- Law enforcement (SAPD) took steps that aided in identifying problem areas:
  - E-Tone Radio Network Alerts
  - Created specific code in CAD systems for wrong way driver reports
  - Critical data for developing GIS map
- Many opportunities for sharing lessons learned
  - Dallas, Houston and San Antonio all have active WWD efforts
  - WWD sessions have been included in many technical conferences (ITS Texas November 2011, ITS America May 2012)
  - TxDOT Research Project
  - NTSB Special Investigation Report on Wrong Way Driving (December 2012)

TEXAS DEPARTMENT OF TRANSPORTATION

WRONG WAY DRIVER INITIATIVE

Michael A. Chacon, P.E.
Traffic Operations Division

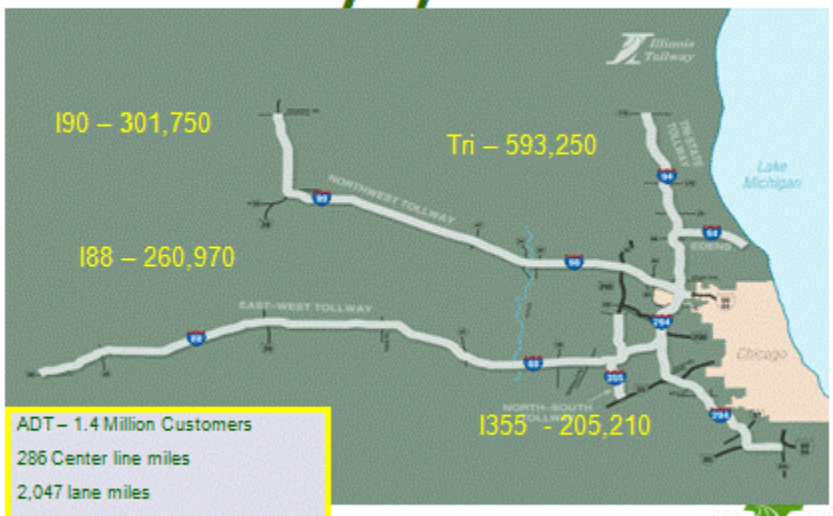
Brian G. Fariello, P.E.
San Antonio District

Traffic Incident Management

John Benda, Illinois Toll Highway Authority

INTEGRATED OPERATIONAL APPROACH TO WRONG-WAY DRIVERS

Illinois Tollway System



ADT – 1.4 Million Customers
286 Center line miles
2,047 lane miles
11 Maintenance Sections
5 Illinois State Police Patrol Zones

Extent of Problem: Tollway recent experience

2013

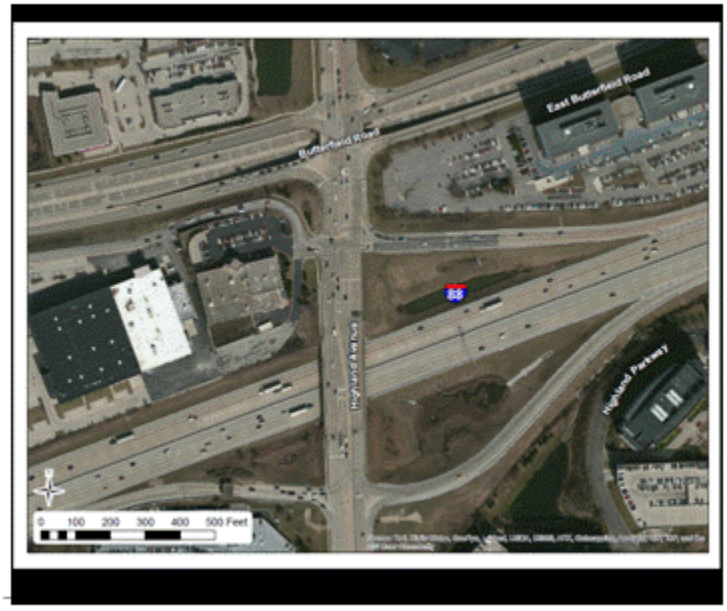
- 81 Reports of Wrong Way Drivers to Date
  - 8 Confirmed
    - 3 DUI's
    - 5 Accidents (3 involved a DUI)

2012

- 125 Reports of Wrong Way Drivers
  - 21 Confirmed
    - 12 DUI's
    - 9 Accidents (2 involved DUI's)

Profile of Confirmed Wrong Way Driver

- % Impaired Driver
  - 65-75% DUI
  - 25-35% Other (?)

