TRB Webinar – April 20, 2016

Wrong Way Driving:

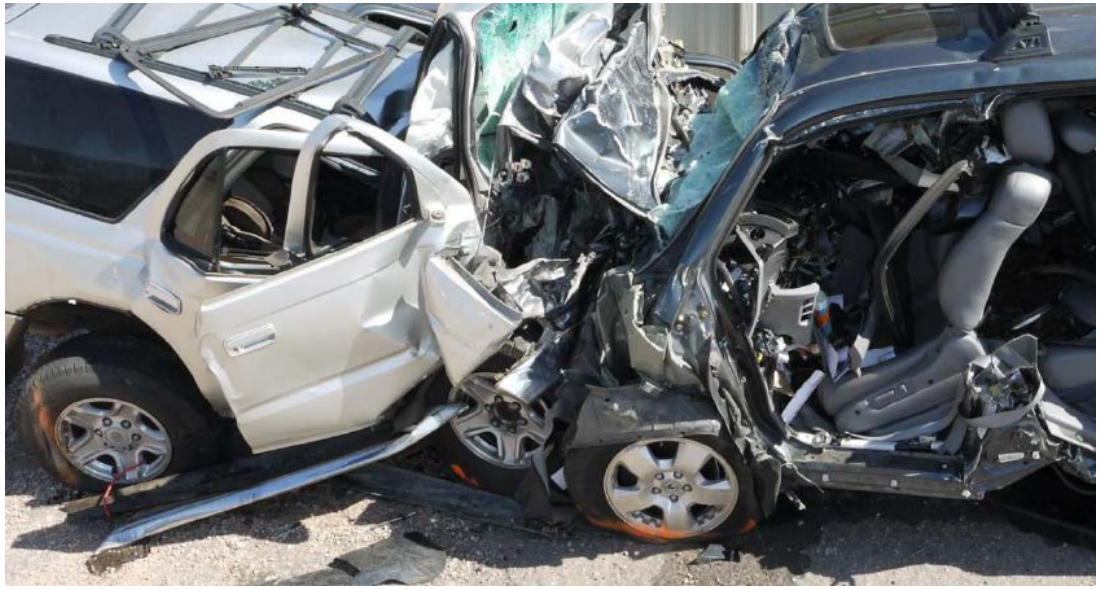
New Focus on a Persistent Problem

Mark Doctor
Federal Highway Administration
Resource Center

What do we know?

Wrong-way collisions are only about 3% of the crashes on high-speed divided highways

Wrong-way collisions are much more likely to result in fatal and serious injuries than other types of highway crashes



On average, about 360 lives are lost each year in about 260 fatal wrong-way collisions

FARS Data 2004-2009

Sources: NTSB Special Investigation Report 12/01 Dec 2012

Is Alcohol a Factor?

About 69% of fatal wrong-way collisions had indications of alcohol involvement

Source: NTSB Analysis of FARS data

About 31% of all traffic fatalities involve alcohol impairment

Source: NHTSA Traffic Safety Facts 2013 data

When are Wrong Way Collisions Occurring?

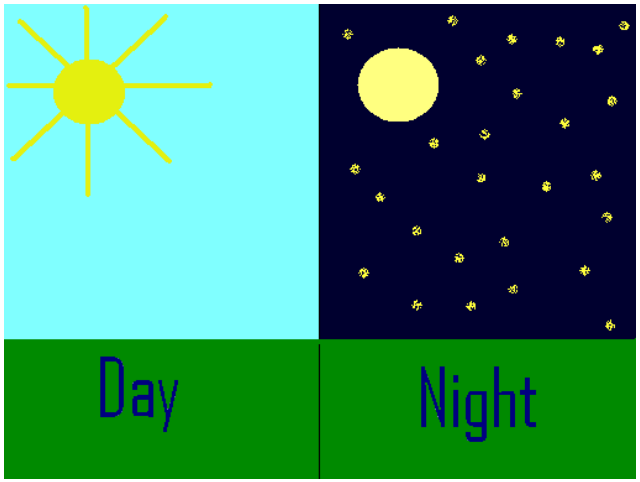
22% between 6:00 a.m. to 6:00 p.m.

12% between 6:00 p.m. and 9:00 p.m.

18% between 9:00 p.m. and midnight

31% between midnight and 3:00 a.m.

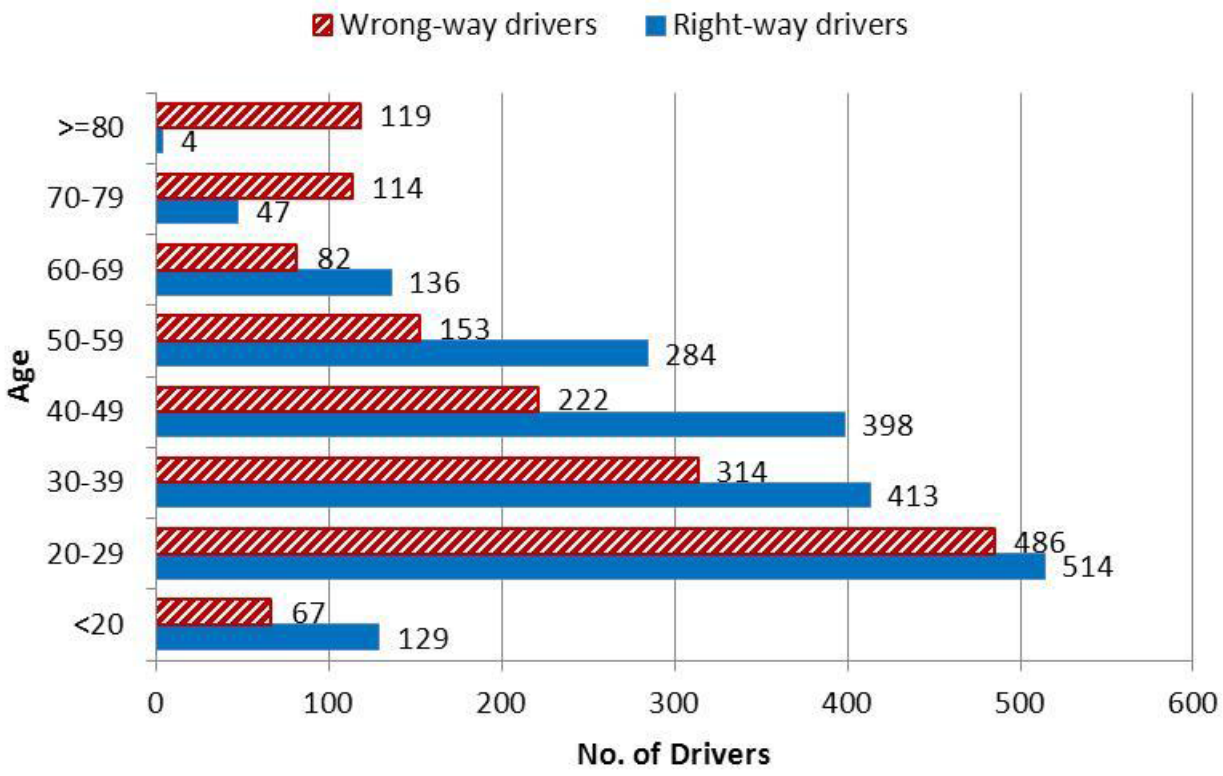
17% between 3:00 a.m. and 6:00 a.m.



Approximately 57% occurred on the weekends

Source: NTSB Analysis of FARS data

Is Age a Factor?



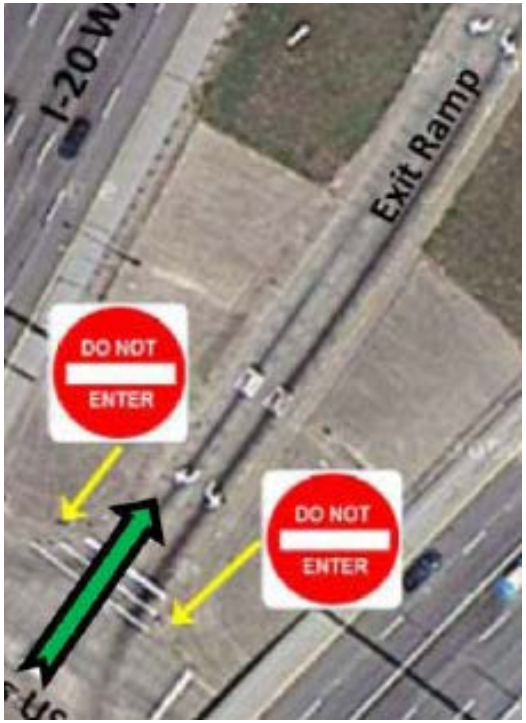
Drivers over the age of 70 constitute about 15% of the at-fault wrong-way drivers

Within the 70+ age group, wrong-way collisions are over-represented compared to other types of controlled-access highway crashes

Source: NTSB analysis of FARS data for 2004–2009

How is it happening?

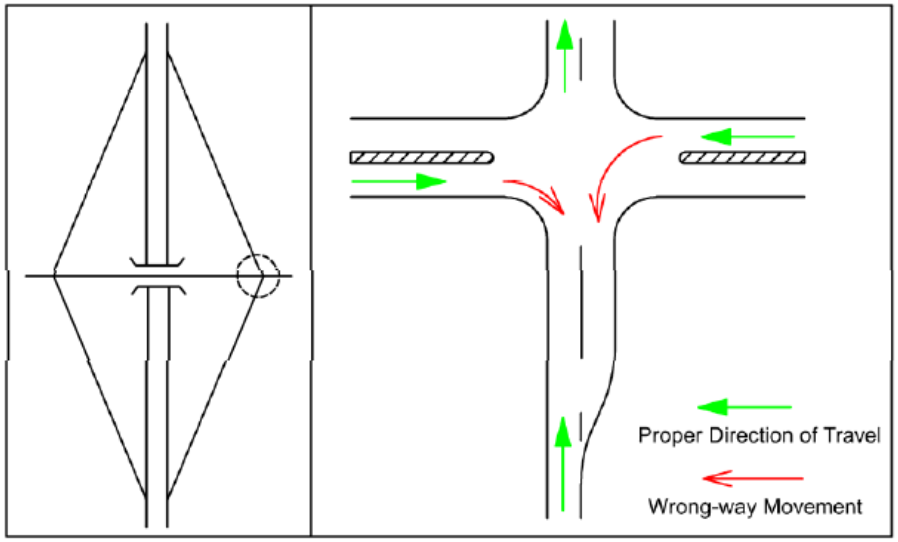
The primary origin of wrong-way movements (when the origin can be determined) is entering the wrong-way at an exit ramp

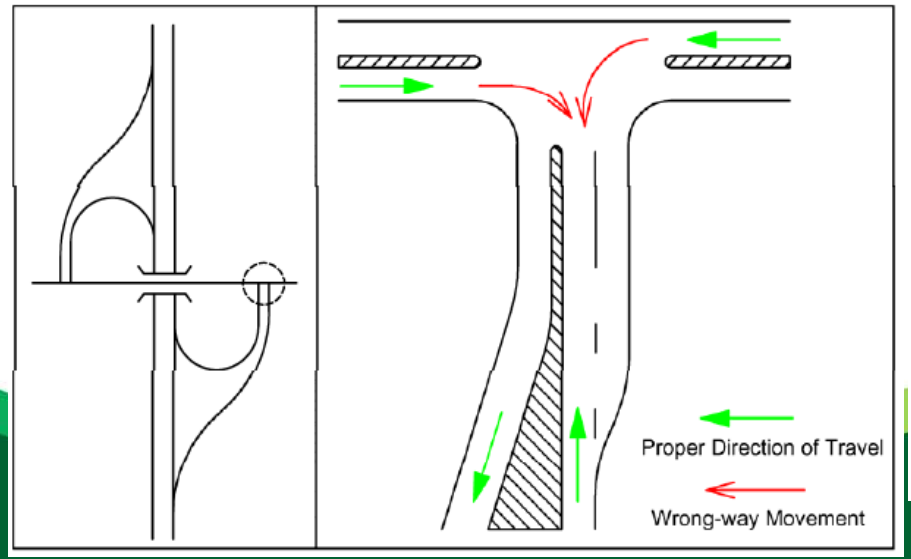


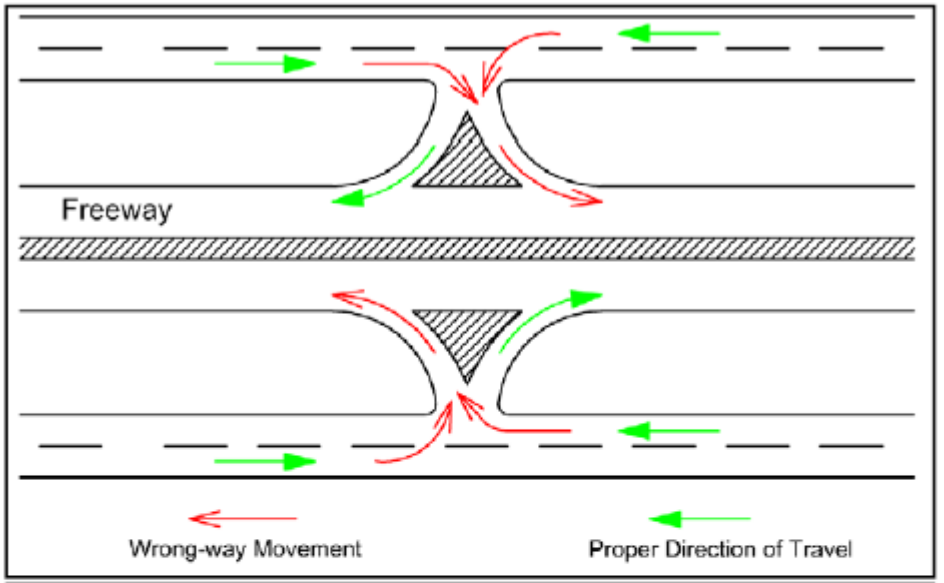
Other errors resulting in wrong-way movement include making an improper U-turn on the mainline or improperly using the emergency turnaround through the median

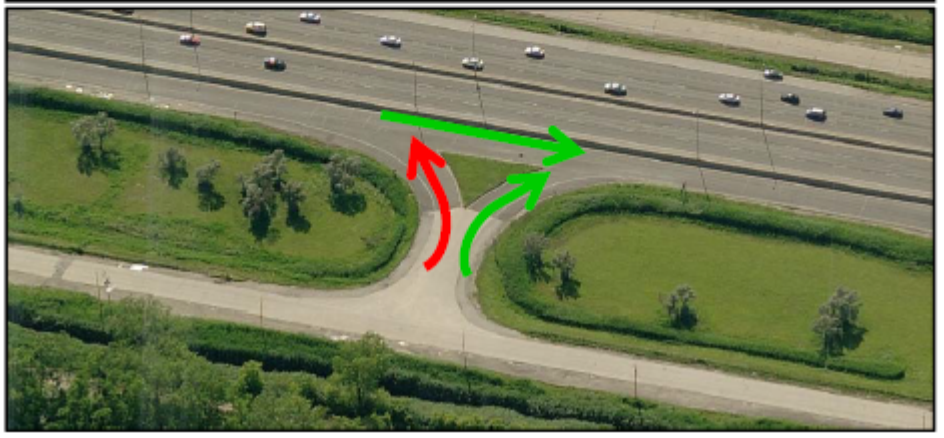
Does the Interchange Type Matter?