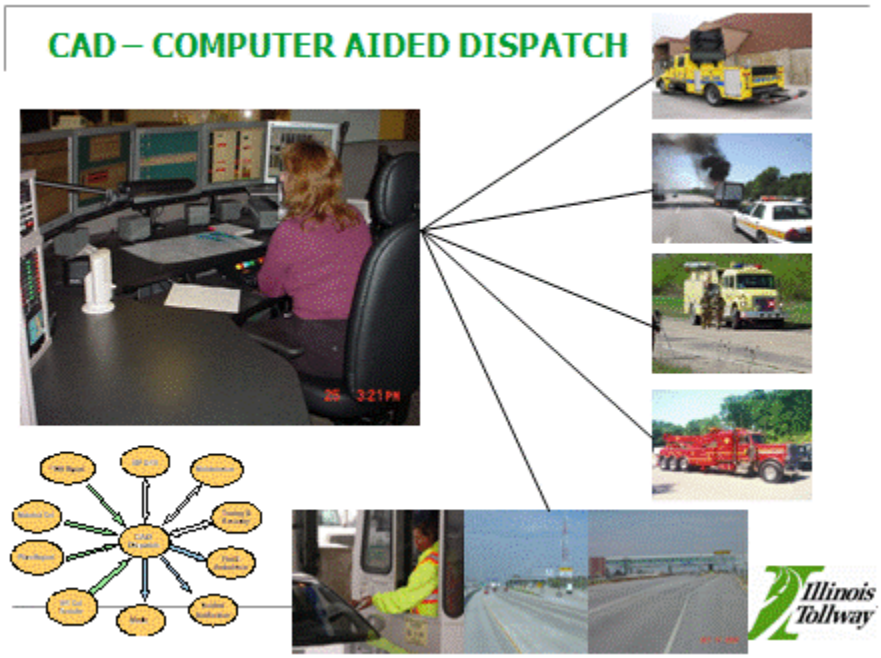


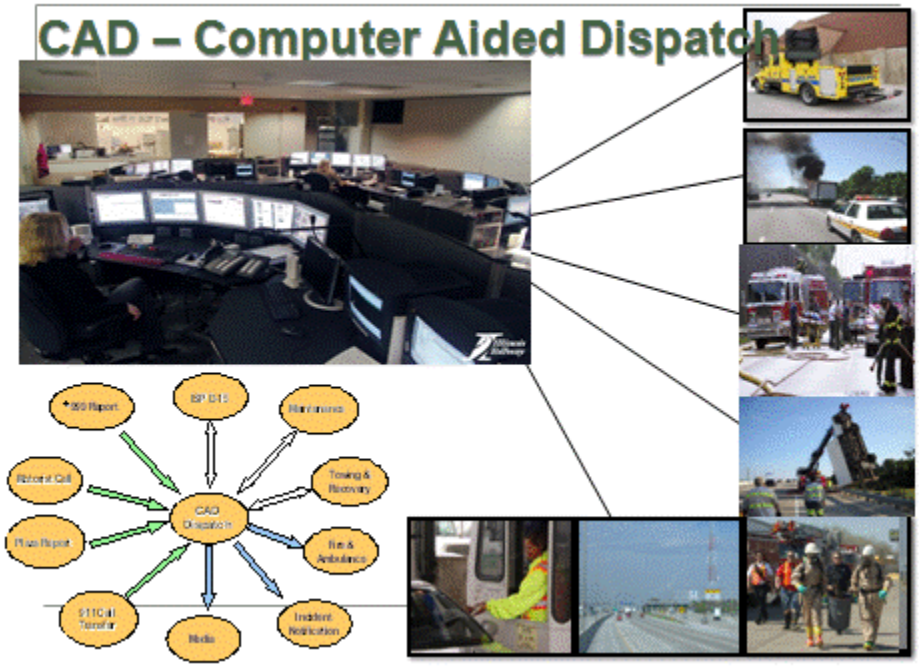
Relationship to Incident Management

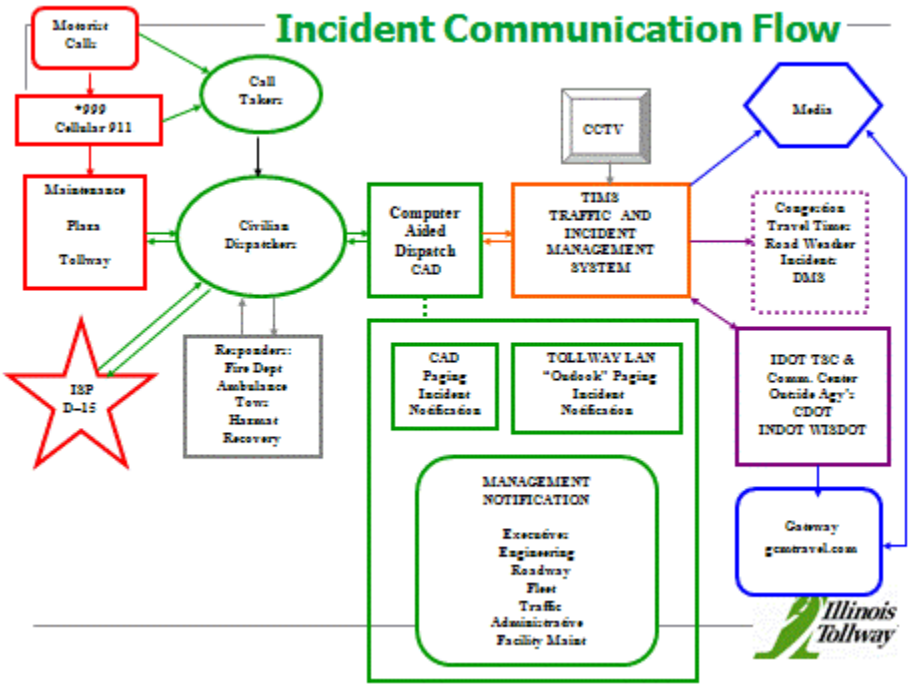
Previous approach:

- Wrong Way Driver Results in Crash
- Crash Became the Incident

This changed when the Dispatch / CAD System was integrated to the Traffic Operations Center and the Tollway developed an Integrated Operational Approach to Incident Management.

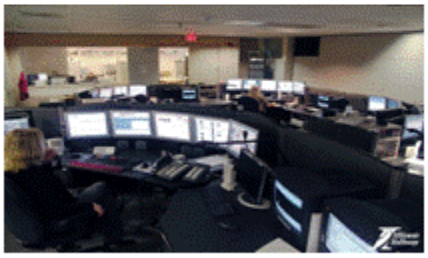

CAD – COMPUTER AIDED DISPATCH
Illinois Tollway


CAD – Computer Aided Dispatch
CAD Dispatch
Maintenance
Towing & Recovery
Fire & Ambulance
Incident Notification
Media



Operational View

- Report of Wrong Way Driver Creates an Incident
- Dispatch / CAD System Alerts:
  - Illinois State Police, District 15
  - Tollway Maintenance
  - Traffic Center
  - Toll Plazas



Illinois Tollway

Illinois State Police

- Attempt to Locate and Intercept the Wrong Way Driver

Traffic Center

- Performs a Camera Search in Reported Area
- Messaging to Traffic if DMS in Right Location
  - What to tell the Motorist
  - Do you Alert Without Confirmation?

Toll Plazas Alerted

- Confirm Wrong Way Driver
- Provide Description of Vehicle

Maintenance Alerted

- All Maintenance Employees are Trained as Incident Responders
- Significant Resource Base on the Road
- Empowered to React to Dispatch Notification

Maintenance Has Stopped 4 Wrong Way Drivers

1 – Struck Snow Plow in the act.
(Plow won, but both drivers injured)

3 - Maintenance Trucks on Routine Activity were able to curb & Block Wrong Way Drivers

Comment: Not something we train, but employees in Maintenance Sections claim ownership of Safety in their Sections and work With ISP to intercept WWD

Operations Focus Success

- Incident Management Clearance Times
  - PDO Crashes < 16 minutes
  - PI Crashes < 30 minutes

Secondary Crashes are under 5%

On The Drawing Board

- Detection on Exit Ramps to Increase Response to WWD
- Messaging to Customers of WWD Presence
- Increased Alert Message on Ramps (directed at the WWD)
- Challenge – If 65-75% of the WWD's on the Illinois Tollway are DUI. How to Effectively Communicate with the Impaired Driver.

Conclusion: There is no Silver Bullet Solution

- On our System the Use of an Integrated Operational Approach has been Successful in at least reducing the potential impact of Wrong Way Drivers
- We look forward to continued ITS Developments to further mitigate or prevent WWD

Thank You! Questions??

- John L. Benda
  General Manager of Maintenance & Traffic
  Illinois State Toll Highway Authority
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  jbenda@getipass.com

Appendix A: Moderator and Speaker Information

Aaron Weatherholt, P.E.
Illinois Department of Transportation
Deputy Director Division of Highways
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217-782-7231

Aaron has worked for IDOT in various construction, design, planning, traffic engineering, and operations capacities since 1984. He was the District 6 Traffic Engineer for 12 years before becoming the State Traffic Engineer in 2005. In 2008 he was promoted to the position of State Operations Engineer which includes Maintenance Operations, Traffic Engineering & Operations, Transportation Infrastructure Security, and Day Labor Construction activities. In 2011 Aaron was promoted to Deputy Director for the Division of Highways. He is responsible for policy development and program development for highway operations, and acquisition, local agency roads and streets, and project design and environmental studies. Aaron represents the Illinois Department of Transportation as a member of the AASHTO Subcommittee on Traffic Engineering, Subcommittee on Maintenance, and Subcommittee on Systems Operations and Management. He has served as a technical committee member of the National Committee on Uniform Traffic Control Devices. He is a member of the Illinois Terrorism Task Force (ITTF) and Chair of the ITTF — Transportation Committee. Aaron has a Bachelor of Science in Civil Engineering from the University of Missouri at Rolla. He is a registered professional engineer in Illinois and a graduate of the inaugural class of the Operations Academy Senior Management Program held at the University of Maryland.

Brian G. Fariello, P.E.
Traffic Management Engineer–TransGuide
San Antonio District
Texas Department of Transportation
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210-731-5247

EDUCATION:
B.S. Civil Engineering, 1984, Texas A&M University
M.S. Civil Engineering, 1990, the University of Houston

EXPERIENCE:
Texas Department of Transportation- 1985 to present
Traffic Management Engineer for TxDOT's San Antonio District, 1994 to Present.

Brian is responsible for the design, construction, maintenance and operation of the TransGuide Intelligent Transportation System.

Brian J. Fouch
brian.fouch@dot.gov
202-366-0744

Since August 2012, Brian has served as the Safety Design Team Leader for the Federal Highway Administration (FHWA) Office of Safety Technologies in Washington, DC. Brian leads a team of safety professionals that promote roadway departure and intersection safety on a national level.

Brian joined FHWA in 1997 as a Highway Engineer Trainee. He has served in several key positions within FHWA including Area Engineer, Safety Engineer, Safety and Traffic Operations Team Leader, Field Operations Team Leader and prior going to FHWA Headquarters he served as the Assistant Division Administrator in the FHWA Iowa Division.

Prior to joining the FHWA, Brian worked for the West Virginia Division of Highways in Charleston, West Virginia as a Pavements and Research Engineer. He holds a Bachelor's Degree in Civil Engineering from Virginia Tech and is a registered Professional Engineer in Virginia and Tennessee.

Brian Windle
windleb@isp.state.il.us
847-561-9720

Brian Windle has worked for the Illinois State Police for the past 24 years all on the Chicago Expressway System. He currently holds the rank of Lieutenant. During his career he has worked in crash reconstruction, child passenger safety, roadway safety assessment, and instructing standard field sobriety testing. He holds a Master's of Science Degree in Criminal-Social Justice from Lewis University and is a graduate of the FBI National Academy Session 249.

Chiu Liu
Chiu_Liu@dot.ca.gov
916-475-0205

Chiu Liu, a 1997 PhD graduate of Longhorn from Civil and Environmental Engineering in University of Texas, is currently responsible for monitoring and implementing the wrong way, the 2- and 3-lane cross centerline, and the multi-lane cross median collision programs in the safety branch of the traffic operation division in Caltrans. He has been with the traffic safety and operation group in Caltrans for the last 7 years. Collaborating with other colleagues, he has been studying various areas in transportation, including signal timing, geometric design, roadside barrier and sight distances, freeway operation and control, active heat removal in mass concrete, transportation planning, pavement response to dynamic truck loading, roadway profile characterization, and management system. As a member of ASCE and ITE, he is a licensed PE in the State of California and a certified PTOE.