Certain interchange configurations may be more susceptible to WWD





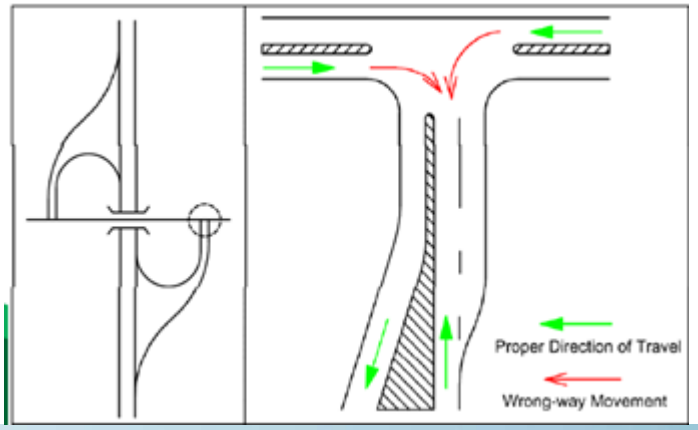




Source: Illinois Guidelines for Reducing Wrong-Way Crashes on Freeways

Lessons Learned: Michigan

- 60% W-W entries associated with partial cloverleaf interchanges
- Applied a systemic approach



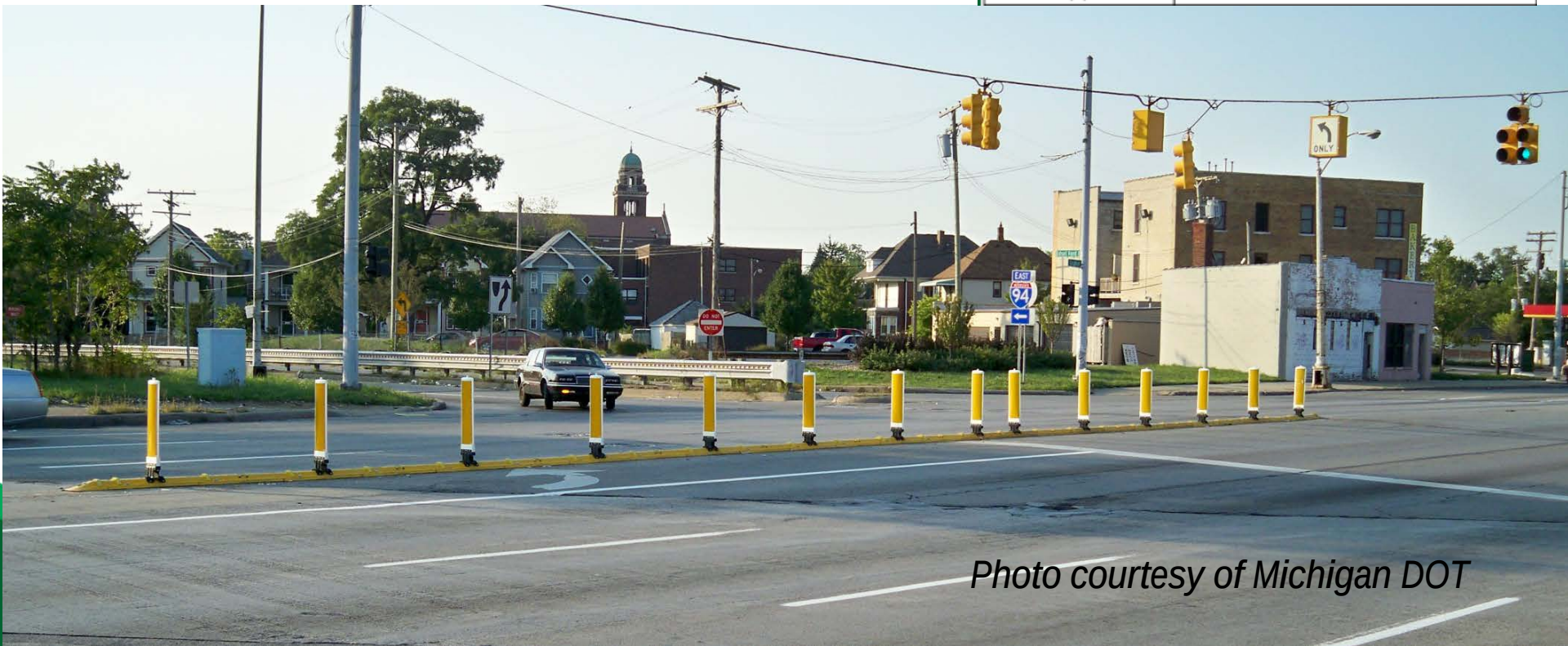


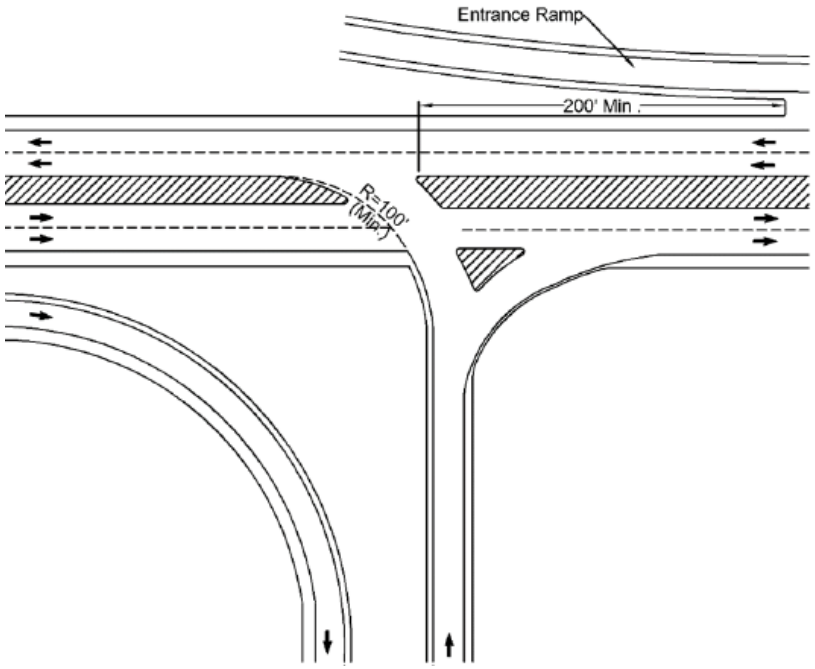
Photo courtesy of Michigan DOT

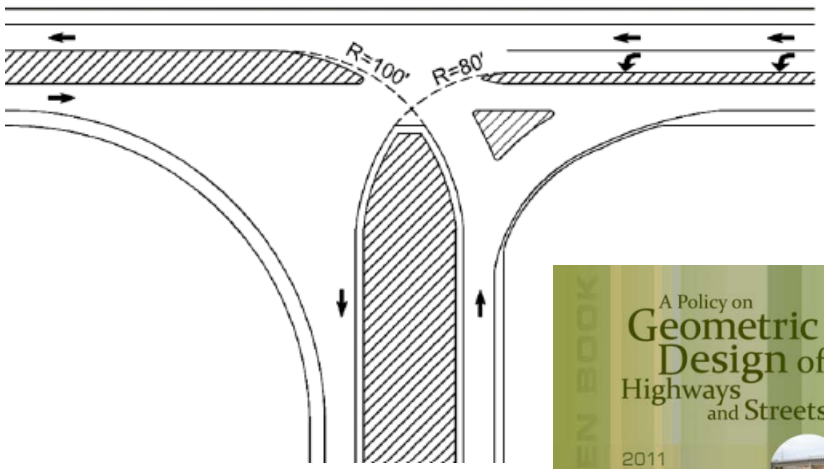
Lessons Learned: Michigan

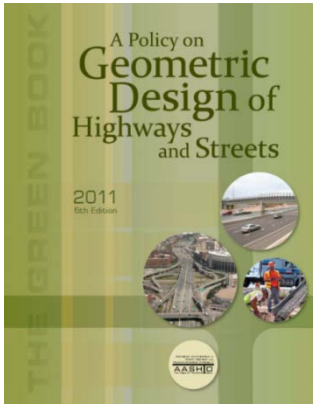
- SEVERITY DEPENDS ON THE CRASH LOCATION
  - WW crash on mainline: 42% fatal or severe injury
  - WW crash on ramp: 6% fatal or severe injury

If you can stop a wrong-way driver along the ramp (before reaching the mainline), there is a much greater chance of lessening the crash severity

Ramp Terminal Designs



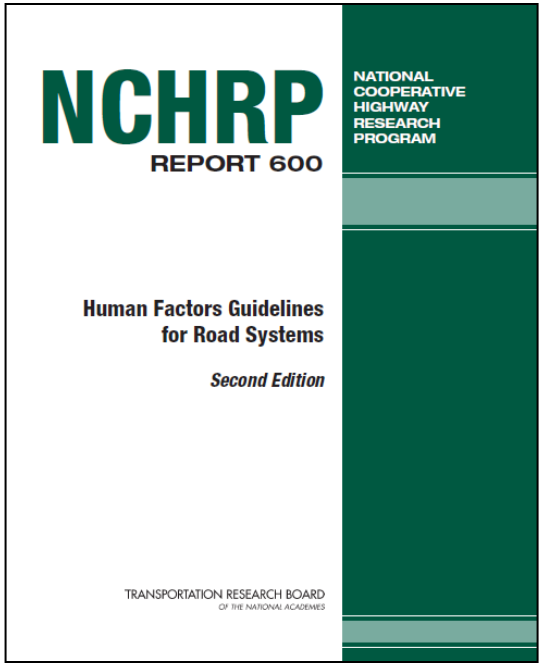




- Raised channelization and islands with angular edges
- Signs and markings to simplify decisions
- Increase/improve roadway lighting

Human Factors

"… countermeasures that reduce the affordance of driving the wrong way (such as geometric alterations) may be more effective than those which require the perceptual abilities of the drivers to function at a certain level (such as signage or pavement markings)."



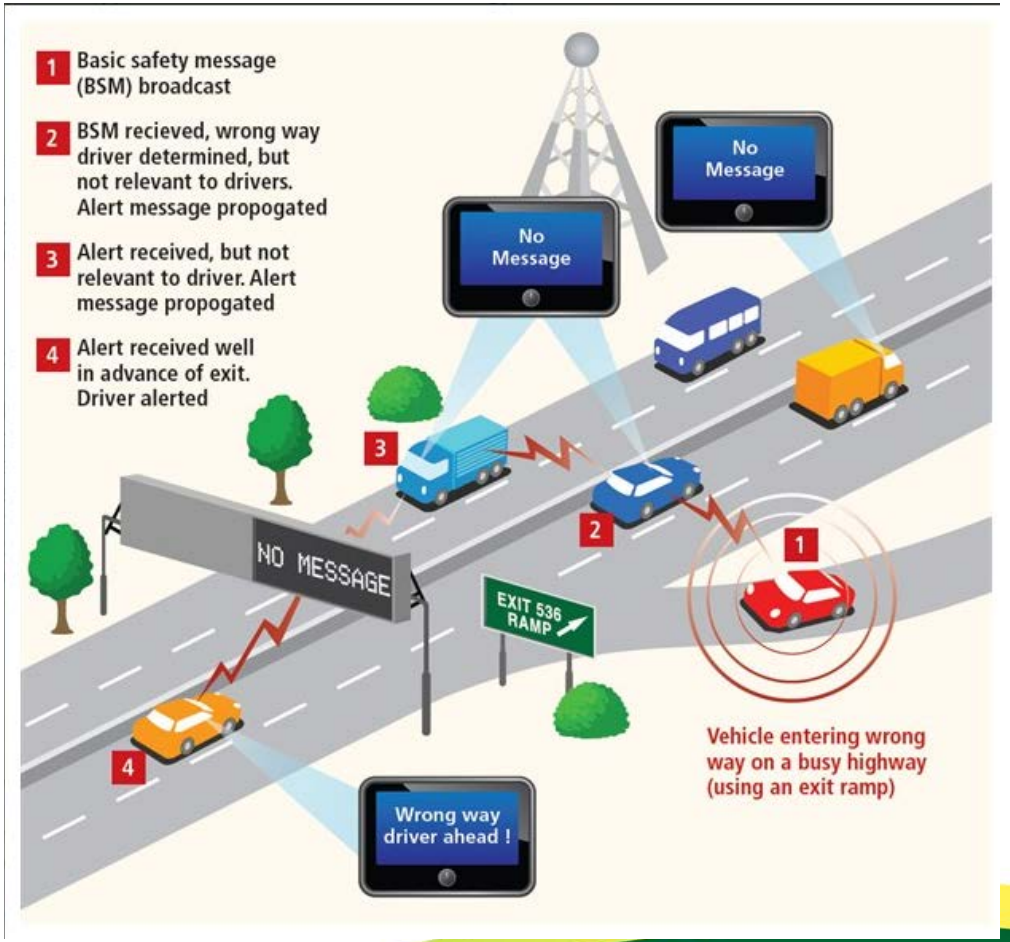
Source: NCHRP Report 600

Roundabouts may provide excellent channelization against wrong-way entries

Location: Topeka, KS – I-70 at Rice Road

Connected Vehicle Technologies

- Possible V2I and V2V applications adapted to address WWD



Simple Strategies

Double-posted “Do Not Enter” and “Wrong Way” signs on an exit ramp
(Courtesy of the New York State Department of Transportation)

Need for a Coordinated Effort

Engineering

Signing
Markings
Design
Technology

Education

What to do

Enforcement

DUI
Dynamic
Response

Transportation Safety

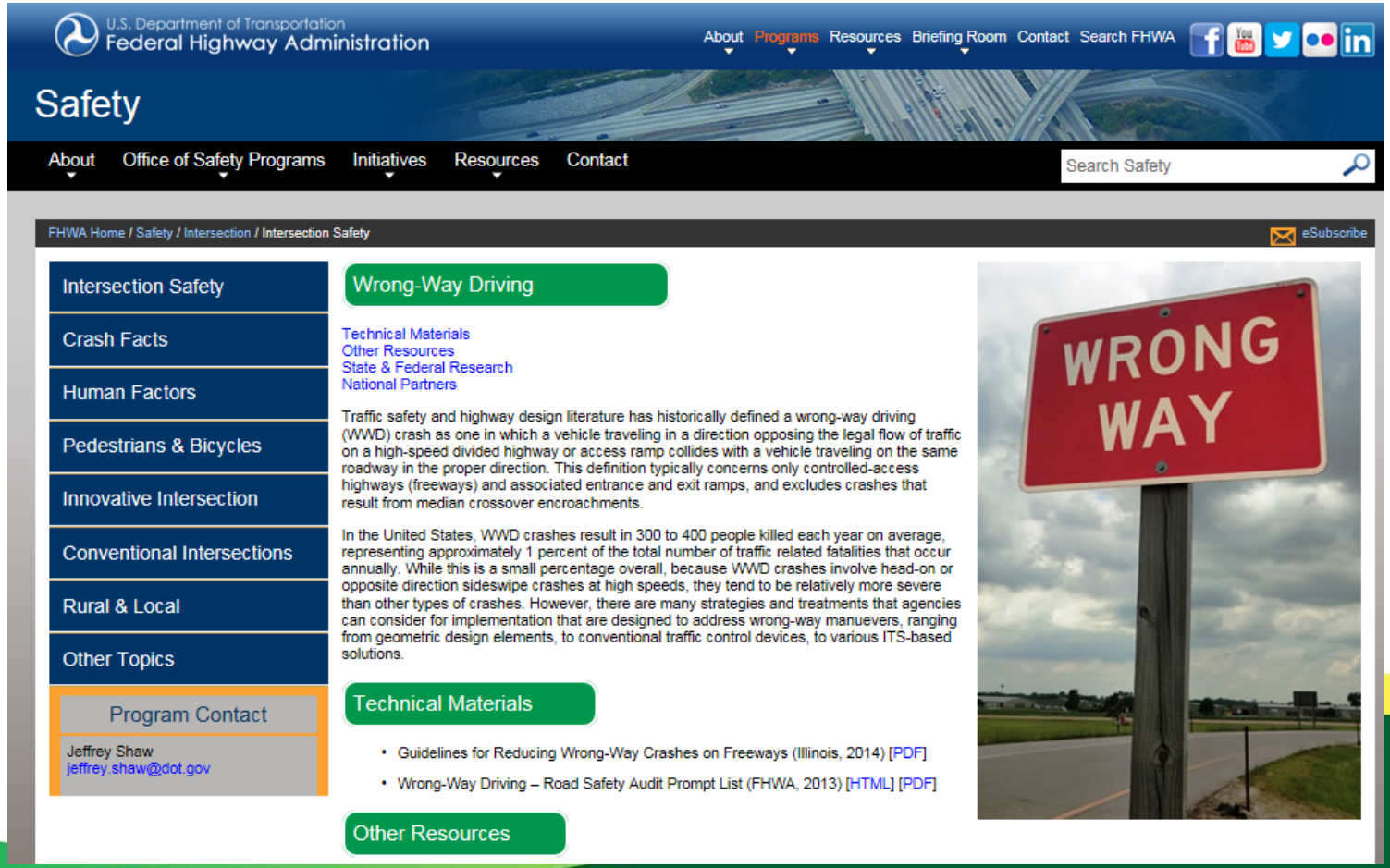
Emergency Response

Reframe the Thinking

- Avoid a “drivers fault” mindset
- There are actions that can be taken to address the problem proactively
- Apply pertinent Human Factors knowledge

Available Resources

safety.fhwa.dot.gov/intersection/other_topics/wwd/



Thank You!

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FHWA Office of Safety WWD Contact Information

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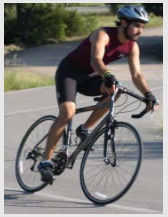


WRONG WAY DRIVER PROJECT

TxDOT San Antonio District – TransGuide

John Gianotti, P.E.