Craig Virgin
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618-537-9500

Craig was inducted into the U.S. National Distance Running Hall of Fame based at Utica. NY in July 2001. He was a member of the fourth class of inductees and joined his early American running heroes Steve Prefontaine, Billy Mills, Frank Shorter and Bill Rodgers in the Hall of Fame. Recently has boon elected into the U.S. National Track & Field Hall of Fame based in New York City.

Craig is a 3-time Olympian (1976, 1980, 1984) on the U.S. Track & Field Team in the 10,000 meter event. This accomplishment is unprecedented for an American born athlete in that event. He finished 2nd in the U.S. Olympic Trials in 1976, first in 1980 and second in 1984. Ho set the U.S. Olympic Trials record of 27:45.6 for that event in 1980. That record hold for 24 years until it was broken in 2004. He ran the fastest 10,000 meter time (27:29.2) in the world during 1980, but was prevented from competing in the Moscow Olympics by the United States-led boycott. It was the biggest disappointment of Craig's running career. Craig had wanted to be the first American to win an Olympic medal in the 10,000 meter track event since Billy Mills' captured gold in 1964.

To date, Craig is the first and only American man to win the I.A.A.F World Cross Country Championship, winning in 1980 at Paris and again in 1981 at Madrid. He qualified for 10 U.S. World Cross Country Teams for this 12K (7.5 mile) international cross country race which is the only running world championship hold yearly.

Craig is the former U.S. record holder at the 10,000 meter track distance (27:29.2) as well as the 10K (28:04), 8K (22:46), and 10 mile (46:30) road race events. Craig was the U.S. National Champion in the 10,000 meter track event in 1978, 1979, and 1982. He also set the U.S. National Track & Field Championships meet record of 27:39.4 for that event in 1979. It stood for 25 years until it was broken in the same race that broke the Olympic Trials record in 2004. The U.S. runner who broke it, Meb Keflezighi, went on to finish 2nd in the Olympic marathon later that summer.

Craig won many of the major U.S. sub-marathon road races such as the Peachtree Road Race in Atlanta, Bay to Breakers in San Francisco, Crescent City Classic in New Orleans, Falmouth Road Race on Cape Cod, Trevira Twosome in New York City, and the Maggie Valley Moonlight Rood Race in North Carolina.

Dave Morena
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517-702-1836

David A. Morena has been the highway safety specialist at FHWA's Michigan Division office in Lansing since 1983. Past and current safety initiatives to which he has contributed, both in Michigan and nationwide, include: rumble strips, cable median barrier, traffic signal placement, road diets, elderly mobility countermeasures, high friction surface treatments, wrong-way driving countermeasures, and engineering/emergency medical system collaborations. Morena has a B.S. in industrial engineering and an M.S. in traffic engineering from Ohio State University.

Deborah Bruce, Ph.D.
bruced@ntsb.gov
413-727-8134

Deborah Bruce, Ph.D., has been with the Safety Board since 1996 working as a transportation researcher and more recently as a Project Manager in the Office of Highway Safety. Prior to joining the Safety Board, she worked in the private sector as a human factors specialist in charge of air traffic control research projects. She holds a B.S. Chemistry and an M.A. Communications from the University of Kentucky and an M.A. and Ph.D. in Human Factors Engineering, George Mason University. Her dissertation research looked at the effectiveness of in-vehicle auditory information displays.

Duane Brunell, P.E.
Maine Department of Transportation
Duane.Brunell@maine.gov
207-624-3278

Duane is a registered professional engineer with the Maine Department of Transportation (Maine DOT), working as the Safety Performance Analysis Manager in the Safety Office, administering Federal Safety Fund dollars for highway improvements. He is involved on a wide variety of tasks including coordinating Maine's multi-agency Strategic Highway Safety Plan; chairs Maine's multi-agency Large Animal Crash Group. He conducts crash analysis activities and is on Maine's Traffic Records Coordinating Committee's steering committee. He is a member of Maine DOT's Engineering Council. He also has served as chair of the Maine Transportation Safety Coalition and is on the Data Committee that publishes **The Status of Transportation Safety in Maine** and its annual Crash Results supplements.

Also currently serves on the NCHRP's 'Institutionalizing Safety in Transportation Planning Processes' panel

Huaguo Zhou, Ph.D., P.E.
hhz0001@auburn.edu
334-844-1239

Dr. Huaguo Zhou is an associate professor with the Department of Civil Engineering at Auburn University. Before joining Auburn University, he was an associate professor with the Southern Illinois University, Edwardsville. He obtained his Ph.D. from the University of South Florida in 2001. After that, he worked as a transportation engineering with Parsons Brinckerhoff, Tampa office for over 2 years, and as a senior research associate with the Center for Urban Transportation Research (CUTR) at USF for over 5 years. He has published over 30 peer reviewed journal and over 70 conference papers. His research area focuses on highway safety, access management, and freeway incident management. He has served as principal investigator (PI) for the wrong-way driving project funded by ICT/IDOT since 2009.

Ivan Ulberg
iulberg@mt.gov
406-444-6217

Ivan Ulberg is the Traffic Design Engineer for the Montana Department of Transportation, Traffic and Safety Bureau, Engineering Division. He has been with MDT for over 20 years, starting as a student designer, then on to Safety Management, then seven years re-inventing MDT's Access Management Program, next to Traffic as a Project Engineer before accepting the position of Design Engineer a little over a year ago. The Design Section has a staff of 20, including electrical, signing / striping, safety design, and geometrics.

Ivan has a BS in Civil Engineering from Montana State University, is a registered P.E. in Montana, and is a long-time member of ITE. A native Montanan, on his off-time he is an avid hunter and outdoorsman, the father of five children, and runs a herd of two cats, two dogs, 14 chickens and a bunny.

Jeffrey Shaw
jeffrey.shaw@dot.gov
708-283-3524

Jeffrey Shaw is currently the Intersections Program Manager for the Federal Highway Administration, Office of Safety. In this role, he manages programs, projects and products of National interest that are intended to enhance intersection safety. Prior to joining FHWA in 2005, Jeff worked for the Illinois Department of Transportation and as a consulting engineer. He is a registered professional engineer in Illinois, and has been board certified as a Professional Traffic Operations Engineer and Professional Transportation Planner. He also serves as Chair of the ITE Transportation Safety Council and co-Chair of the TRB Intersections Joint Subcommittee.

John Benda
jbenda@getipass.com
630-241-6800

John Benda began with the Illinois Tollway in 1983 as Superintendent of Maintenance and currently holds the position of General Manager of Maintenance & Traffic. In this capacity, John is responsible Maintenance and Operation of the 286 mile Toll System including Roadway Maintenance , Traffic & Incident Management, Central Dispatch Center, Fleet and Permits & Utilities Units. He manages an operating budget of approximately $50M with 530 employees. Mr. Benda has been very active in several Professional and Industry Associations during his tenure at the Tollway.

John Price
California Highway Patrol
JPrice@chp.ca.gov
916-843-3210

Captain John Price is the commander of Media Relations and Community Outreach programs for the California Highway Patrol in Sacramento, California. Price leads a team of professionals working daily to educate the public about traffic safety through leading edge marketing, publicity campaigns, and educational programs. He oversees driver safety education courses focused on combating adult and teen distracted driving, older driver safety, and Start Smart classes targeting new and future licensed teenage drivers and their parents/guardians.

Previously, Price served directly for Assistant Commissioner, Field helping oversee statewide field operations for the California Highway Patrol. He is a Federal Bureau of Investigation National Academy #249 graduate and earned a Bachelor of Arts in Public Administration and Psychology from California State University, Chico. Prior to joining the California Highway Patrol, Price held positions within California as a deputy sheriff and police officer.

Keith Gaston
Florida Highway Patrol
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Jacksonville, FL 32205
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KeithGaston@flhsmv.gov

Keith Gaston is a 33-year veteran of the Florida Highway Patrol serving in Naples, Fernandina, Miami, Orlando, and Jacksonville, Florida. He has served in various positions and capacities during his career rising through the ranks to his current position as Captain. Captain Gaston received his Master's in Public Administration from the University of North Florida and is currently a Doctoral Candidate in Educational Leadership at UNF.

Kimberly Ault
Aultk@michigan.gov
517-335-2859

Kimberly Ault has been employed as a traffic safety engineer with the Michigan Department of Transportation for 6 years. She has spent much of her time providing traffic crash analysis and other traffic safety assistance to local road-owning agencies through MDOT's Local Safety Initiative. Kim has a B.S. in civil engineering from Michigan Technological University and is a registered professional engineer in Michigan.