April 20, 2016

In Memory of Stephanie Brown

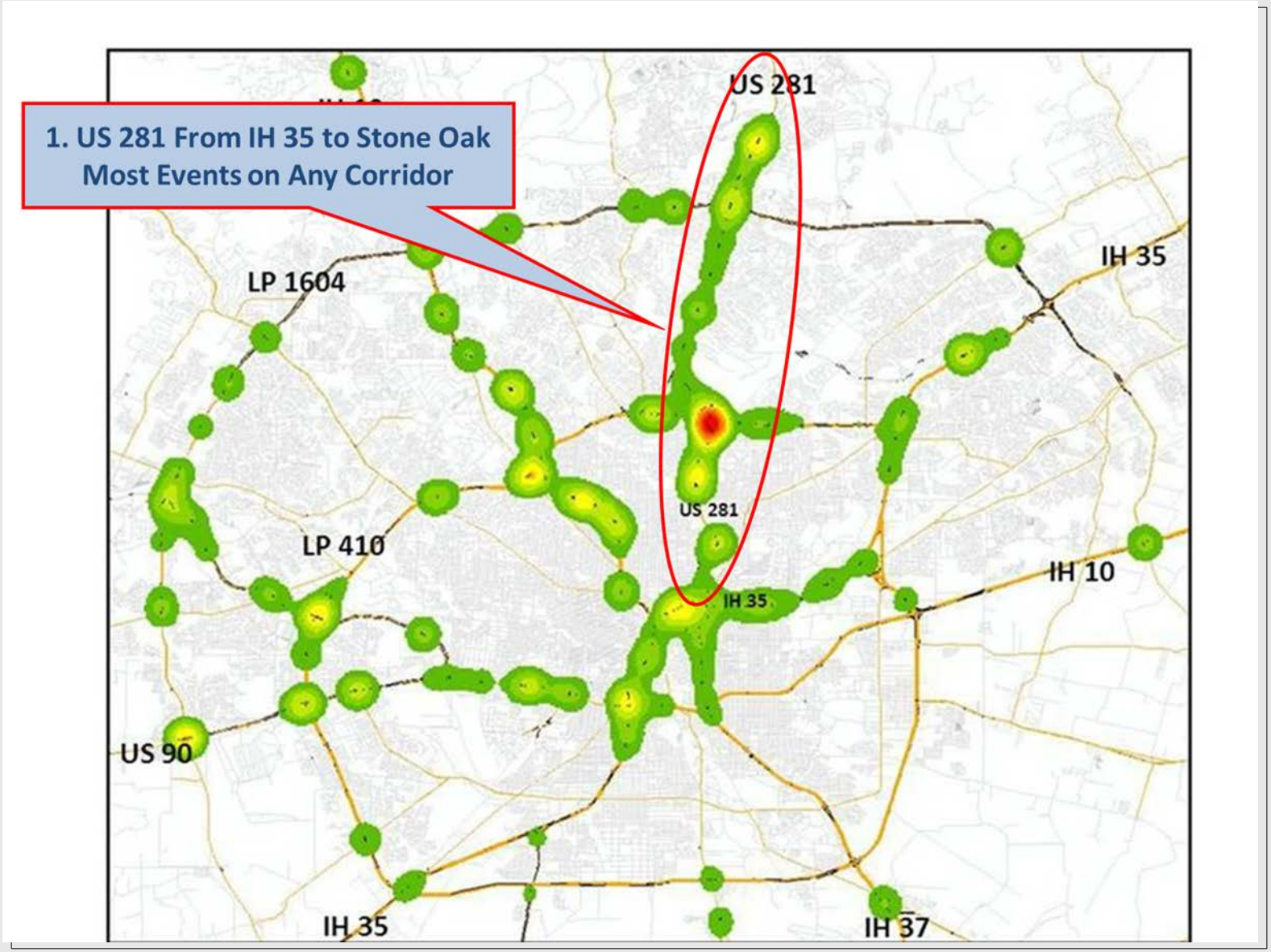
SAPD Officer Stephanie Brown (27 yrs old) killed by a WWD in the line of Duty March 15, 2011

What do we know ? WWD on IH 35 at 3 am – 4/1/14

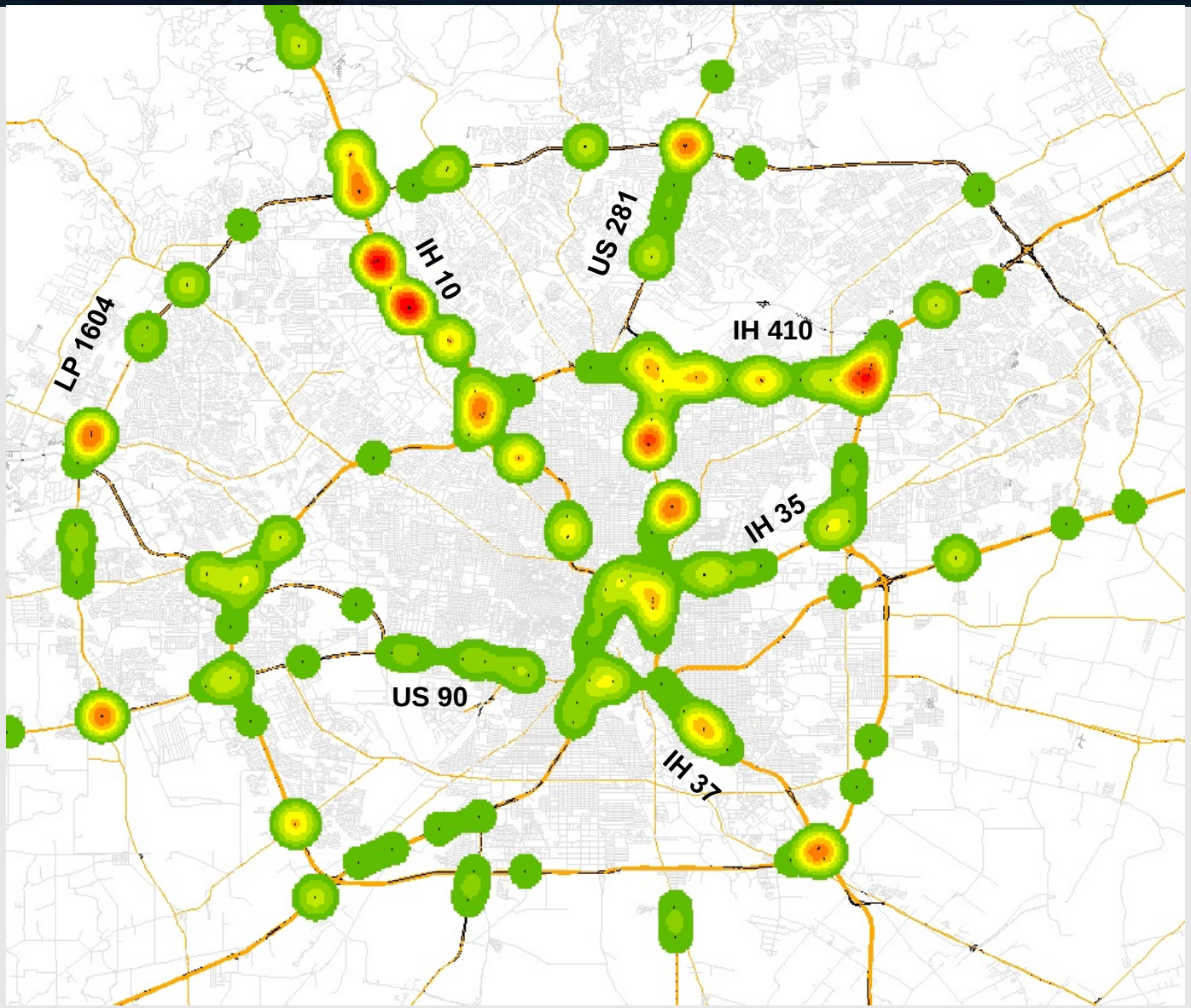
WWD on US 90 at 3:30 am – 4/19/14

WWD on IH 35 @ O'Connor, 4-18-15 at 1:55 am

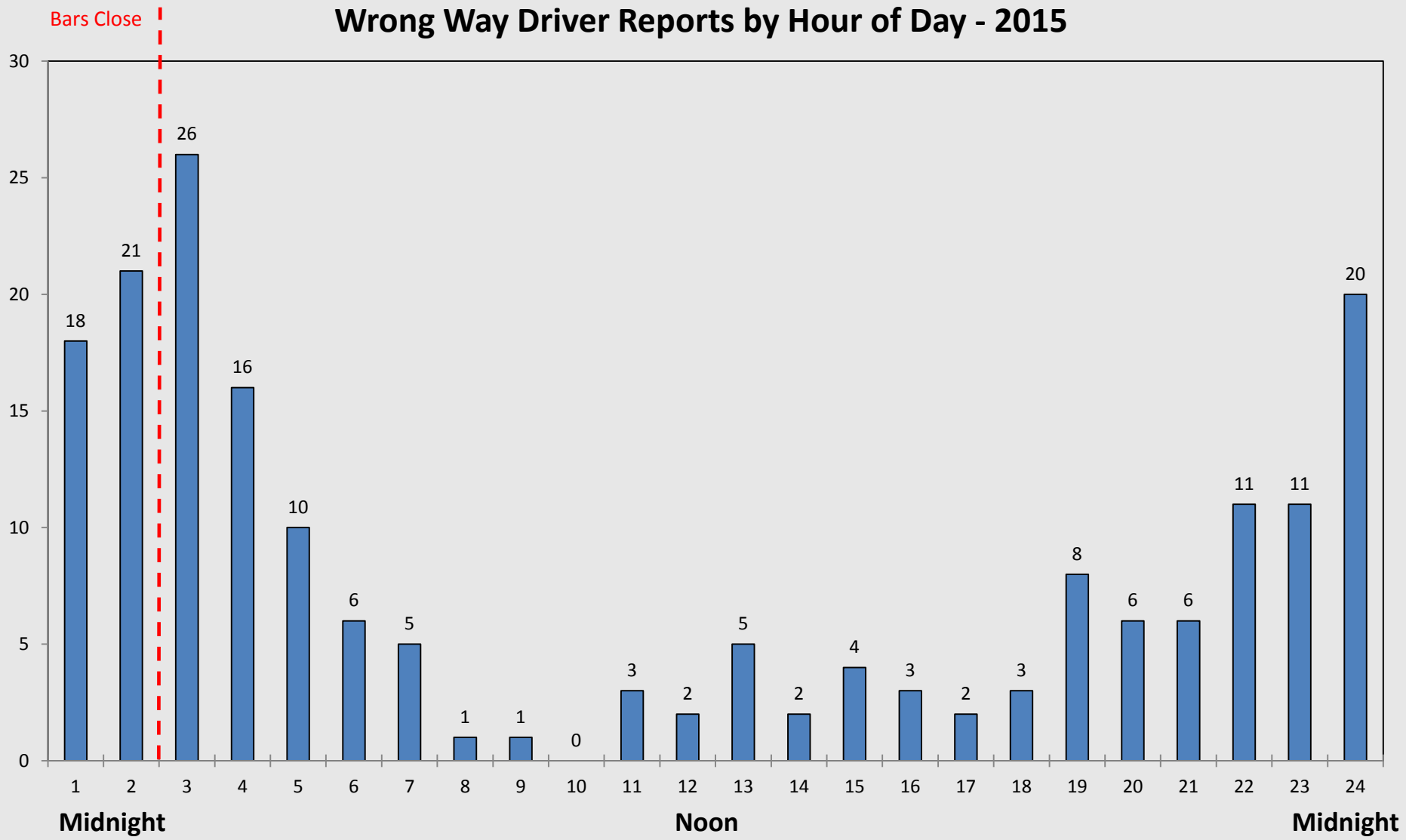
US 281 Pilot Project – 2011 data



2015 GIS Density Map



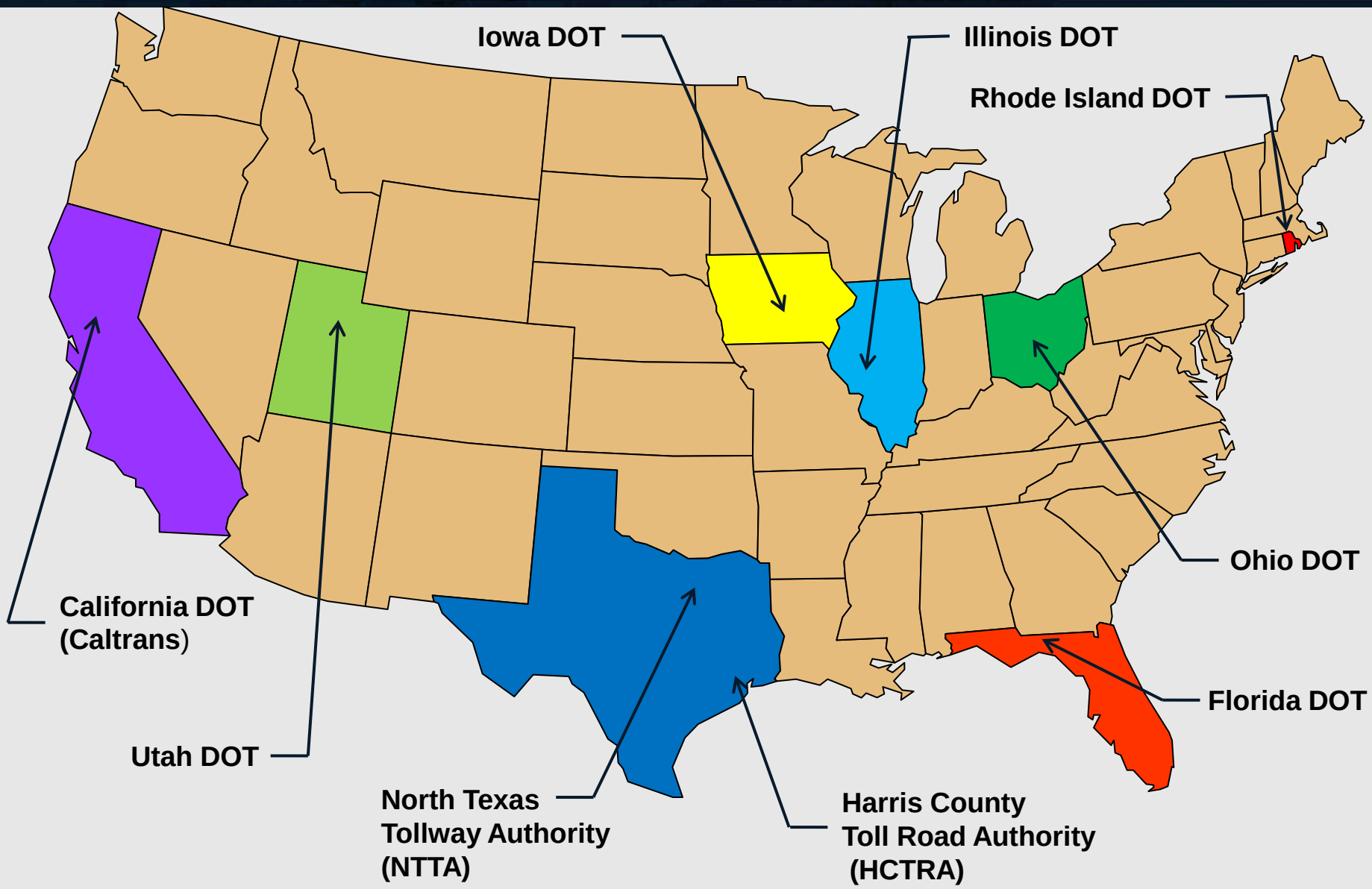
2015 WWD Statistics Reports by Hour of the Day



San Antonio Wrong Way Driver Task Force

- Challenges
  - Determining points of entry for WWDs
  - More than 400 exit ramps in San Antonio metro area
  - How to get the attention of drivers that are severely impaired
  - Manual of Uniform Traffic Control Devices compliance
  - Spike strips are not MUTCD compliant

Learn from others



What are we doing ? Wrong Way Driving Task Force

Organized in the spring of 2011 to examine factors contributing to wrong way driving and to identify methods of addressing wrong way drivers

Task Force Members

- Texas Department of Transportation
- San Antonio Police Department
- San Antonio Transportation and Capital Improvements (TCI)
- Bexar County Sheriff's Office
- Federal Highway Administration
- Texas A&M Transportation Institute

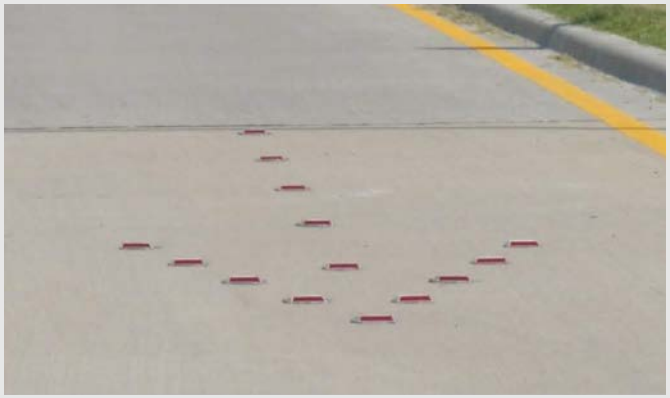
Enhanced Static Signing & Pavement Markings

- 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



Wrong Way Arrows
TxDOT Standard Sheet FPM (1)-12

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 now allows a 3 ft lowered sign height

2012-14 TTI WWD Study – WRONG WAY Sign Findings

- Takes longer to find sign at BAC 0.12 then at BAC = 0.04 and 0.08
- No difference in the time to identify the sign
  - Among treatments
  - Between sign heights
- Preference data did reveal some differences

Treatments	Thought Difficult to Find Sign
Standard	31%
Oversize	17%
Tape	13%
LED	13%

Treatments	Thought Caught Attention More
Oversize	92%
Tape	**88%**
LED	85%
2 FT	54%