Kim Kolody
kkolody@ch2m.com
773-458-2833

Ms. Kolody is a professional engineer in CH2M HILL's Chicago office with over 15 years of experience in highway safety, transportation planning, preliminary design, and operations. She has specialized experience on safety management, safety analysis, network screening methodologies, countermeasure selection, strategic safety program and policy development, development of safety implementation programs at the state and local level, including Highway Safety Manual analysis approaches. Ms. Kolody has served as the Illinois Safety Program manager since 2006, has worked on safety projects for Department of Transportation's, local municipalities and the National Cooperative Research Program. Ms. Kolody is a member of the Transportation Research Board (TRB) Transportation Safety Management Committee, is co-chair of the TRB Global Road Safety Subcommittee, is a member of the TRB Safety Performance User Liaison and Technical Facilitation subcommittee, is a member of the TRB Road Safety Cultures subcommittee, is Past President of the Institute of Transportation Engineers (ITE) Illinois Section, and an Eno Fellow. Ms. Kolody received her Bachelors of Science and Masters of Science degrees from Michigan State University.

Michael A. Chacon, P.E.
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512-416-3120

TITLE:
Policy & Standards Engineer- Traffic Operations Division, Texas Department of Transportation
EDUCATION:
B.S. Civil Engineering, 1993, the University of Texas at Austin
EXPERIENCE:
Texas Department of Transportation- 1994 to present

Michael is responsible for the Texas Manual on Uniform Traffic Control Devices, Traffic Control Standard sheets, policies and standards related to traffic control devices and approval of traffic control devices.

Priscilla Tobias, P.E.
State Safety Engineer
Illinois Department of Transportation
Priscilla.Tobias@illinois.gov
217-782-3568

Priscilla Tobias is the State Safety Engineer for the Illinois Department of Transportation. She is a graduate of Virginia Tech and a licensed professional engineer for the state of Illinois. She has been with IDOT for over 20 years and has worked both in the district and central office. She has served as the Illinois State Safety Engineer and Bureau Chief of Safety Engineering since 2004. Priscilla is responsible for Illinois' SHSP, HSIP, SRTS, work zone safety, RSAs, roadside hardware, and for establishing programs and policies focused on improving the safety performance of Illinois roadways both at the state and local level. She works closely with multi-discipline safety stakeholders to provide an integrated approach to safety.

Rich Coakley
richard.coakley@ch2m.com
414-847-0423

Rich is a Principal Transportation Engineer with CH2M Hill in Milwaukee. He is the co-chair of the panel for the Wrong-Way Driving research project.

He has a Bachelor of Science in Civil Engineering from the University of Illinois in Champaign - Urbana, a Master of Science in Civil and Environmental Engineering from the University of Wisconsin – Madison and a Master of Business Administration from Keller Graduate School of Management.

He has been working in the industry for 35 years including 11 years at the Illinois Department of Transportation in District 1, 10 years with another consulting firm and 14 years with CH2M Hill. He has been an adjunct faculty member at UW – Madison teaching geometric Design of Transport Facilities and Traffic Control. He teaches the Interchange Design course offered periodically at Marquette University.

Rich is a member of the TRB Geometric Design Committee and the Context Sensitive Design Task Force. He is on the editorial board for the Korean Society of Civil Engineers, he reviews papers for their Journal of Civil Engineering. He is the President of the Wisconsin Section of ITE and a member of the ITE Transportation Safety Council.

Rudolph M. Umbs, P.E.
Senior Traffic Safety Engineer
rudy.umbs@wi.rr.com
202-365-3285

Rudy Umbs is the Senior Traffic Safety Engineer with Tindale-Oliver & Associates of Tampa, Florida.

Rudy is currently providing guidance, technical assistance, and training to State and local agencies to further enhance their transportation safety programs including road safety audits.

Prior to joining Tindale-Oliver, Rudy had a 39-year career with the Federal Highway Administration serving as the FHWA's Chief Highway Safety Engineer, and Chief of Safety Design and Operation Division including responsibility for the Manual on Uniform Traffic Control Devices.

In 2005, Rudy was on a 5-month special detail with the Illinois DOT's Bureau of Safety Engineering during the development of the Illinois Strategic Highway Safety Plan

Rudy is lives in Oak Creek, Wisconsin, is a graduate of Marquette University, and a Professional Engineer.

Terry Thurman
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281-584-7541

My Name is Captain Terry Thurman with the Harris County Constable Pct.5 and currently assigned to the Harris County Toll Road Authority Incident Management.
I began my Law Enforcement career with the Pct. 5 Constable Department in 1984 and have worked in Patrol, Special Operations, Motorcycle Patrol and Toll Road Divisions.
He was born in Houston, Texas and married with two children

Tim Sheehan, P.E.
tim.sheehan@illinois.gov
217-782-3568

Tim received a Bachelor of Science in Civil Engineering from the University of Illinois in Champaign – Urbana, IL in 1979. He is a Licensed Professional Engineer in the State of Illinois, and is currently the Safety Design Unit Chief with the Illinois Department of Transportation (IDOT), Bureau of Safety Engineering (BSE). In his position at BSE , Tim administers statewide safety crash analysis to identify patterns with specific roadway designs and recommends mitigating measures; manages published research on state-of-the-art safety related topics; reviews recommendations to revise existing policies or develop new policies; provides statewide technical guidance on highway clear zones and roadside treatments; assists in Highway Safety Improvement Program (HSIP) administration; and coordinates statewide Roadside Safety Assessments (RSAs) and Review (RSRs). He has also been involved in IDOT's / BSE's Wrong-Way Driving Mitigation efforts, including the statewide HSIP signage and pavement marking interchange upgrades.

Tim has practiced engineering for over 34 years in both the public and private sector. He has nearly 5 years of experience with the Illinois Department of Transportation including his current position, 12 years of working for a central Illinois consulting firm, 8 years of owning and running Sheehan Engineering, Inc. a Springfield, IL consulting firm, and was City Engineer for the City of Springfield, IL for 9.5 years.

Yang Ouyang
youyang@ntta.org
214-224-2256

Yang Ouyang is the Traffic Operations Engineer for North Texas Tollway Authority (NTTA) in Plano, Texas. He received his Bachelor of Engineering from Tongji University in Shanghai, China, and his Master of Science in Transportation Engineering from Texas A&M University. He is a registered professional engineer in Texas and certified Professional Traffic Operational Engineer (PTOE). He has over 18 years of experience in various aspects of traffic and transportation engineering working at research institute, private consulting firm, and public agency. He is a key member of the NTTA's Wrong-Way Driving Task Force and stays engaged in various ongoing research, pilot testing, and implementation efforts to keep the roadways safe for the traveling public.

Appendix B: Summit Agenda

Day 1

7:00 am to 8:00 am	**Continental Breakfast and Registration**
8:00 am to 8:30 am	**Welcome** **Setting the Goal and Vision for the Workshop** *National picture and trend based on research; Who is here, # states; Review the day and goals for the Summit* Aaron Weatherholt, Illinois Department of Transportation (30 minutes)
8:30 am to 9:15 am	**Setting the National Scene** • Deborah Bruce, National Transportation Safety Board *Wrong-Way Driving Study Findings and Objectives* (20 minutes) • Brian Fouch, Federal Highway Administration Office of Safety *Wrong-Way Driving: Renewed Emphasis on a Familiar Problem* (20 minutes)
9:15 am to 10:00 am	• Huaguo Zhou, Southern Illinois University *Illinois Center for Transportation Research Findings: Investigation of Contributing Factors Regarding Wrong-Way Driving on Freeways* (45 minutes)
10:00 am to 10:30 am	**Break**
10:30 am to Noon	**Research and Program Best Practices** *This session reviews research findings and WWD programs; including data, program elements, implementation and challenges, and program effectiveness.* Facilitator: Rudy Umbs, Tindale-Oliver & Associates, Inc. Speakers: • Chiu Liu, California Department of Transportation *California Wrong-Way Driving Monitoring Program* (30 minutes) • Yang Ouyang, North Texas Tollway Authority *North Texas Tollway Authority Wrong-Way Driving Program* (30 minutes) Discussion on future research needs (30 minutes)

Day 1 (continued)

Noon to 1:30 pm	**LUNCH (provided)** Craig Virgin *How Wrong-Way Driving Changed My Life* (30 minutes)
1:30 pm to 3:00 pm	**Preventing Wrong-Way Driving Crashes From Occurring** *This discussion includes why WWD crashes occur and methods for preventing them and may relate to specific types of WWD crashes (i.e. older, alcohol related, and urban areas) and types of prevention (i.e. signing, geometric improvements, striping, presence of law enforcement, and education at particular establishments).* Facilitator: Kim Kolody, CH2M HILL Speakers: • Duane Brunell, Maine Department of Transportation *Older Drivers Wrong-Way Driving Study and Countermeasures* (20 minutes) • Lt. Brian Windle, Illinois State Police *Law Enforcement Approach to Preventing Wrong-Way Driving Incidents* (20 minutes) • David Morena, Federal Highway Administration Michigan Division Kim Ault, Michigan Department of Transportation *Engineering Strategies for Reducing Wrong-Way Driving Crashes* (20 minutes) Discussion (30 minutes)
3:00 pm to 3:30 pm	**Break**
3:30 pm to 4:30 pm	**Breakout Discussions** Pre-assigned groups will meet in the designated rooms
4:30 pm to 5:00 pm	**Breakout Discussion Report Back** Facilitator: Jeff Shaw, Federal Highway Administration
5:00 pm	**Closing Remarks** Aaron Weatherholt, Illinois Department of Transportation Rich Coakley, CH2M HILL

Day 2

7:30 am to 8:00 am	**Continental Breakfast**
8:00 am to 8:30 am	**Setting the Vision for 2nd Day Peer Exchange** Aaron Weatherholt, Illinois Department of Transportation **Overview of Highlights of DAY 1** Rich Coakley, CH2M HILL
8:30 am to 10:00 am	**Alerting Drivers, Allowing for Correction and Traffic Incident Management Response** *This session discusses the action after a wrong-way driver has entered the freeway and includes methods to alerting the driver, alerting other drivers, providing for correction of the maneuver and incident response from EMS and law enforcement.* Facilitator: Rich Coakley, CH2M HILL Speakers: • Captain Terry Thurman, Harris County Toll Road Authority, Texas *Law Enforcement Approach for Wrong-Way Detection & Correction* (20 minutes) • Brian Fariello and Michael Chacon, Texas Department of Transportation *Wrong-Way Driving Mitigation Through Intelligent Transportation Systems and Traffic Engineering* (20 minutes) • John Benda, Illinois Toll Highway Authority, *Traffic Incident Management* (20 minutes) Discussion (20 minutes)
10:00 am to 10:30 am	**Break**

Day 2 (continued)

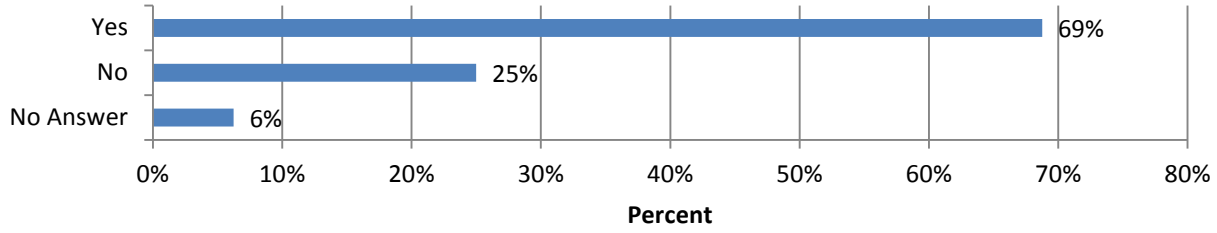
10:30 am to Noon	**Panel Discussion:** **Lessons Learned, Implementation Programs** Facilitator: Jeff Shaw, Federal Highway Administration Speakers: • Tim Sheehan, Illinois Department of Transportation • John Price, California Highway Patrol • Ivan Ulberg, Montana Department of Transportation • Captain Keith Gaston, Florida Highway Patrol (5 minutes each for opening remarks, 70 minute discussion)
Noon to 12:15 pm	**Closing and Adjourn** Aaron Weatherholt, Illinois Department of Transportation Rich Coakley, CH2M HILL
12:15 pm to 2:15 pm	**Research Team Working Lunch**

Appendix C: Survey Questionnaire and Results

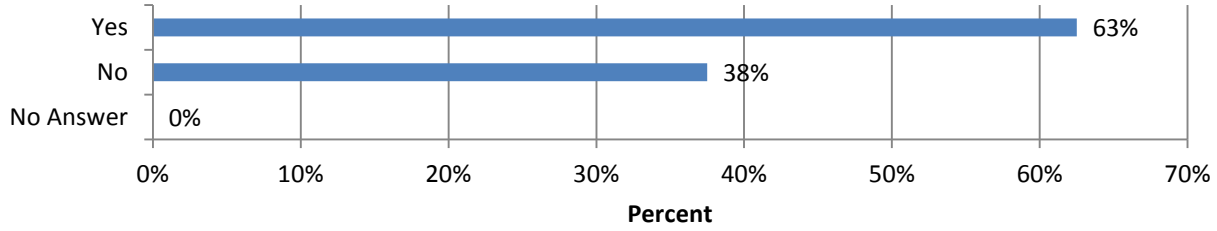
A survey questionnaire was devised and distributed to the attendees during the Summit to gather the latest information about current and emerging countermeasures to mitigate wrong-way driving issues from different states. A total number of 16 state representatives submitted their completed survey questionnaire to the summit organizers. The analyses of the results are presented in this section.

General Questions

1) Do you believe wrong-way driving is a severe problem in your state?

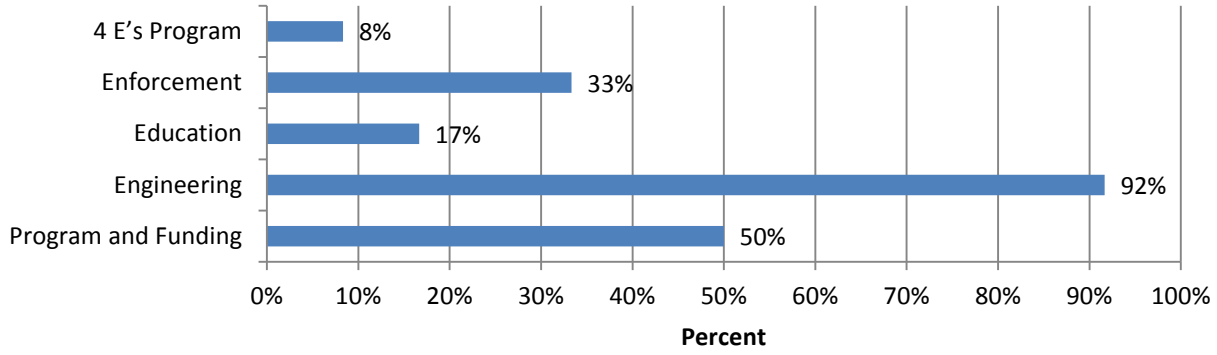


2) Has your state conducted any studies or implemented any countermeasures to reduce wrong-way driving crashes?



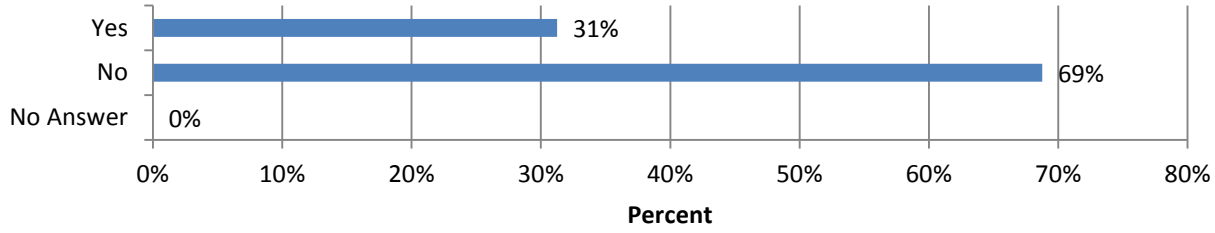
If Yes:

- Which type of countermeasures has been implemented to combat wrong-way driving crashes?