DMS Wrong Way Driver Warning Message – May 2011

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

2012-14 TTI WWD Study – Warning Message Recommendations

- Recommended warning messages

WARNING WRONG WAY DRIVER REPORTED	WARNING WRONG WAY VEH REPORTED
> 15 characters per line	< 15 characters per line

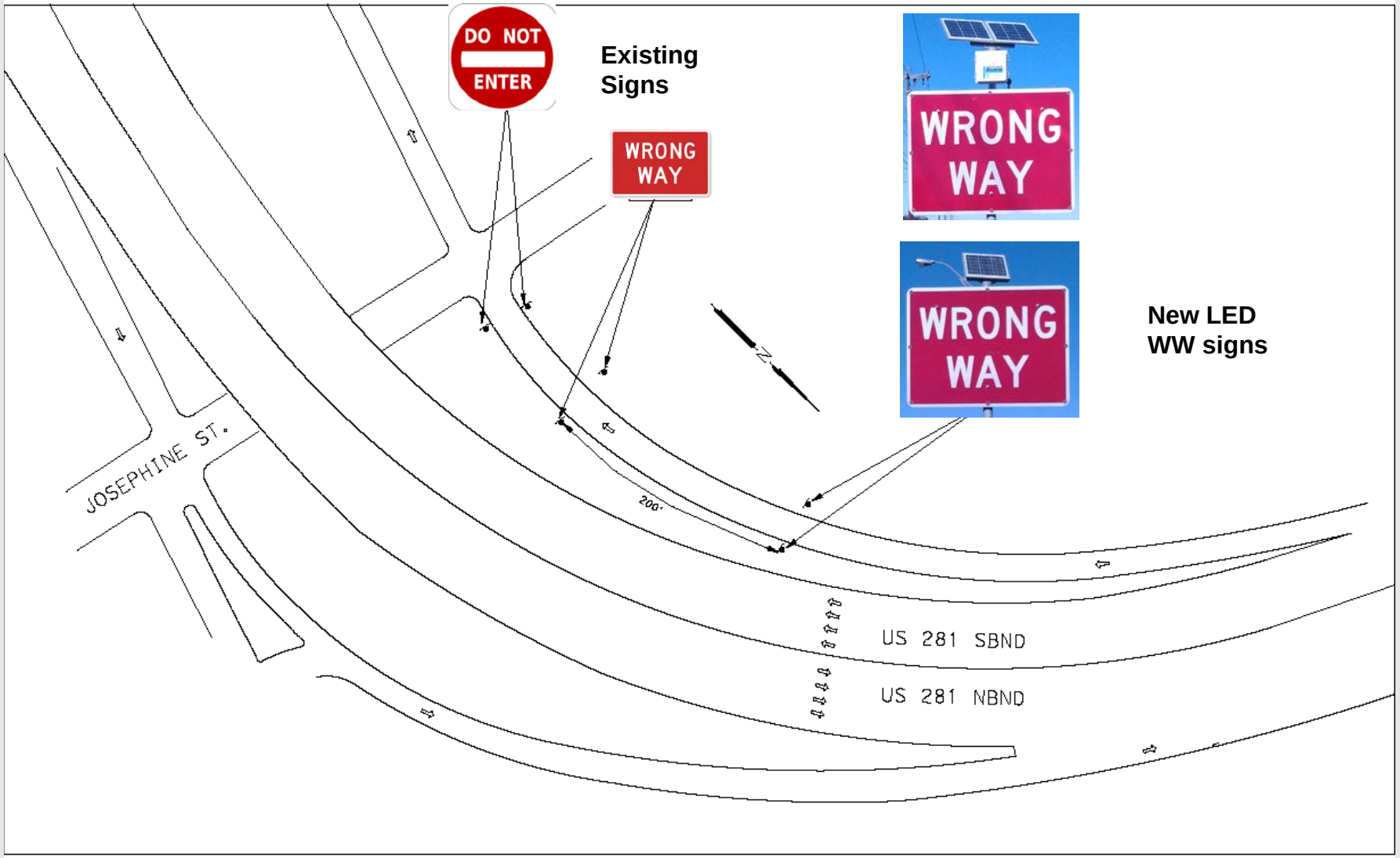
- Activate beacons when warning message displayed
  - Catch attention of motorists
  - Distinguish from other messages
- What if the sign does not have beacons?
  - Can flash entire message
  - Do not flash one line
- Post when wrong way driver reported
- Displayed in both directions of travel

Detection Technologies (Radar Sensors)

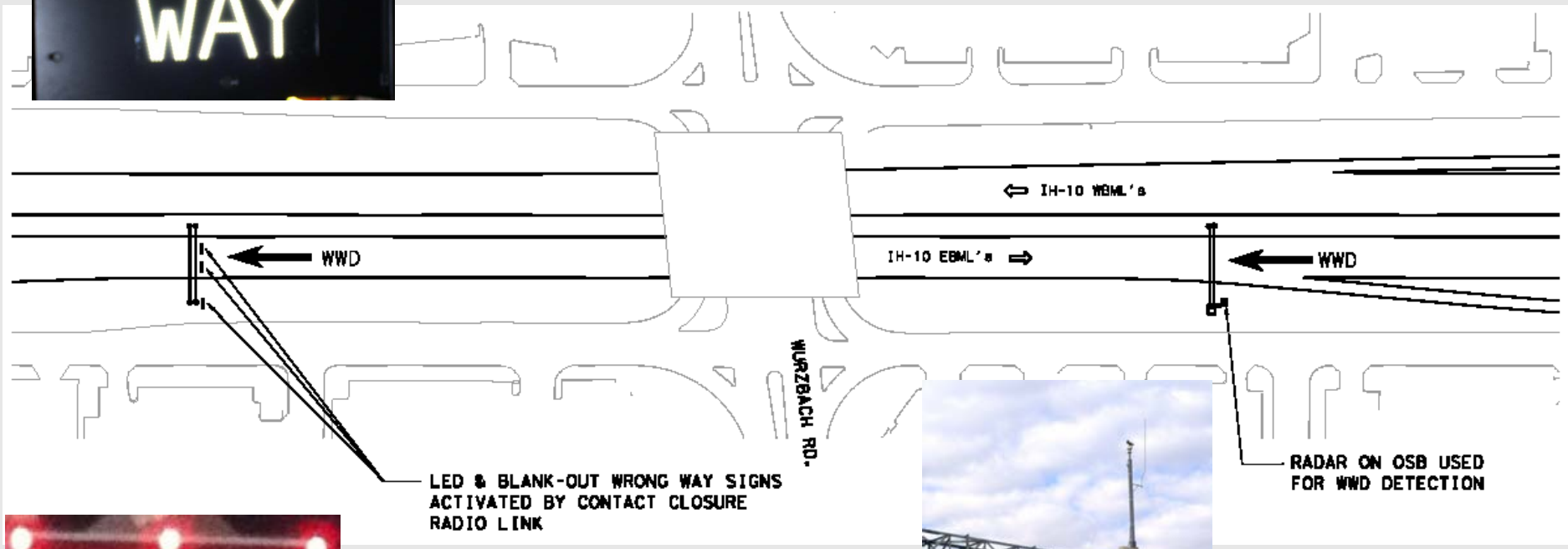
Radar on Exit Ramps

Radar on Mainlanes

Exit Ramp Counter measures



Mainlane Counter measures

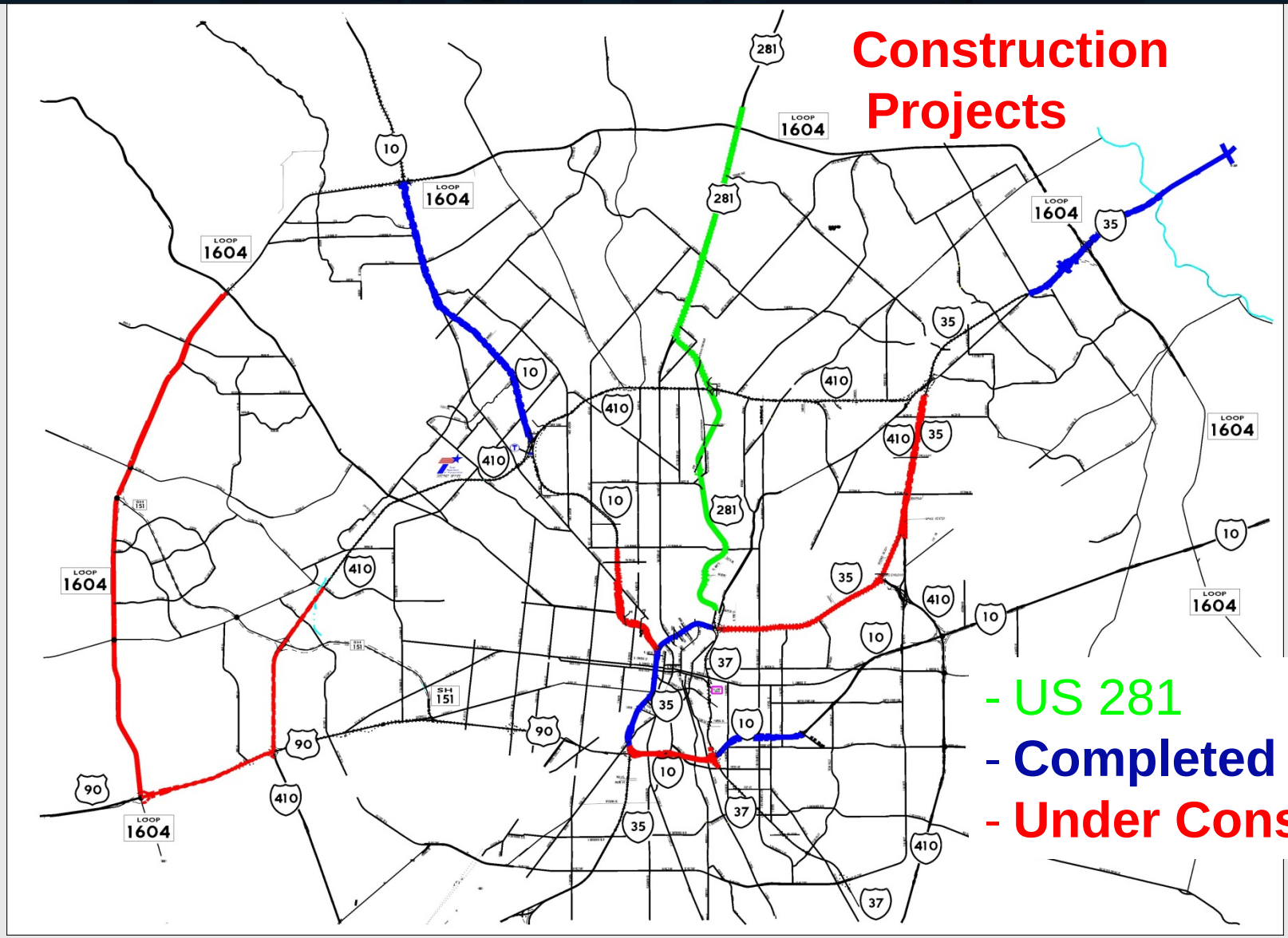


Mainlane Counter measures

US 281 Pilot Project - 44 Month Results

	July 2012 to March 2016
Reduction in Avg. Rate of WWD Events (TransGuide Logs)	34.62%
Reduction in Avg. Rate of WWD Events (SAPD 911 Logs)	31.19% (thru May 2014)
Project Cost	$377,605
Annual Cost Savings – Avg. of SAPD & TxDOT data	$280,282
Benefit - Cost ratio	14.8 : 1
Cost Recovery Time (yrs)	1.3

Where are we going ?



Detection methods

- Single point radars have proven to be unreliable for detecting WWD – too many false positives.
- Dual radars or detection at two points seem to more effective – TxDOT is just beginning to test the dual radar configuration.

New detection ideas or methods

- Dual radars
- Dual radars with a camera
- Radar/camera combination device
- Pods in the pavement for detection
- Loops in the pavement

SAVING LIVES

53 Serious crashes have been prevented since 2011 by TRANSGUIDE OPERATORS, SAPD DISPATCHERS AND OFFICERS.

TRANSGUIDE OPERATORS

David Rodrigues, Ben Lopez, Mando Rodriguez, Louis Ugarte, Crystal King, Mike Barker, Ishmael Trevino, Jason Wells, Christine Jauregui, Don Deaton

SAPD DISPATCHERS

Michael Summers, Stephanie Hovis, Ashley Hard, Dawn Campbell, Scott Arnold

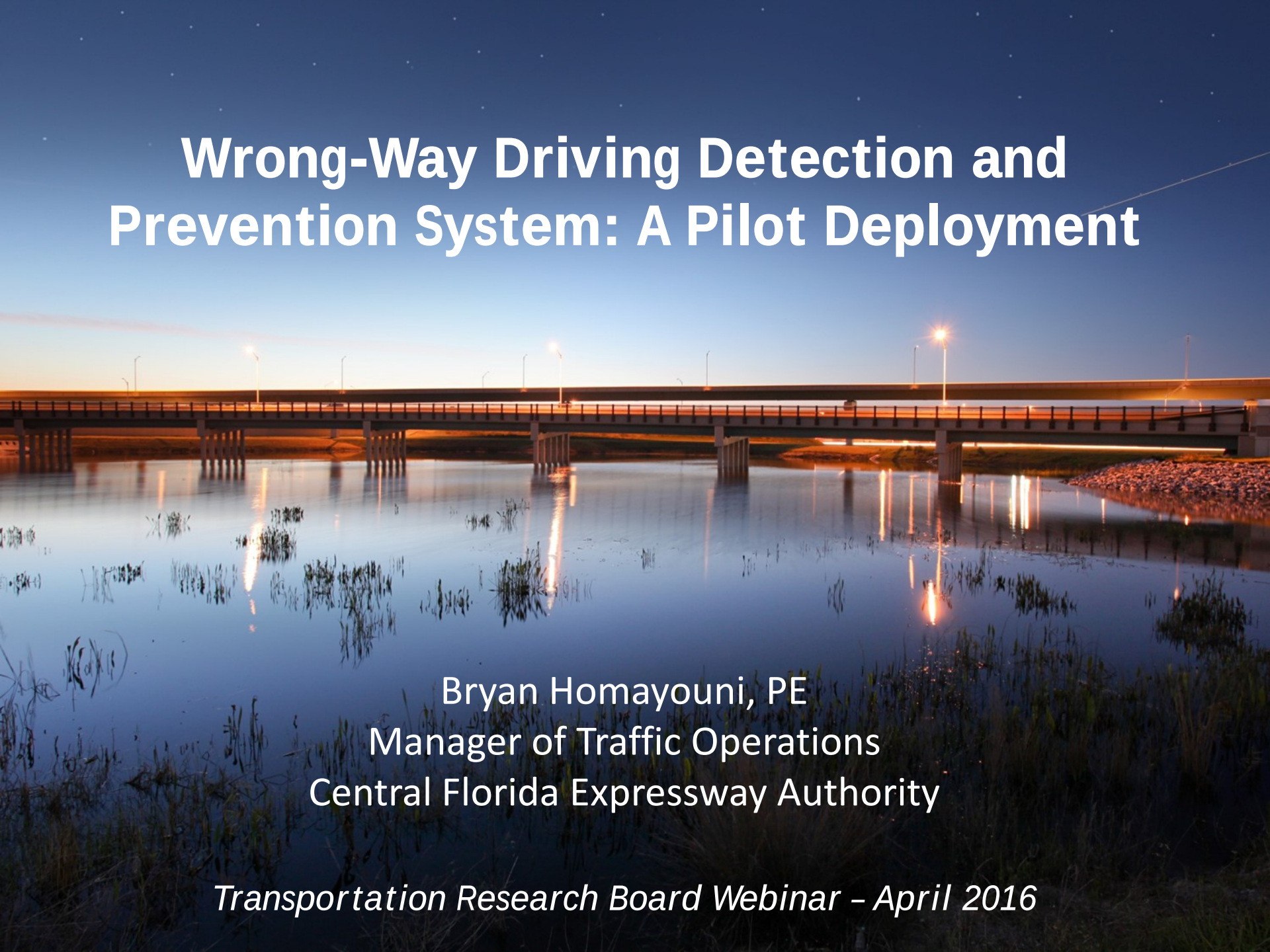
Thank you

John Gianotti, P.E.

john.gianotti@txdot.gov

2015 National Roadway Safety Award Winner

TxDOT San Antonio District TransGuide Office Wrong Way Driver Program



Wrong-Way Driving Detection and Prevention System: A Pilot Deployment

Bryan Homayouni, PE
Manager of Traffic Operations
Central Florida Expressway Authority