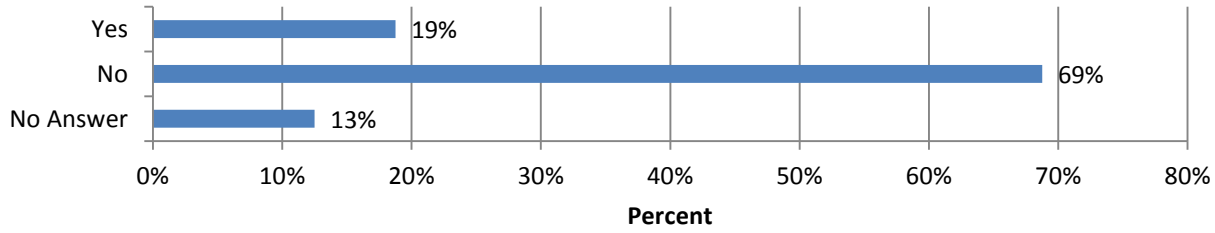


Other(s): Strengthen Alcohol Legislation

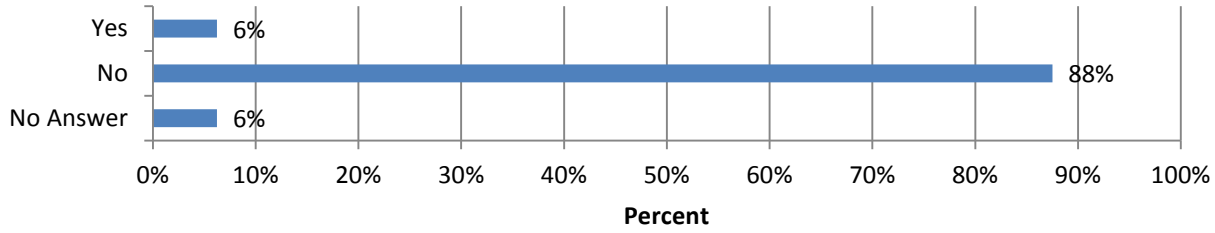
3) Does your state have a wrong-way driving monitor program to obtain information about the location, severity, time of day, etc. for wrong-way collisions?



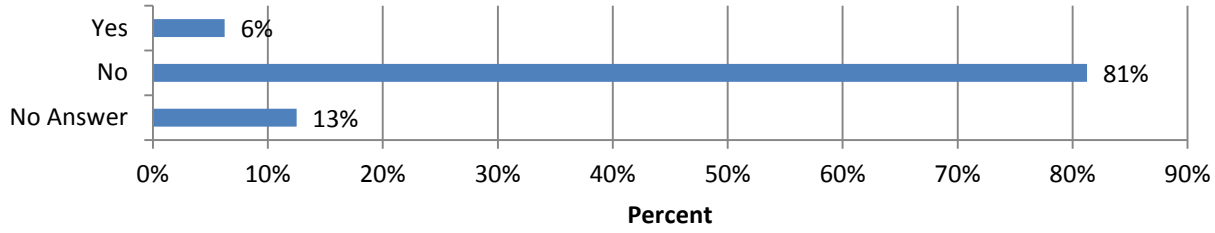
4) Does your state have any supplement to the MUTCD 2009 to mitigate wrong-way incidents?



5) Does your state have any supplement to the AASHTO Green Book 2011 to mitigate wrong-way incidents?



6) Does your state use extra lighting at locations susceptible to wrong-way maneuvers to reduce the visibility problem during nighttime conditions?



Wrong-Way Related Signage

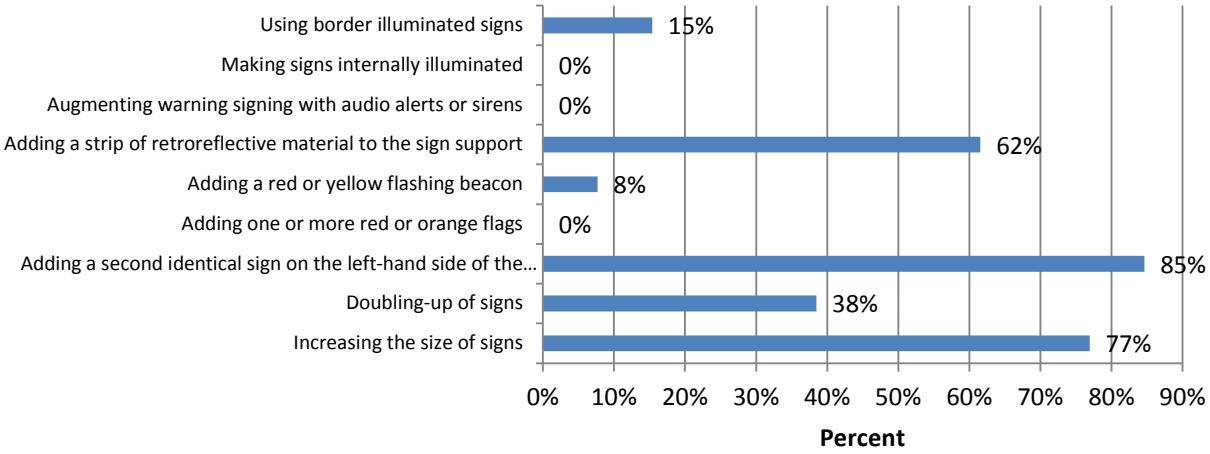
7) Which of the following traditional signs are being used in your state to mitigate wrong-way issues?

Sign / Location		
Exit Ramp	14	16
Frontage Road	11	9
Divided Highway (along non-ramp sections)	13	12

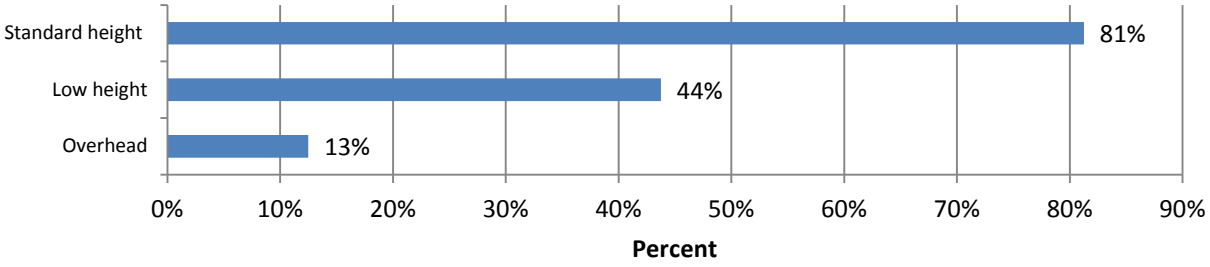
8) Which of the following (combination of) static signs are being used in your state to mitigate wrong-way issues?

Sign / Location				
Exit Ramp	8	6	0	1
Frontage Road	3	5	0	0
Divided Highway (along non-ramp sections)	3	3	0	0

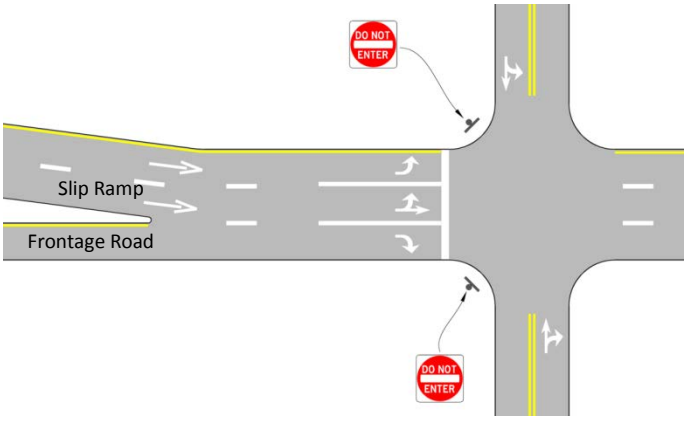
9) What methods has your state used to enhance the conspicuity of wrong-way signs? Check all that apply.

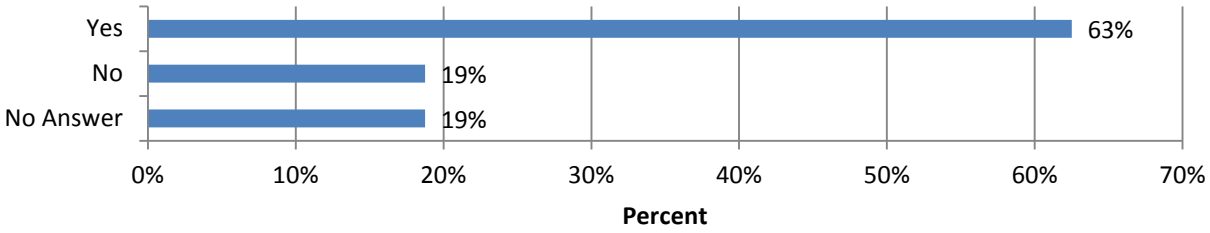


10) What mounting height does your state use for wrong-way related signs (if different signs are mounted differently, please specify separately in front of each choice below)?