Transportation Research Board Webinar – April 2016

ABOUT US

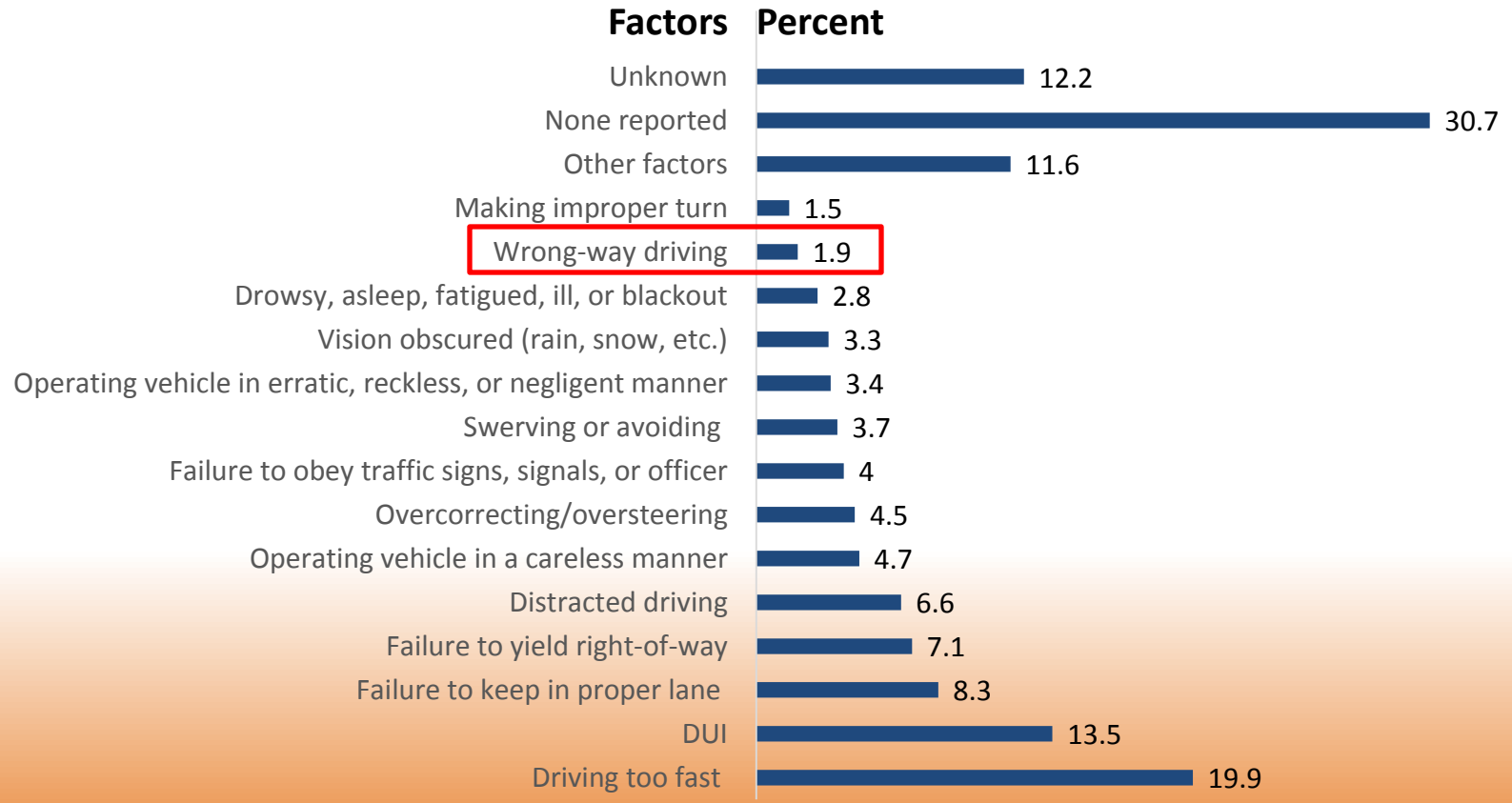
- Created as OOCEA in 1963
- Became Central Florida Expressway Authority on June 20, 2014
- Orlando metropolitan area
- CFX operates:
  - 109-centerline miles of expressway
  - 13 mainline toll plazas
  - Over 1,300,000 weekly transactions

WRONG-WAY DRIVING STATISTICS

- Wrong-way collisions:
  - 3% of crashes on high-speed divided highways
  - 12-27 times higher fatality rate than other types of accidents
- Nationally:
  - 1,566 fatal wrong-way crashes on limited-access highways (2004-2009)
  - 2,139 fatalities (2004-2009)
  - Averages 261 fatal collisions nationally (2004-1011)
  - Averages 360 fatalities per year (2004-2011)

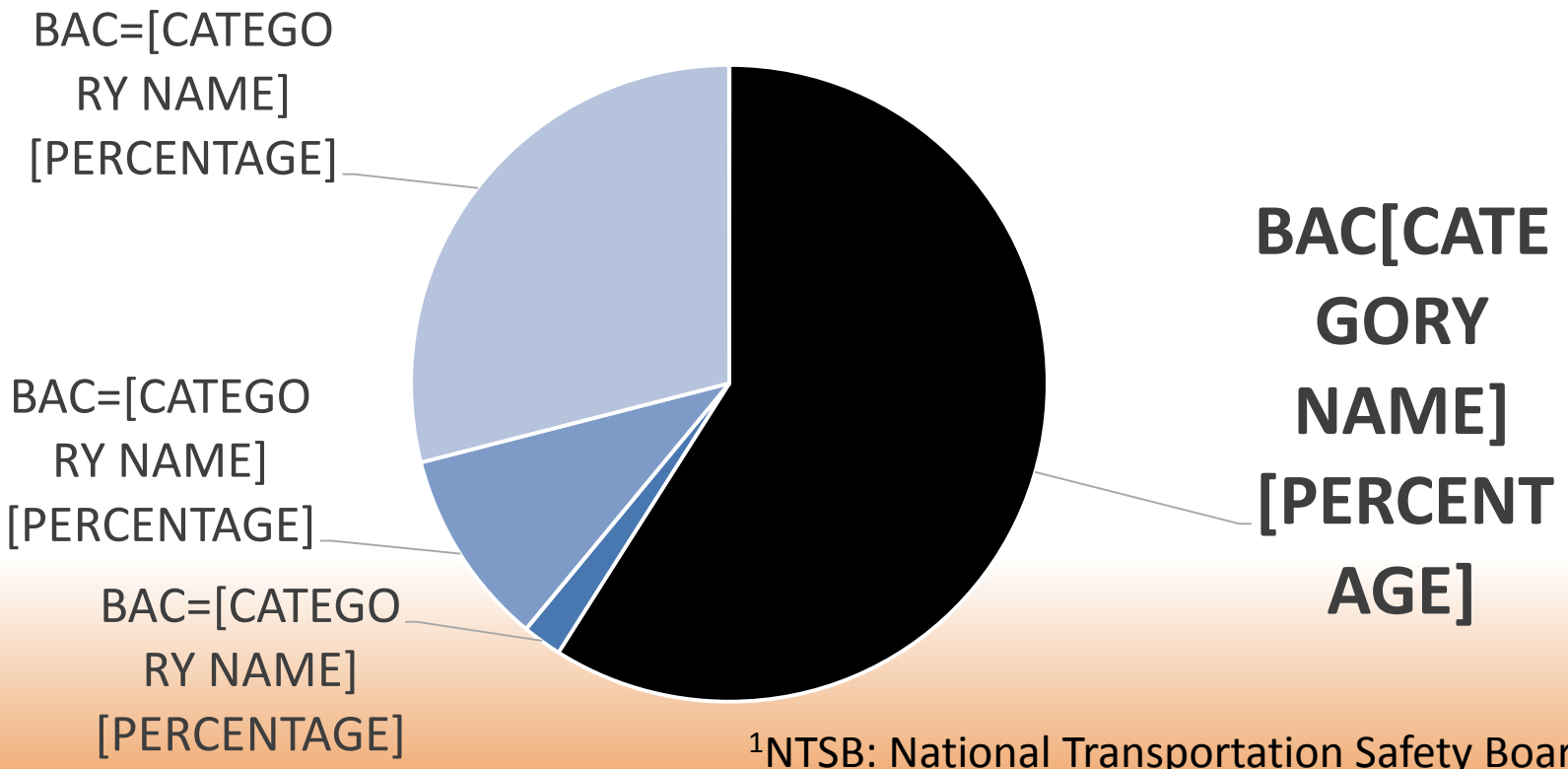
WRONG-WAY DRIVING STATISTICS

Related Factors for Drivers and Motorcycle Riders Involved in Fatal Crashes, 2013
FARS/GES 2013 Data Summary (USDOT)



WRONG-WAY DRIVING STATISTICS

NTSB[1] analysis of FARS[2] data (2004-2009) showing reported blood alcohol concentration (BAC) levels of wrong-way drivers



[1]NTSB: National Transportation Safety Board
[2]FARS: Fatality Analysis Reporting System

STUDYING WRONG-WAY DRIVING ON CENTRAL FLORIDA EXPRESSWAYS

- Research study conducted by the University of Central Florida (UCF)
- Examination of:
  - Crash statistics
  - Citations
  - Reported WWD driving activity
  - Telephone survey of CFX customers
- Based on results of telephone survey:
  - Estimated that only 10% of drivers who see WWD activity call 911
  - WWD driving activity may be under-reported
  - Data collection required to determine the full extent of the problem

STUDYING WRONG-WAY DRIVING ON CENTRAL FLORIDA EXPRESSWAYS

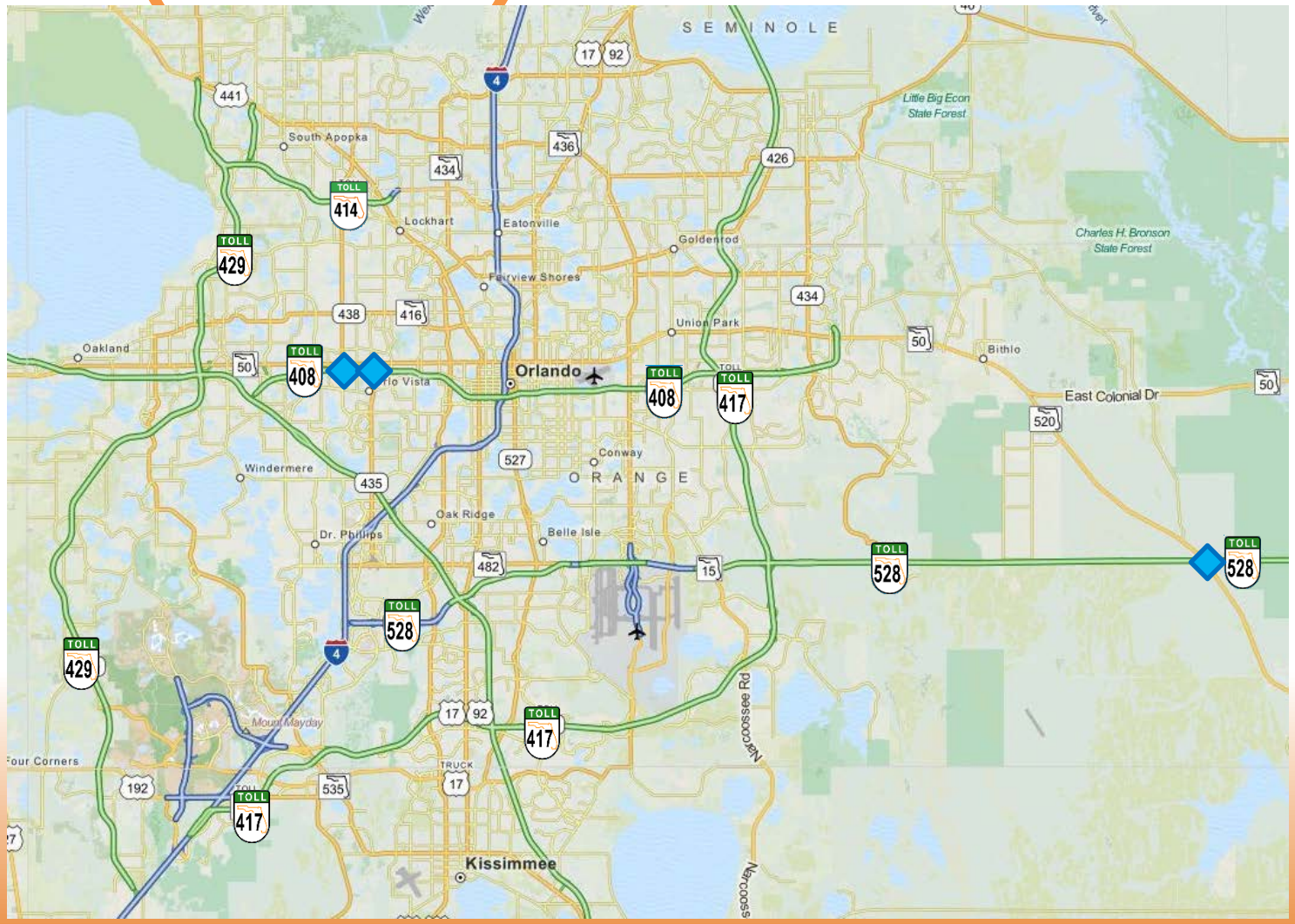
- Study recommended a pilot deployment of WWD countermeasures equipment
- Pilot deployment will:
  - Test RRFB countermeasures
  - Collect data to help CFX determine the extent of WWD activity at the pilot locations
- Study led to a model for predicting number of crashes associated with WWD on CFX network

Picture courtesy of UCF (Concept Slide Produced by UCF and Presented to CFX in Spring 2013)

PARTNERS

- U.S. Department of Transportation Federal Highway Administration
- University of Central Florida (UCF)
- Florida Highway Patrol (FHP)
- Florida Department of Transportation (FDOT)
- Central Florida Expressway Authority (CFX)

CURRENT DEPLOYMENT SITES (PHASE 1)



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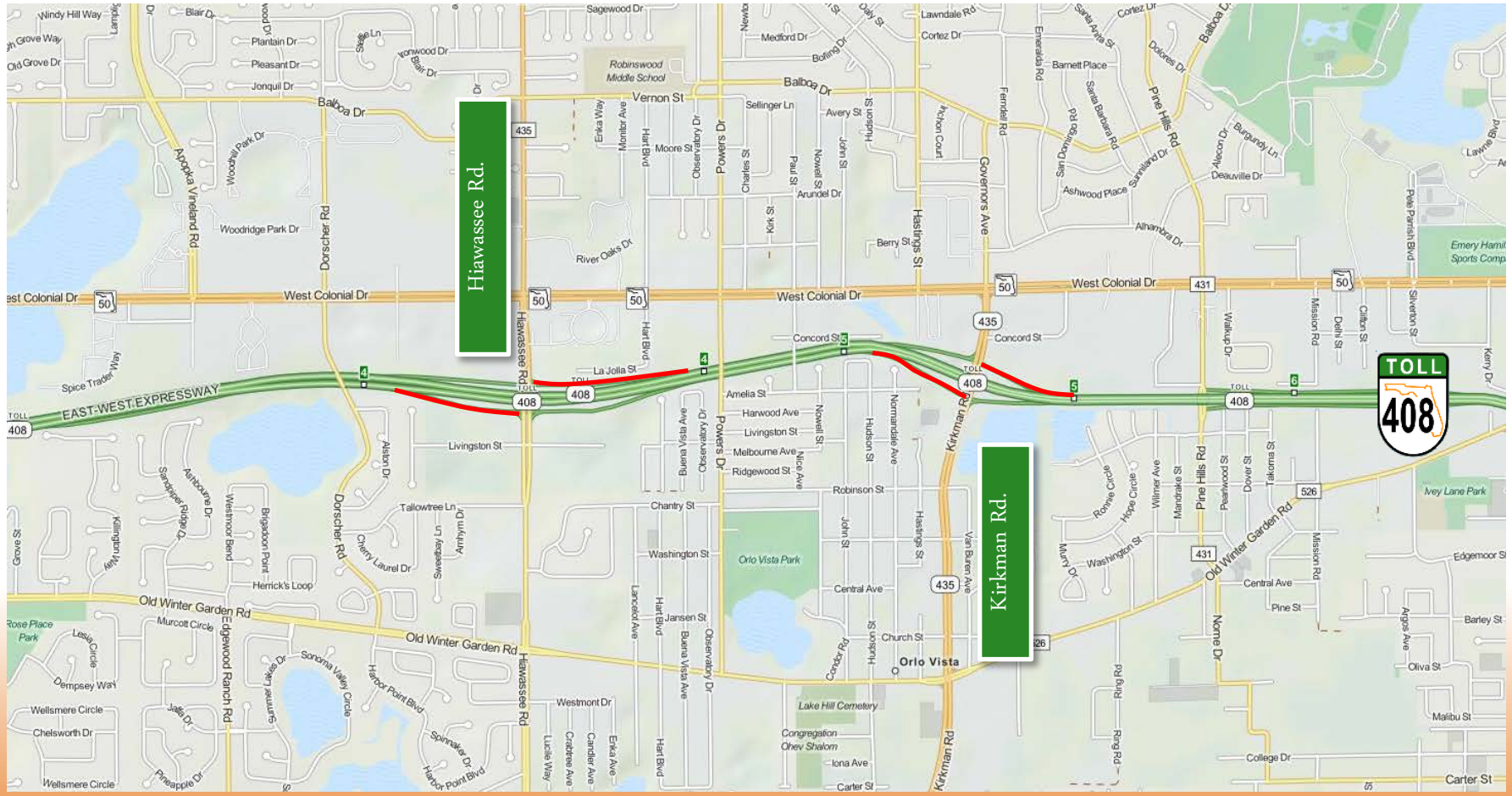

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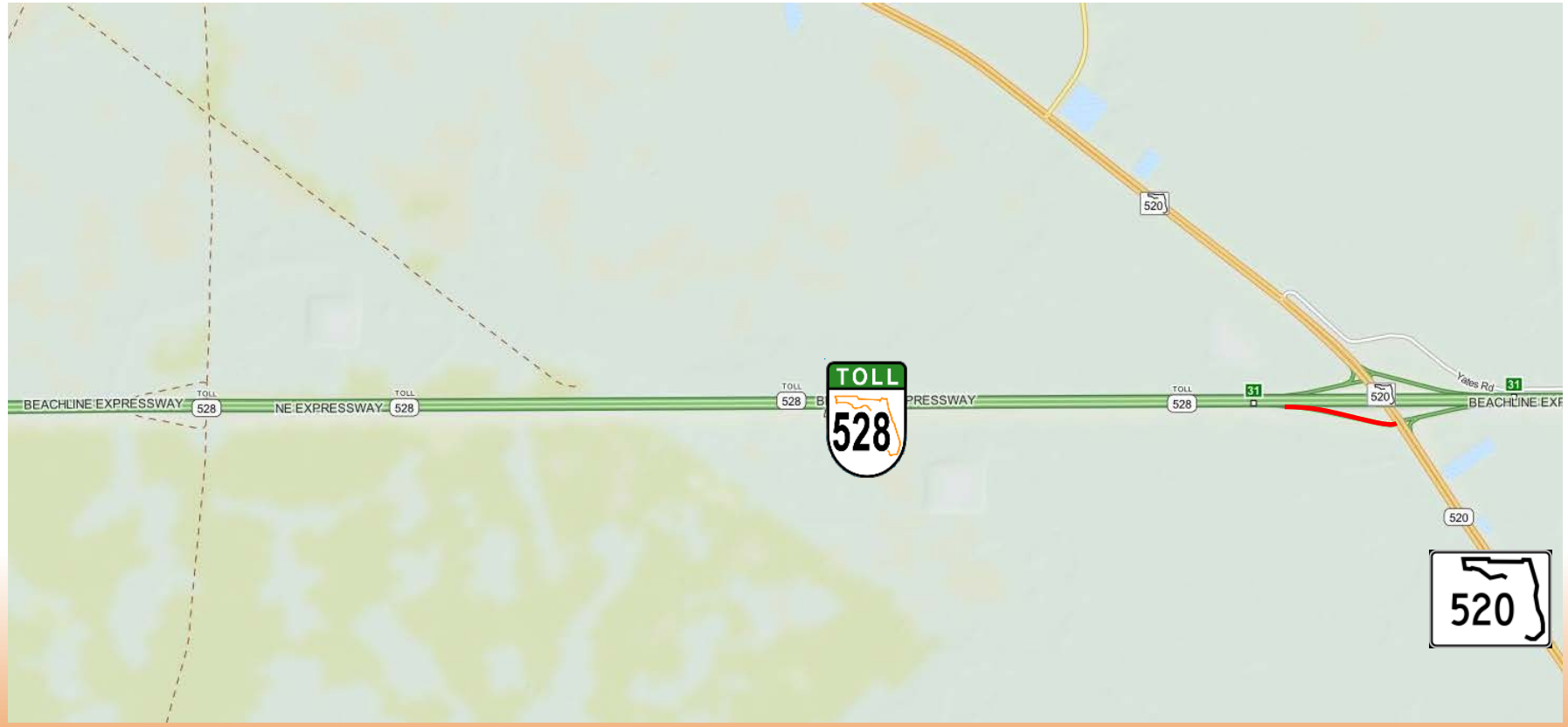


PARKING LOT TESTING

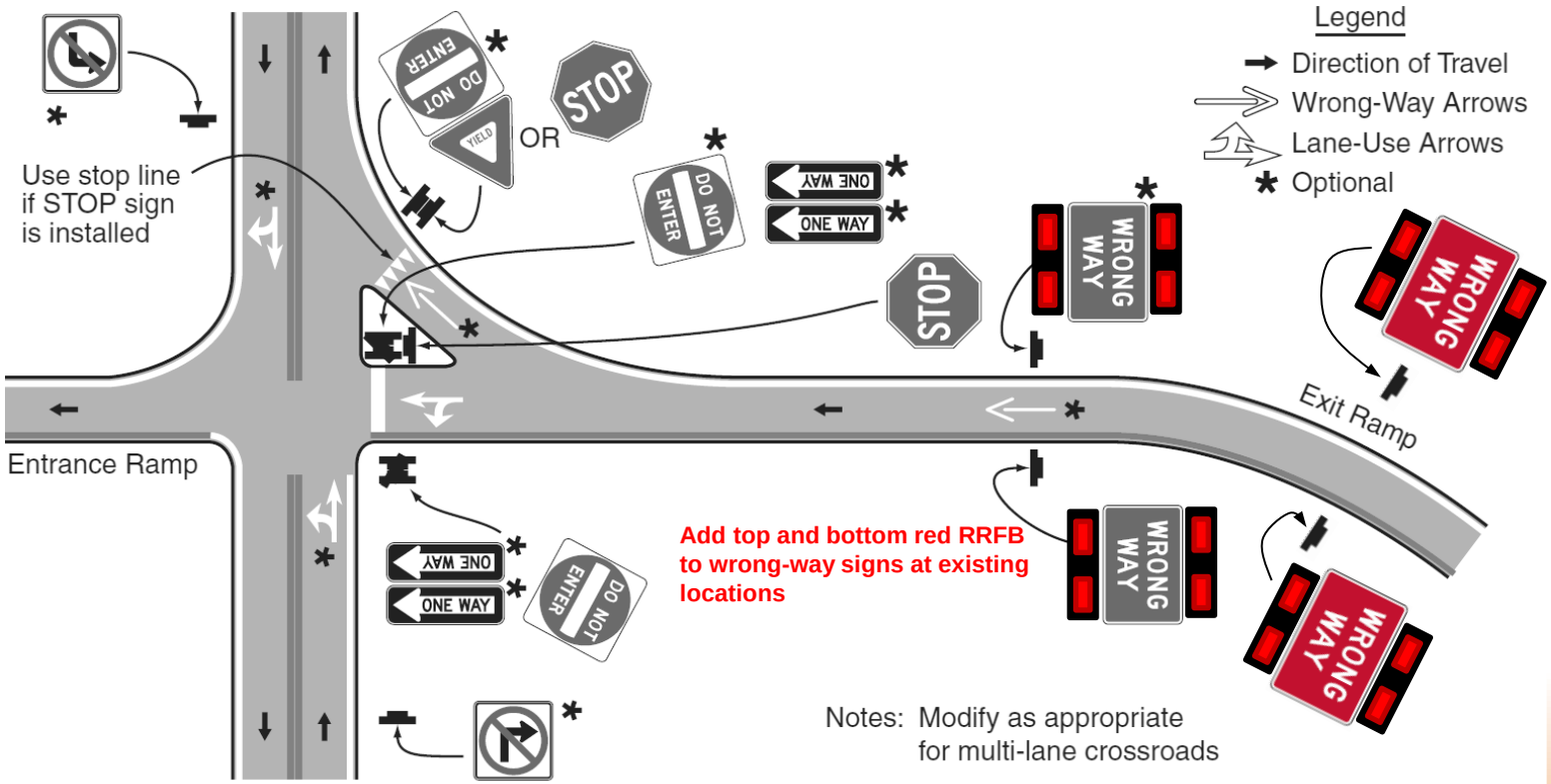
- Temporary parking lot test conducted to verify technology
- Tested visibility of beacons during day and night conditions
- Experimented with radar detection zones in a controlled environment

PARKING LOT TESTING

PRELIMINARY LESSONS-LEARNED

- Two light bars per sign (top and bottom) will be used to improve visibility of beacons
  - Initial test only had one light bar
- Two pairs of signs will be deployed at each ramp (beacons at the remote pair slaved to the first pair)
  - Provides enhanced visibility of warning in the event the driver passes the first sign before beacon activation

RAMP DETECTION EQUIPMENT



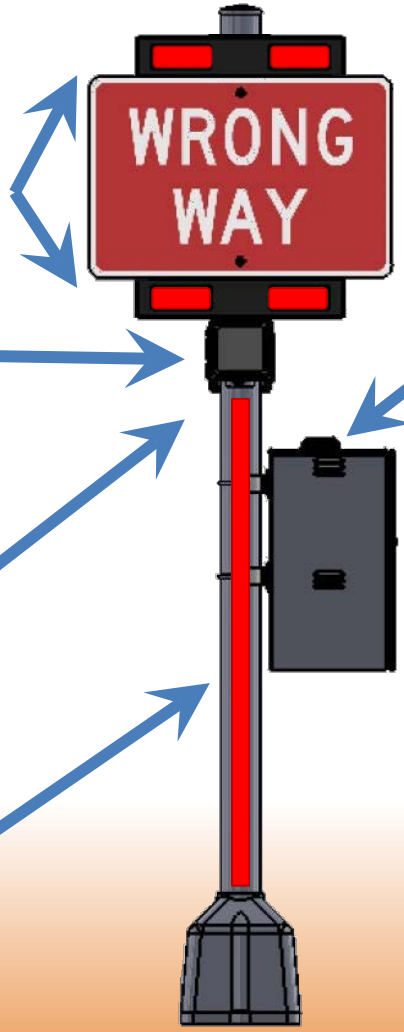
RAMP DETECTION EQUIPMENT

Red rectangular rapid flash beacons (RRFB) (two bars per sign)

Radar (one forward-facing, one rear-facing)

Camera (one forward-facing, one side-facing)