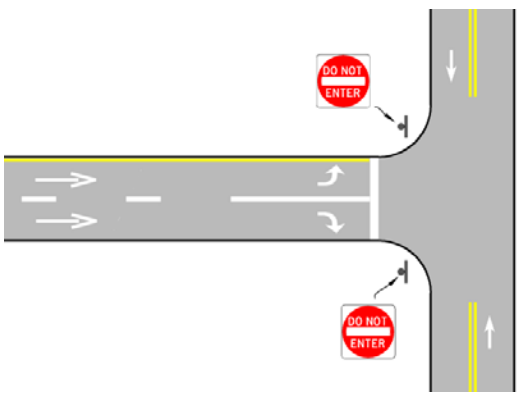


11) Does your state install DO NOT ENTER signs at the entrance of one-way frontage road connected to slip ramps in order to deter wrong-way maneuvers (figure below)?

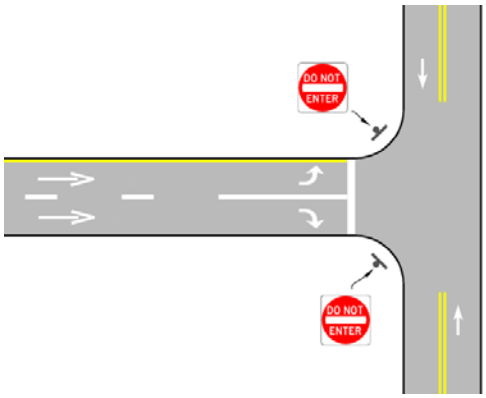




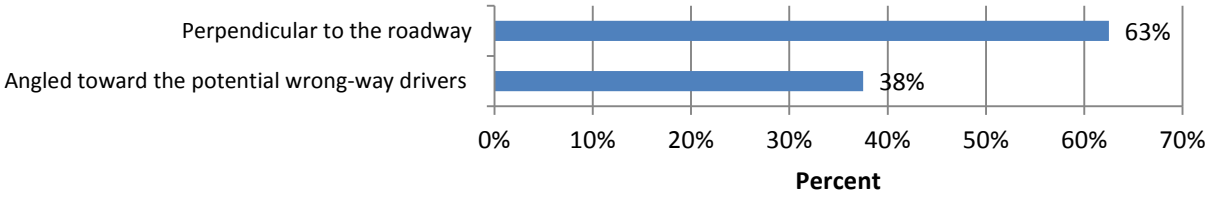
12) What is the typical position of the DO NOT ENTER signs in your state (figures below)?



Perpendicular to the roadway

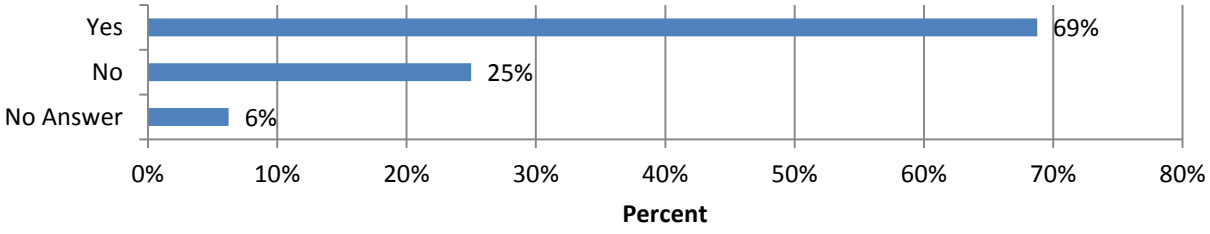


Angled toward the potential wrong-way drivers

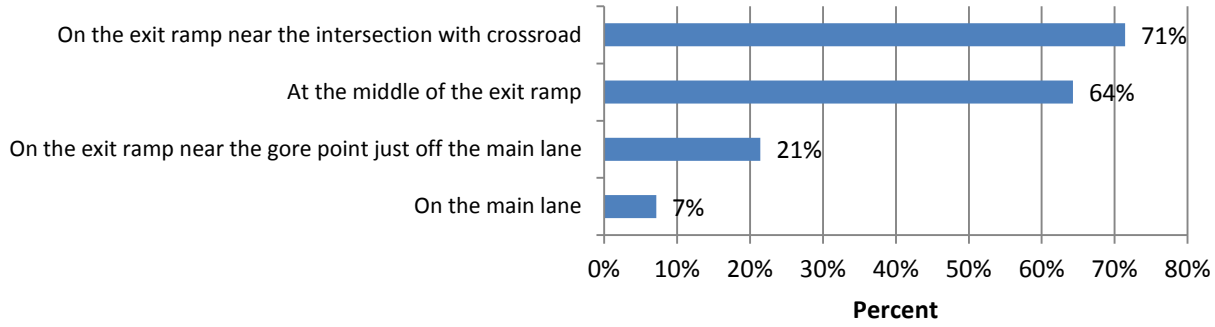


Pavement Marking

13) Does your state use wrong-way arrows as described in the MUTCD 2009 on exit ramps (figure below)?



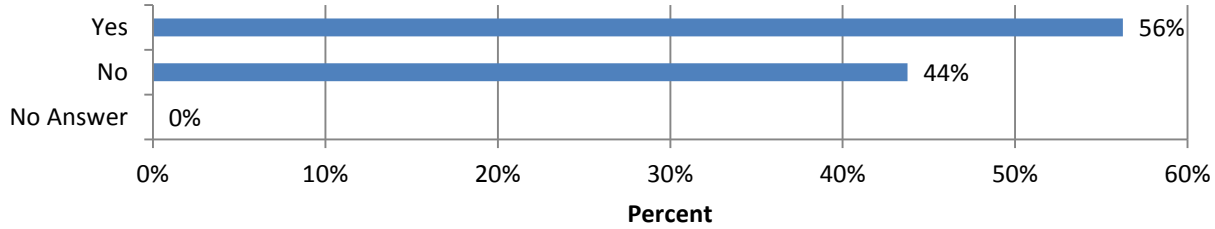
14) Where does your agency place the wrong-way arrows (please check all that apply)?



15) Are the pavement markings being used in your state on exit ramps retroreflective (figure below)? Or other type of illumination is used to make them visible at nighttime conditions?

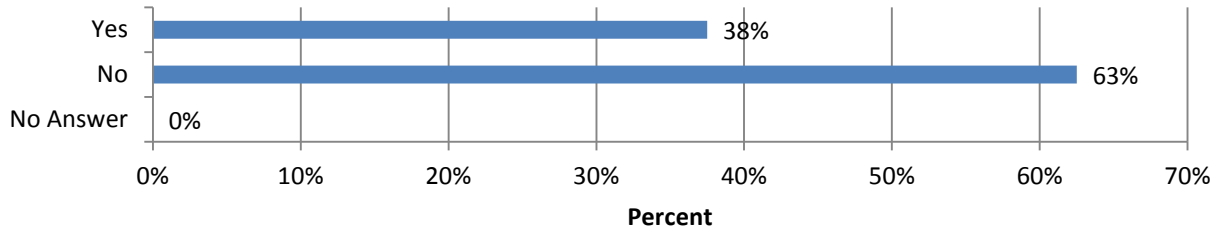
100% of responders claimed they are using retroreflective pavement markings and no agency is utilizing the other types of illumination.

16) Does your state use red-back Raised Pavement Markers (RMPs) on problematic roads (figure below)?



Traffic Signal

17) Does your state use green arrow as traffic signal indication at the intersection of exit ramps and crossroads instead of green ball to make a better understanding of the correct movement direction?



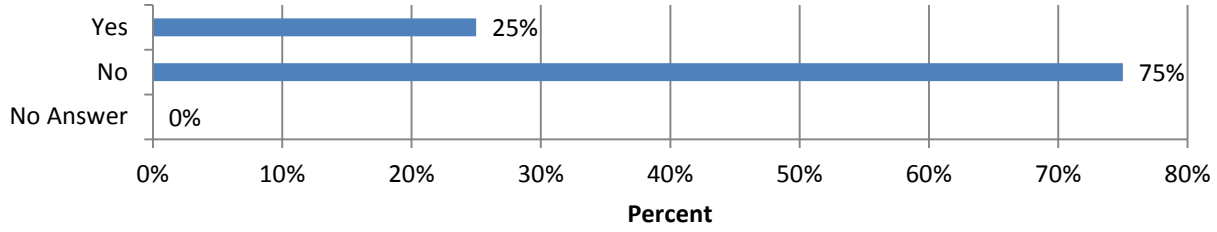
Geometric Modification

18) Please rank (using numbers) the following geometric elements which are given special attention when it comes to wrong-way issues based on your state's policy.