Retroreflective red tape on pole



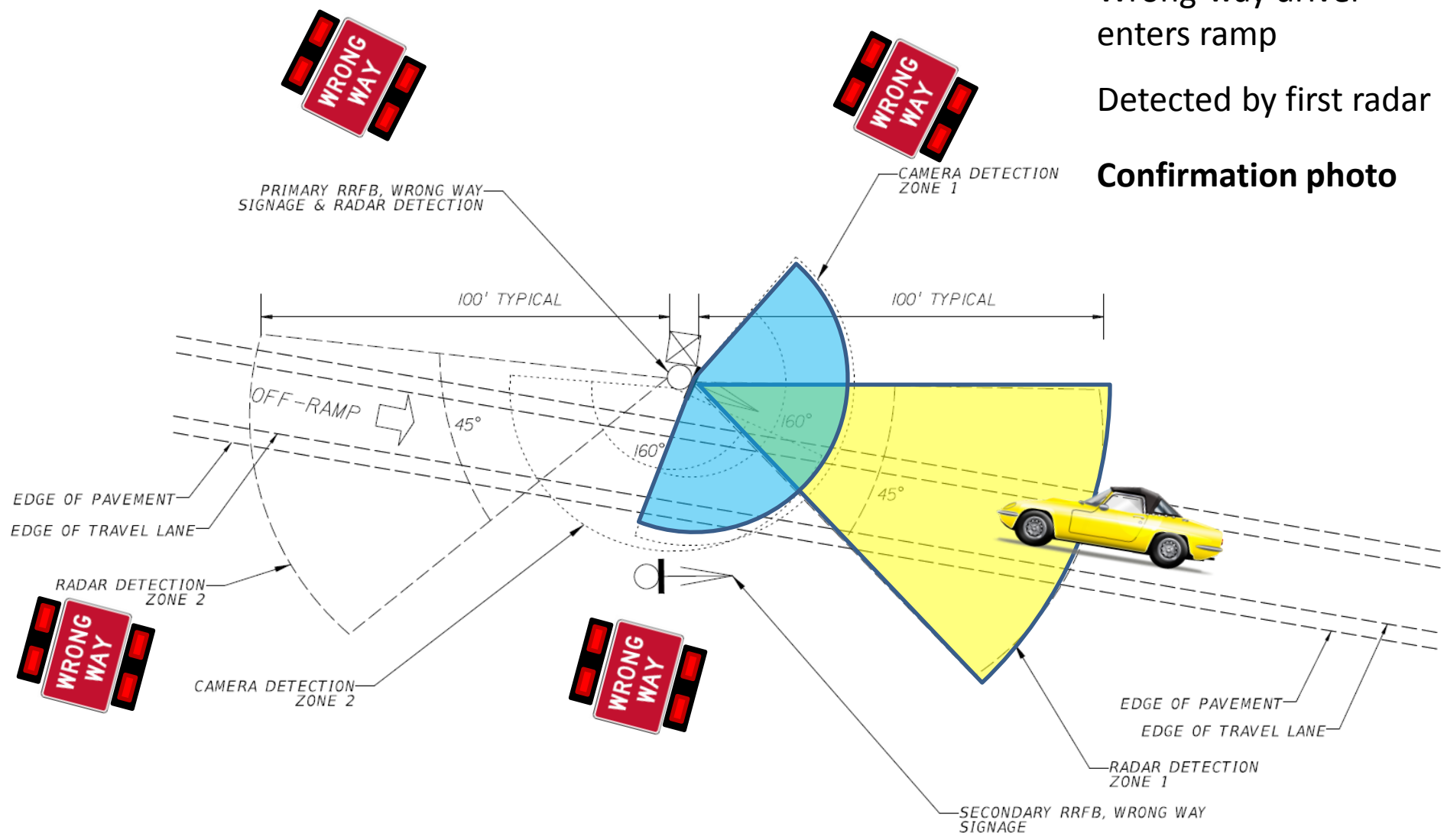
Cellular modem antenna

RAMP DETECTION EQUIPMENT

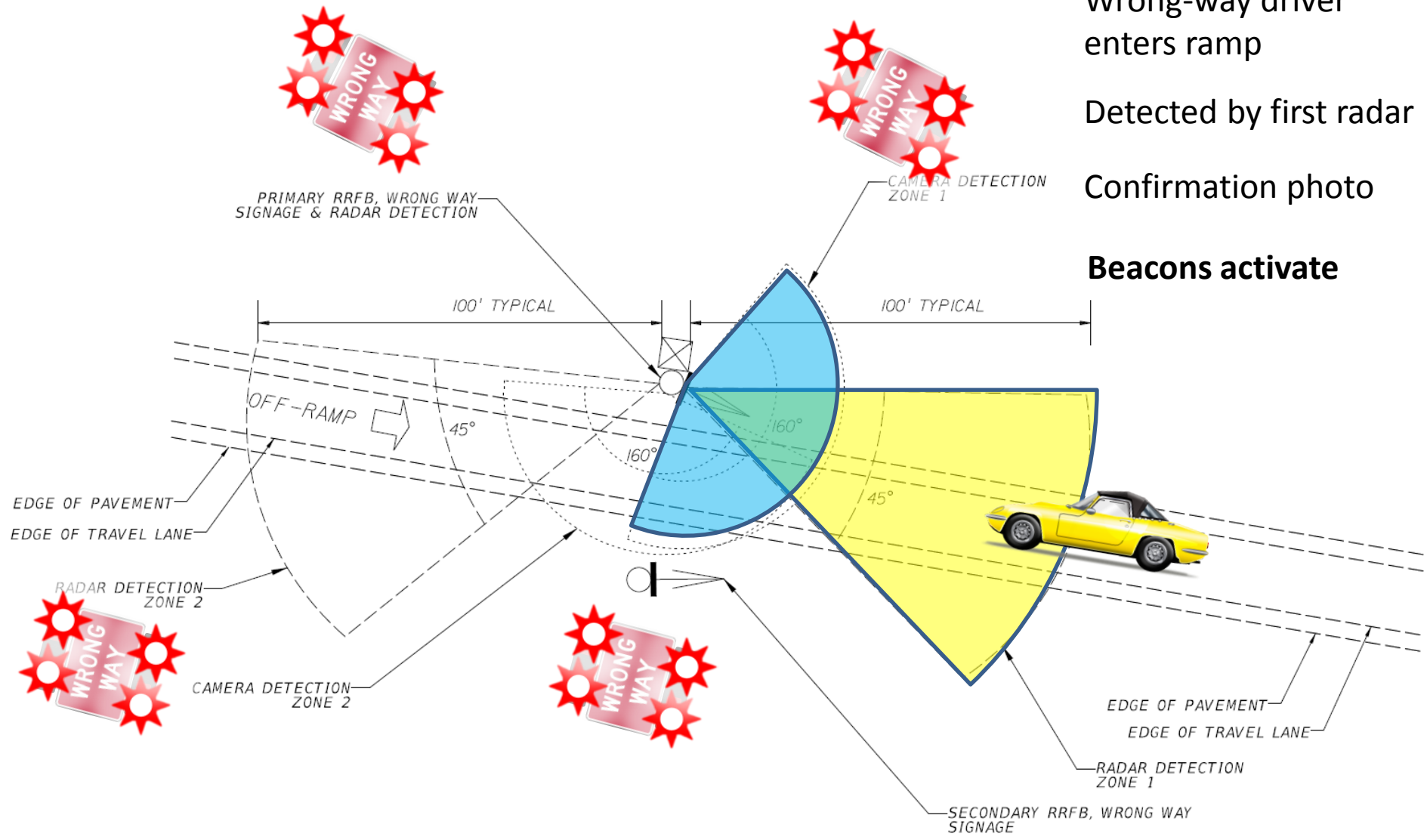
Wrong-way driver enters ramp

Detected by first radar

Confirmation photo



RAMP DETECTION EQUIPMENT



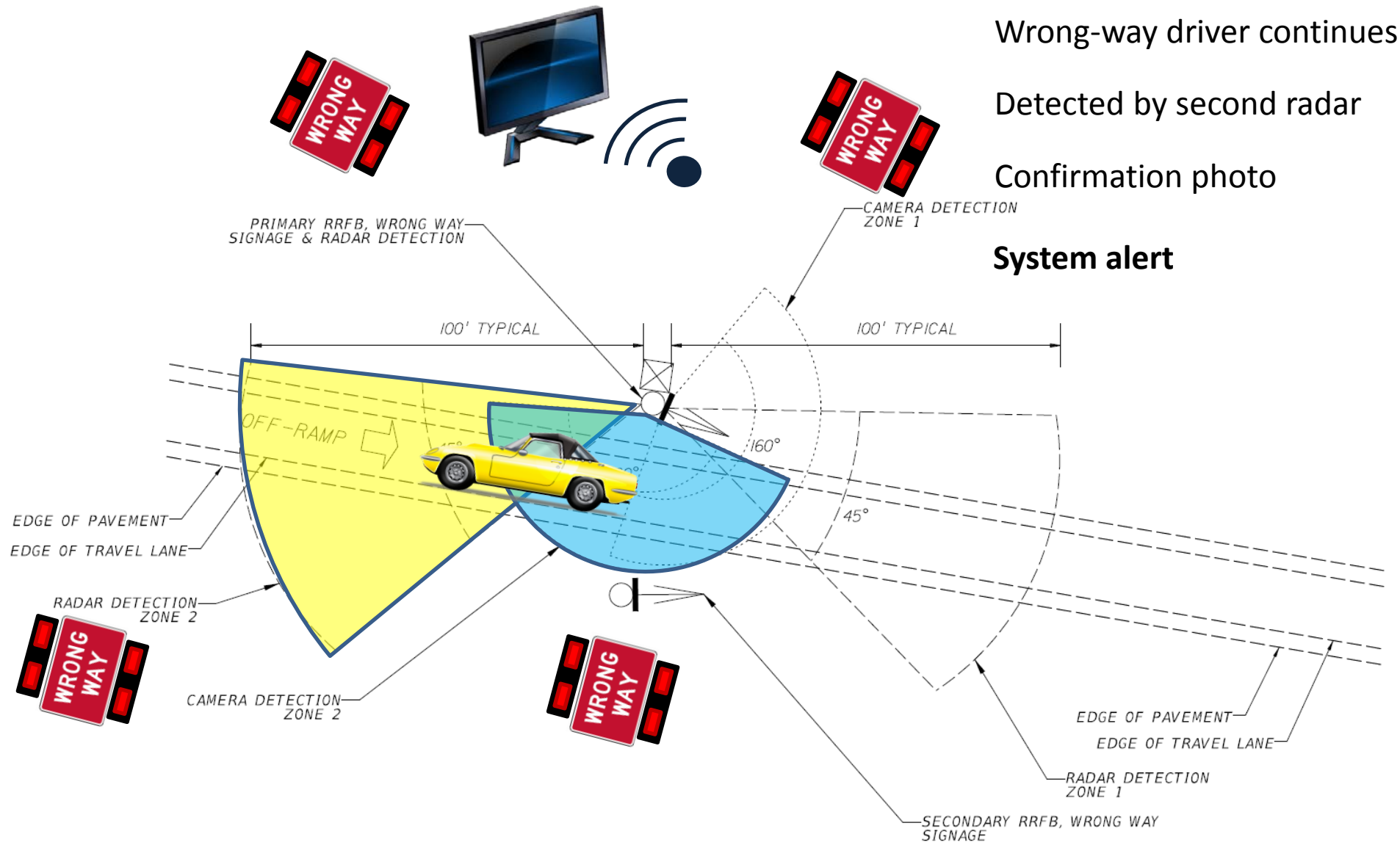
Wrong-way driver enters ramp

Detected by first radar

Confirmation photo

Beacons activate

RAMP DETECTION EQUIPMENT



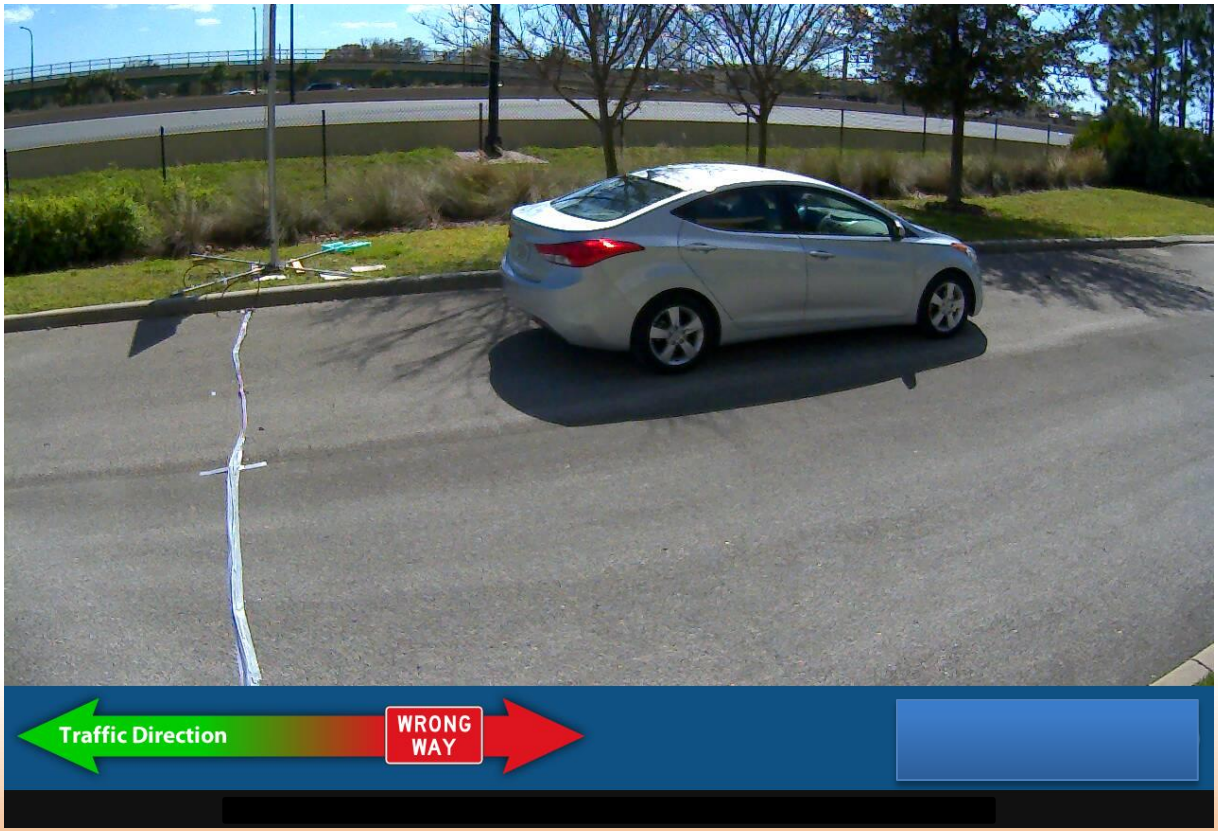
Wrong-way driver continues

Detected by second radar

Confirmation photo

System alert

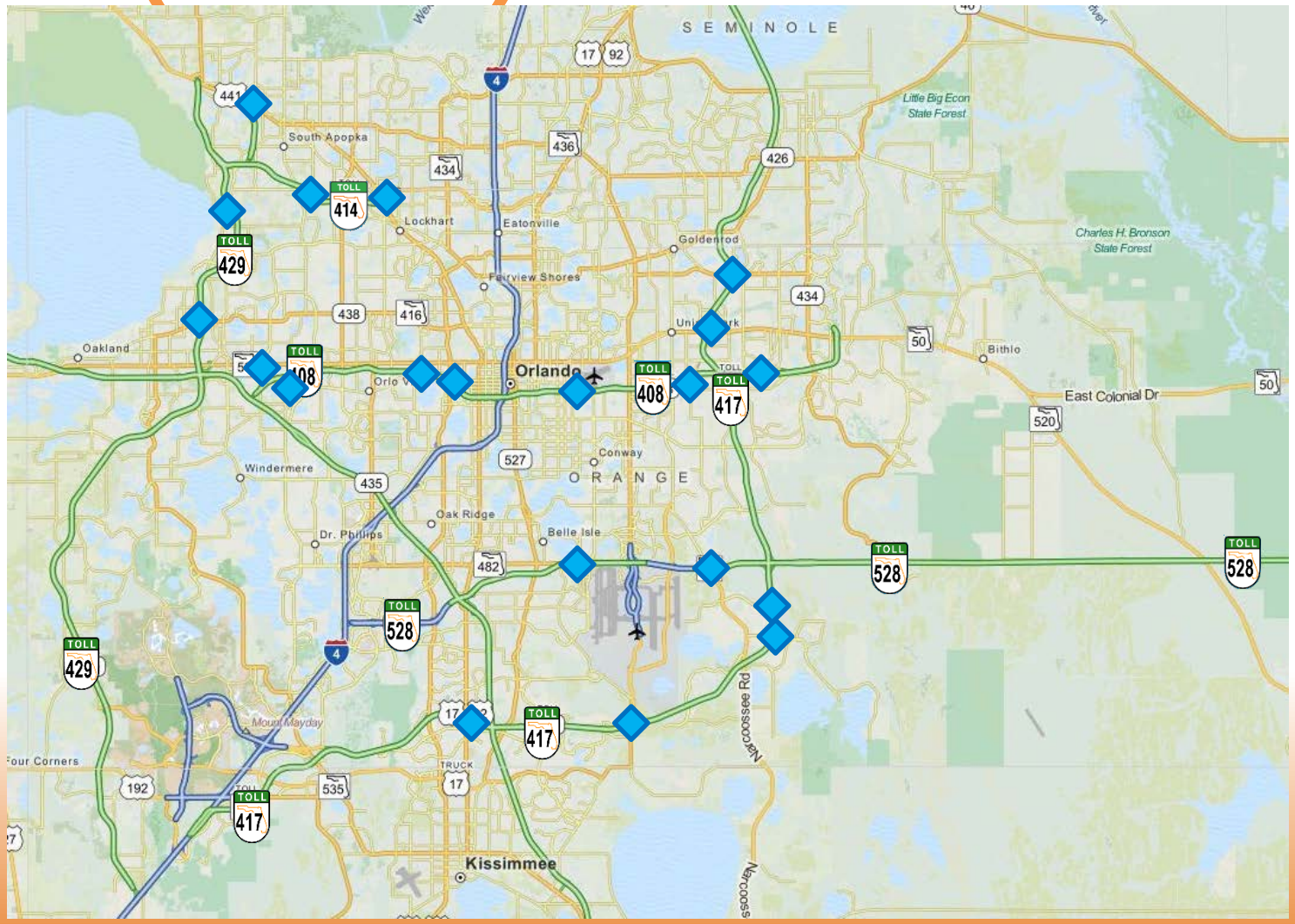
WRONG-WAY DRIVER CONFIRMATION ALERT



STATUS OF PROJECT

- Ramp 1 (Phase 1):
  - Installed January 2015
- Ramps 2-5 (Phase 1):
  - Installed June 2015
- 19 Additional Ramps (Phase 2a):
  - Construction Notice to Proceed in April 2016
  - Anticipated completion by end of summer 2016
- 10 Additional Ramps (Phase 2b):
  - Design complete; advertised for construction in April 2016
  - Construction Notice to Proceed targeted for summer 2016

FUTURE DEPLOYMENT SITES (PHASE 2)



ONGOING ACTIVITY

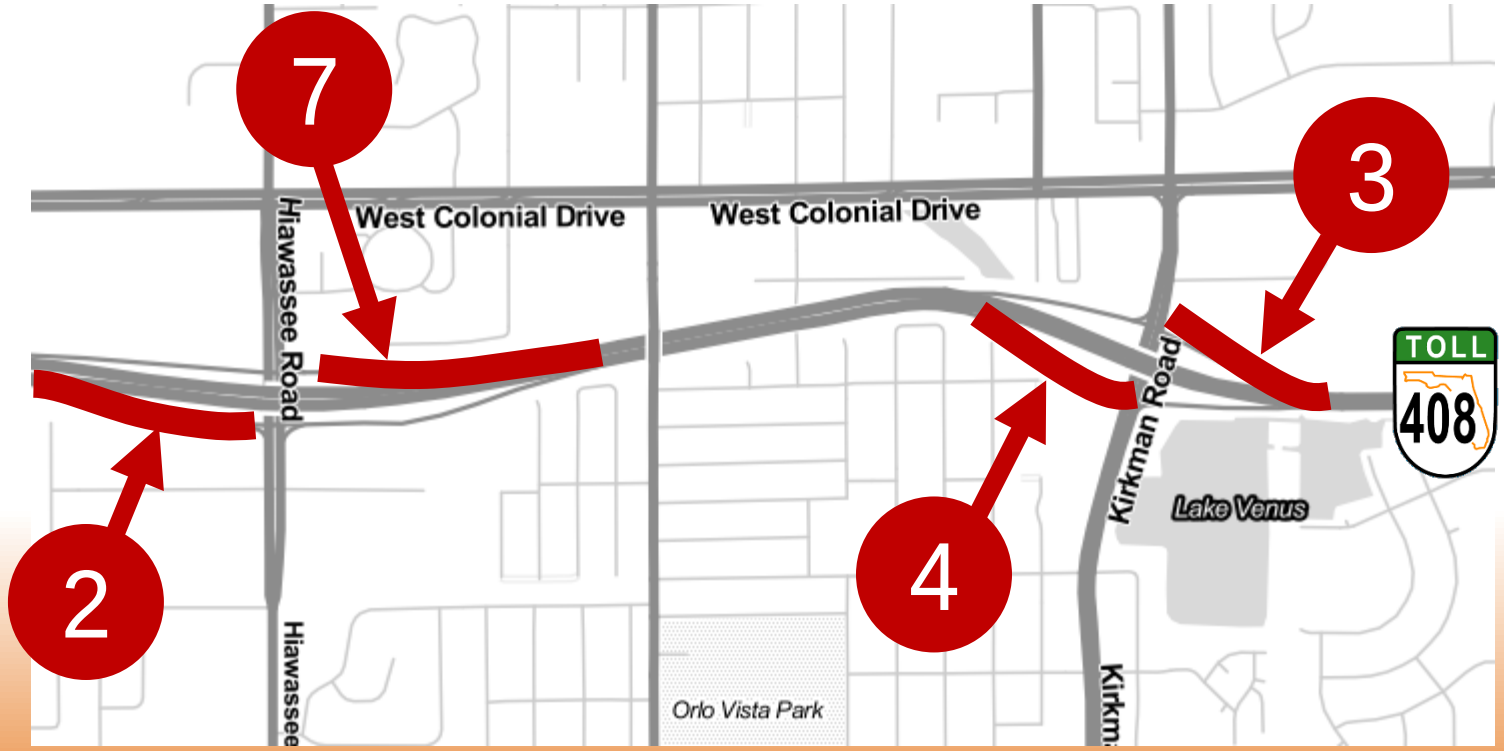
- Coordinating with partners
- Posting messages to CFX dynamic message signs for right-way drivers
  - SR 528 at 520
  - SR 408 at Kirkman and Hiawassee
- Phase 2 deployment underway

SR 408 TESTING

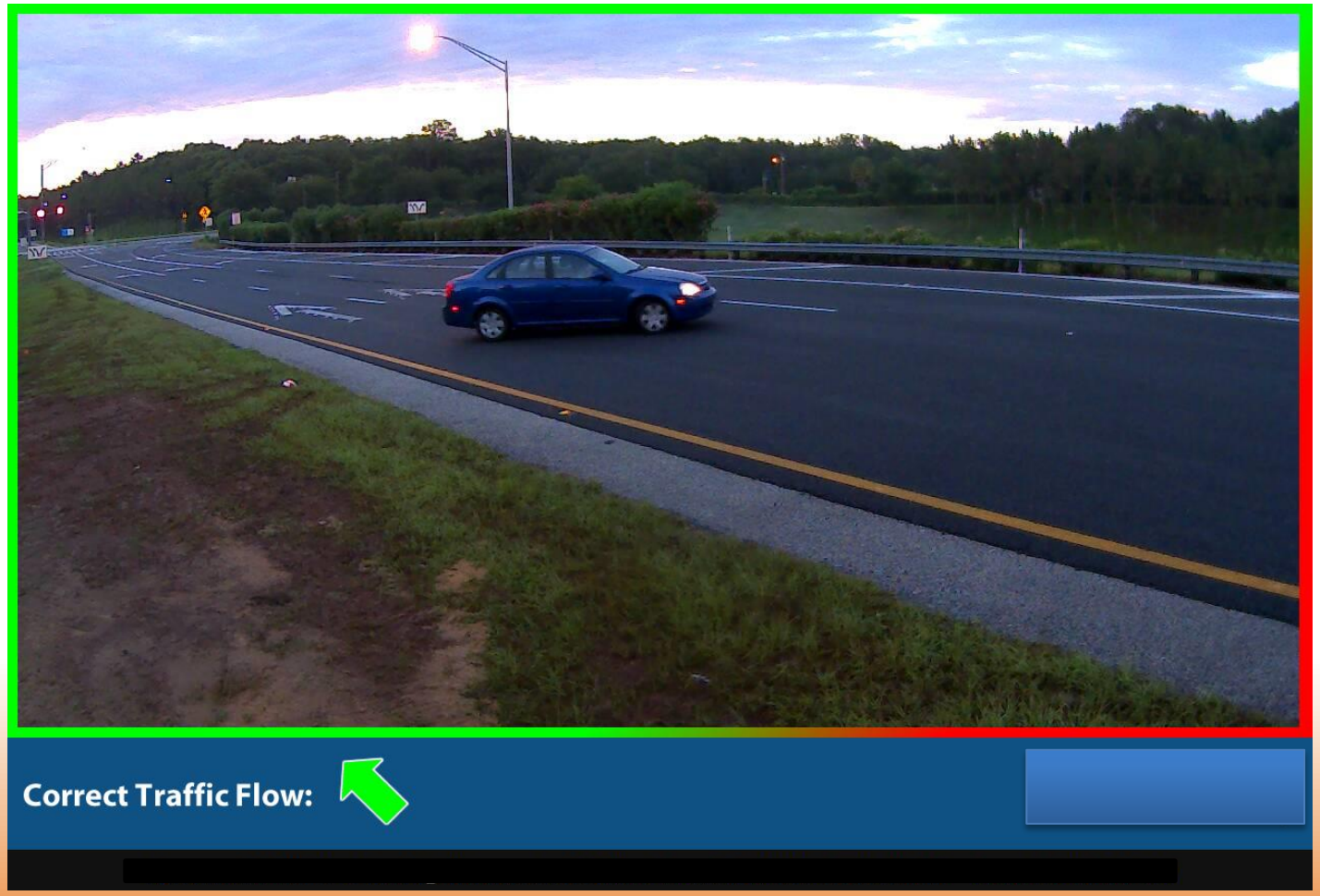
WRONG-WAY TURNAROUNDS

Eighteen documented since January 2015:

- Sixteen on SR 408
- Two on SR 528



ACTUAL TURN-AROUND



THANK YOU!