1. Exit ramps (their angle with crossroad, their shape such as button-hook or J-shaped, etc.)
2. Type of interchange
3. Channelizing islands
4. Medians
5. Frontage roads (their continuity, outer separation, etc.)
6. Control radius at ramp/crossroad intersection

ITS Technologies

19) Has your state utilized any ITS technologies to detect and warn drivers?

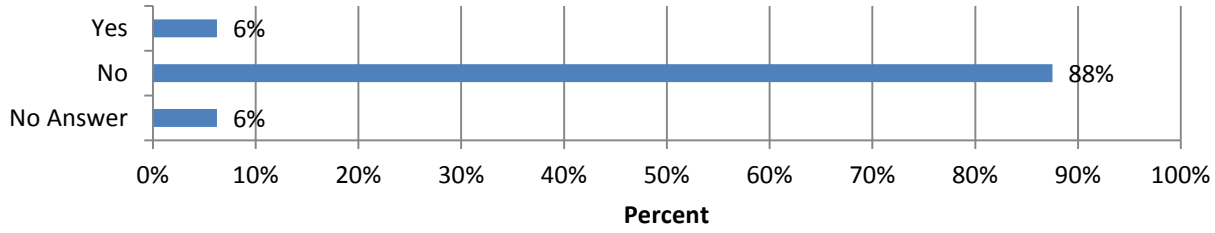


If yes, which of the following methods are used?

Detection	✓ Radar Detectors ✓ CCTV Camera ✓ Inductive Loop Detectors ☐ Other (please specify):

Caution	☐ In-pavement Warning Lights (IPWL) ✓ Flashing Wrong Way Signs ✓ Warning Lights ✓ Dynamic Message Signs (DMS) ☐ Other (please specify):
Action	✓ Patrol Units ✓ Spike Strips ☐ Other (please specify):

20) Does your state use Dynamic Message Signs to warn both wrong-way and other drivers if wrong-way driving is detected?



If yes, what message(s) is displayed separately?

- To wrong-way driver:
- To other drivers:

✓ Wrong Way Driver Ahead
✓ All Traffic Move to Shoulder and Stop

Closing Question

21) Would you recommend elements of the wrong-way driving program to other states? If so, which aspects?

- Caltrans WW package + checklist + WW monitoring report.
- Low cost signage and road working.
- ITS application using cell phone applications that talk to wrong-way drivers.
- When dealing with funding limitations, prioritize interchange types that are problematic and deal with these types first and use uniform and consistent traffic control devices to mitigate wrong-way issues.
- We need to start with having a consistent approach or standard design for the various geometric exit ramps (signs and markings). Then we should incorporate ITS and use media to get the information out there.
- Systematic approaches to upgrades make HSIP funding much simpler.
- Detection with dynamic warning devices.
- Interchange design, sign height and redundancy, education.

22) Are there any specific items you think should be included in a wrong-way driving mitigation guide?

- Language vs. symbol analysis.
- Low cost countermeasures
- Prioritize risk by interchange type
- Routine checklist for operations and traffic engineering sections along with guidance for design staffs.
- Recommended data queries to use to research high impact locations.
- Strong wording from NTSB – FHWA in response to strong DUI legislations.
- Strong wording to states endorsing the use of vehicle interlocking systems for repeat DUI offenders.
- CMF's for countermeasures.
- New data from ongoing studies/pilot programs at Maine DOT, NTTA, and TTI.

Appendix D: Contact Information of Attendees

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1	David	Adams	Georgia Department of Transportation	eadams@dot.ga.gov	404-635-2850
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12	John	Benda	Illinois State Toll Highway Authority	jbenda@getipass.com	630-241-6800
13	John	Biffany	Illinois State Police	john_biffany@isp.state.il.us	815-632-4010
14	Eddie	Blaylock	Missouri State Highway Patrol		
15	Patrick	Braboy	Illinois Department of Transportation	patrick.braboy@illinois.gov	815-434-8564
16	Deborah	Bruce	National Transportation Safety Board	bruced@ntsb.gov	413-727-8134
17	Duane	Brunell	Maine Department of Transportation	Duane.Brunell@maine.gov	207-624-3278
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19	Michael	Chacon	Texas Department of Transportation	michael.chacon@txdot.gov	512-416-3120
20	Cary	Choate	Texas Department of Transportation	cary.choate@txdot.gov	512-416-4735
21	Richard	Coakley	CH2M HILL	richard.coakley@ch2m.com	414-847-0423
22	Regina	Cooper	Illinois Department of Transportation	regina.cooper2@illinois.gov	847-705-4153
23	Mike	Curtit	Missouri Department of Transportation	Michael.Curtit@modot.mo.gov	573-526-0121
24	James	Danila	Massachusetts Department of Transportation	james.danila@state.ma.us	857-368-9640
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29	Natasha	Fatu	Connecticut Department of Transportation	natasha.fatu@ct.gov	860-594-3022
30	Greg	Feeny	Illinois Department of Transportation	greg.feeny@illinois.gov	217-557-3405
31	Scott	Ferguson	Illinois Department of Transportation	scott.ferguson@illinois.gov	815-434-8563
32	Stephen	Ferrier	Missouri State Highway Patrol	stephen.ferrier@mshp.dps.mo.gov	314-606-8788
33	Melisa	Finley	Texas A&M Transportation Institute	m-finley@tamu.edu	979-845-7596
34	Brian	Fouch	Federal Highway Administration	brian.fouch@dot.gov	202-366-0744
35	Julia	Fox	Illinois Department of Transportation	julia.fox@illinois.gov	847-705-4151
36	Morrie	Fraser	Illinois State Police	morrison_fraser@isp.state.il.us	618-223-3089
37	Ryian	Fries	Southern Illinois University Edwardsville	rfries@siue.edu	618-578-1772
38	Keith	Gaston	Florida Highway Patrol	KeithGaston@flhsmv.gov	904-695-4164
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40	Kurt	Glazier	Illinois Department of Transportation	kurt.glazier@illinois.gov	815-284-5478
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42	Brett	Harrelson	South Carolina Department of Transportation	harrelsodb@scdot.org	803-737-3378
43	Lisa	Heaven-Baum	Illinois Department of Transportation	Lisa.Heaven-Baum@illinois.gov	847-705-4158
44	Daniel	Helms	Mississippi Department of Transportation	dhelms@mdot.ms.gov	601-359-1454
45	Tim	Hemmen	Illinois Department of Transportation	Timothy.Hemmen@illinois.gov	217-342-8242
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48	Jeffrey	Hochmuth	CDM Smith	hochmuthjj@cdmsmith.com	630-874-7913
49	Cynthia	Hodge	Illinois State Police	hodgecy@isp.state.il.us	815-698-2332
50	Mohammad	Jalayer	Auburn University	jalayer_145@yahoo.com	312-351-4730
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54	Katie	Knapp	TAPCO	events@tapconet.com	262-814-7000
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56	Michael	Kraft	Illinois State Police	kraftmi@isp.state.il.us	815-275-9565
57	Teresa	Krenning	Missouri Department of Transportation	KRENNT@mail.modot.state.mo.us	314-340-4317
58	Jason	Kugel	TAPCO	events@tapconet.com	262-814-6996
59	Adam	Lintner	Illinois State Toll Highway Authority	allntner@getipass.com	630-241-6801
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62	Lauren	Ludwig	Oklahoma Department of Transportation	pmcelroy@odot.org	405-521-2863
63	Rob	Macklin	Illinois Department of Transportation	rob.macklin@illinois.gov	217-342-8245
64	Martez	Malone	Illinois State Police	Martez_Malone@isp.state.il.us	815-546-3356
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66	John	Miller	Missouri Department of Transportation	John.p.miller@modot.mo.gov	573-526-1759
67	Yadollah	Montazery	Chicago Department of Transportation	yadollah.montazery@cityofchicago.org	312-744-6541
68	David	Morena	Federal Highway Administration	David.Morena@dot.gov	517-702-1836
69	Rick	Mowlds	Washington State Department of Transportation	mowldsr@wsdot.wa.gov	360-705-7988
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94	Max	Smith	TAPCO	events@tapconet.com	262-814-6997
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99	Terry	Thurman	Harris County Toll Road Authority	terry.thurman@hctra.org	281-584-7541
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117	Daniel	Williams	Illinois State Police	willdan@isp.state.il.us	309-383-2133
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121	Gary	Sims	Illinois Department of Transportation	Gary.Sims@Illinois.gov	217-251-4859
122	Juan	Pava	Illinois Department of Transportation	juan.pava@illinois.gov	217-782-0551
123	Steve	Ratke	Federal Highway Administration	stephen.ratke@dot.gov	512-536-5900


Illinois Department
of Transportation


ILLINOIS
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