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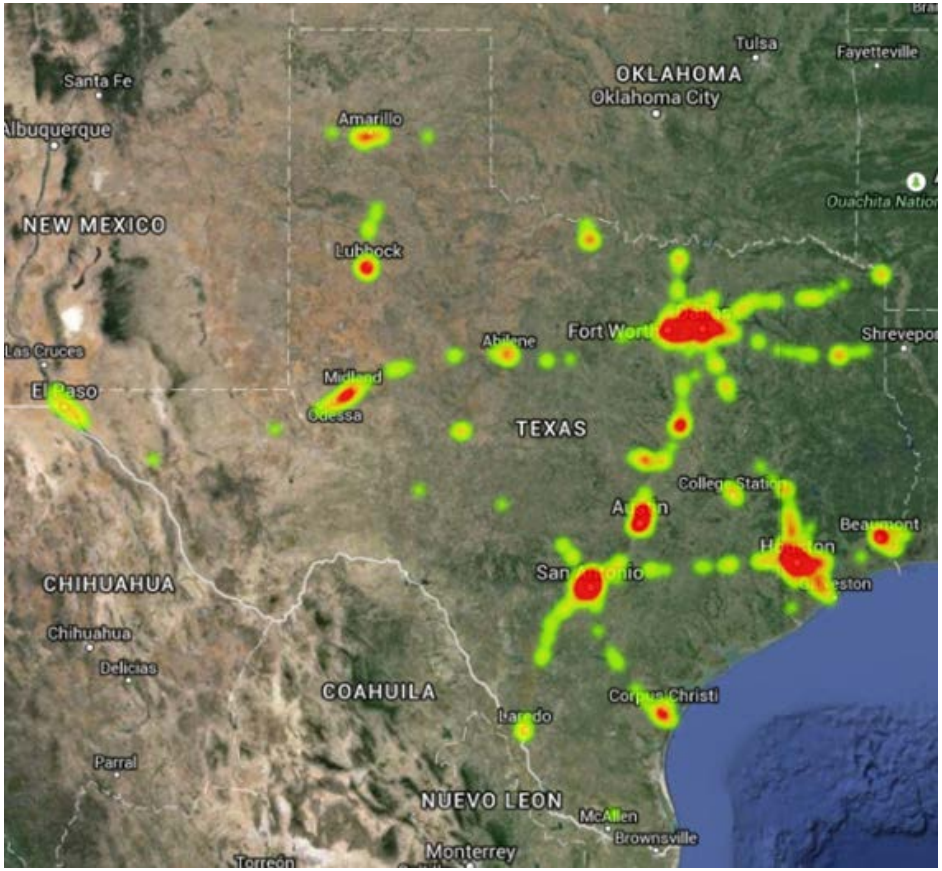
Mitigating Wrong-Way Driving (WWD) Using Connected Vehicles (CV)

Melisa D. Finley
Research Engineer
Texas A&M Transportation Institute

TRB Webinar
April 20, 2016

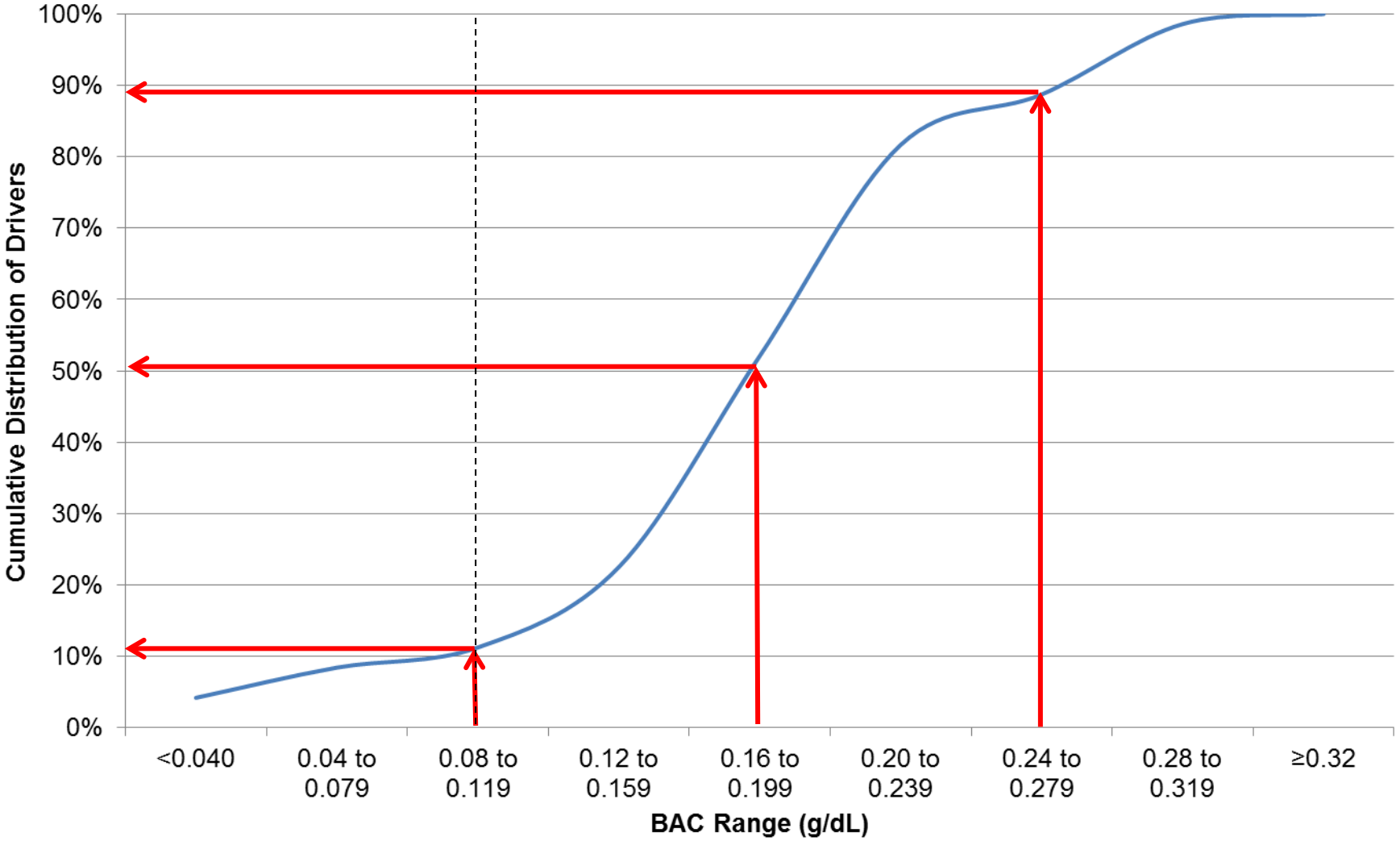
Texas WWD Crashes on Freeways*

- 1187 crashes
  - 2551 vehicles
  - 3726 people
- Severity
  - 10% fatal crashes
  - 46% injury crashes
- 86% in urban areas
- Primary cause = alcohol



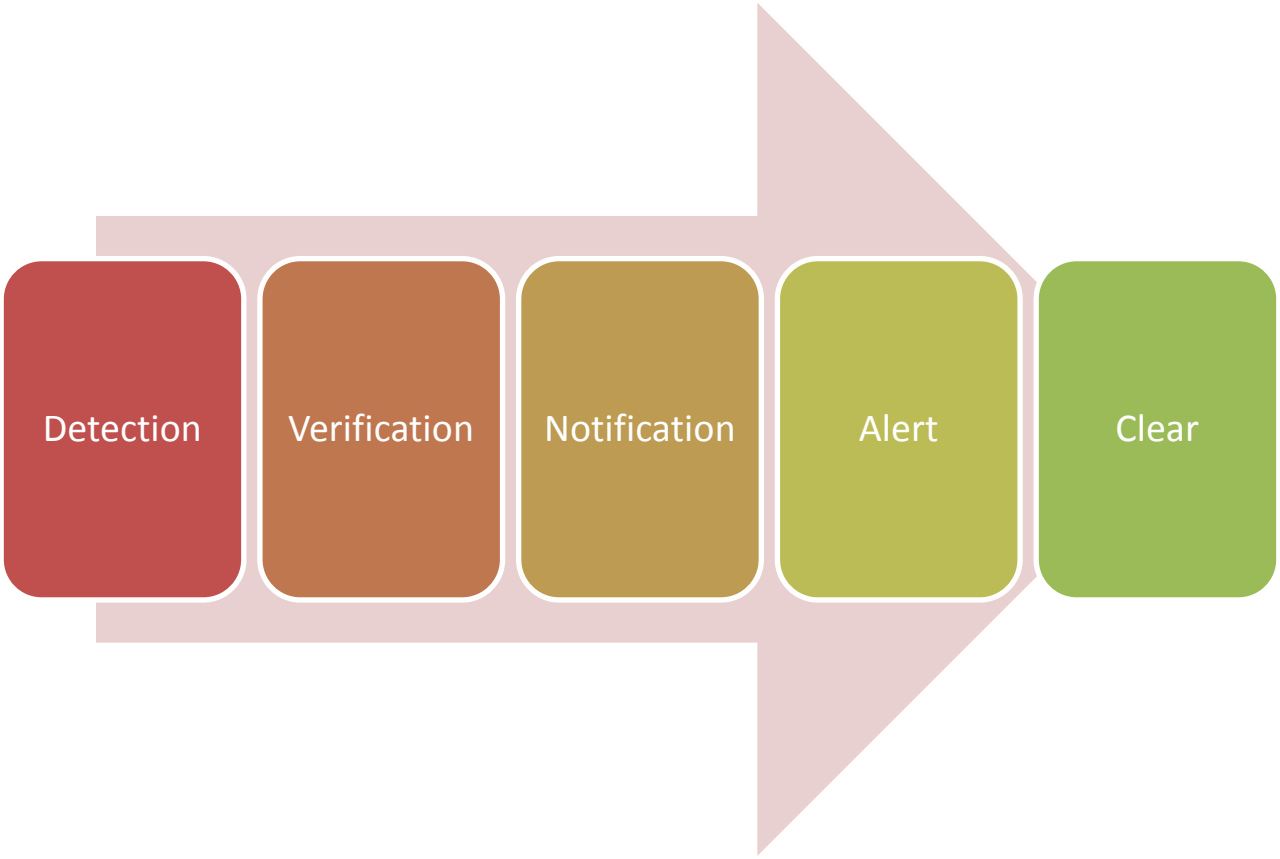
* 2010 to 2014

Blood Alcohol Concentration*



* 2007 to 2011 on freeways

CV WWD System



Phase 1

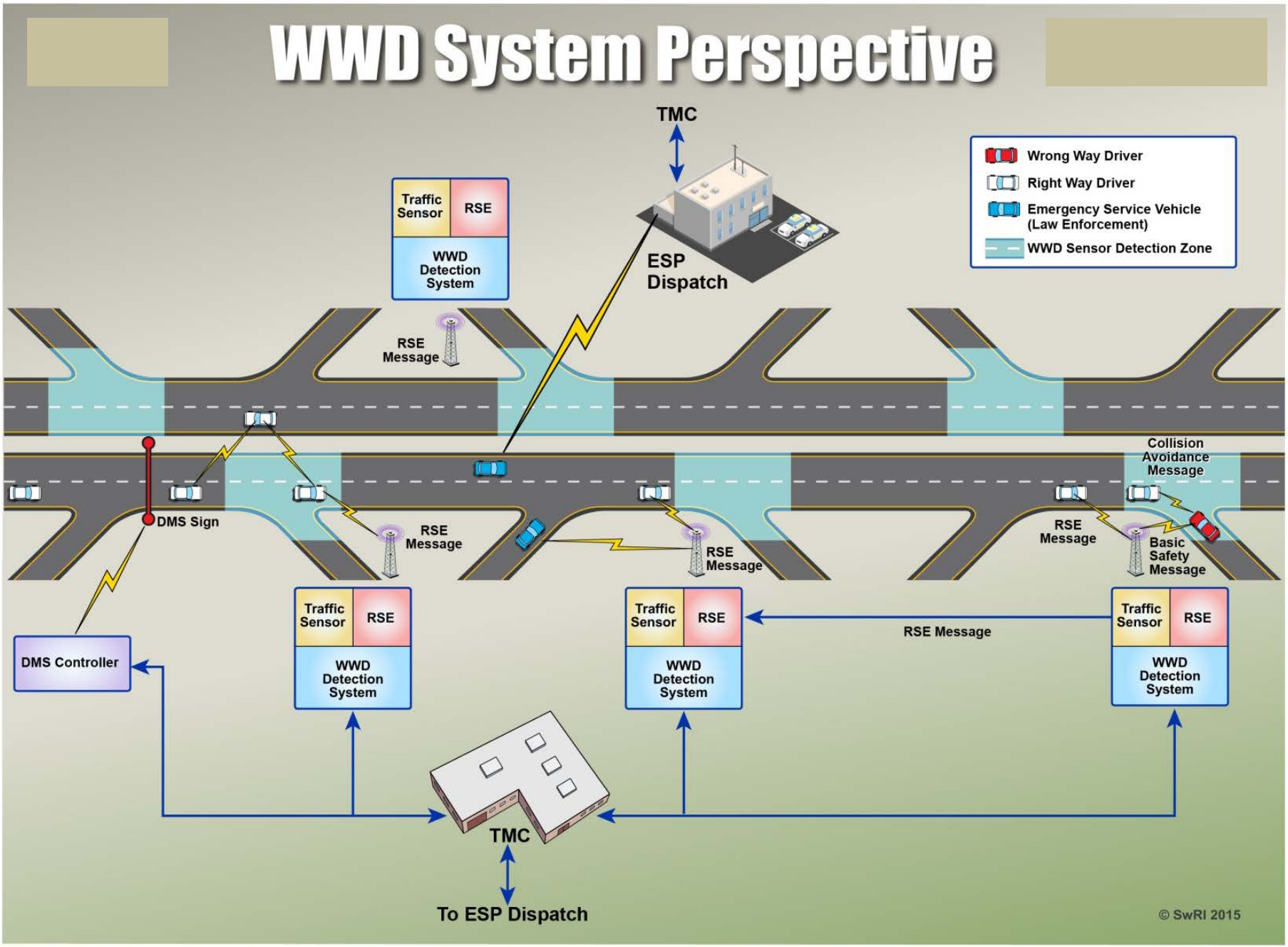
- February 2015 – December 2015
- Research tasks
  - Summarized state-of-the-practice
  - Conducted needs assessment
    - Traffic management entity
    - Law enforcement
    - Drivers (CV and non-CV)
  - Developed concept of operations, functional requirements, and high-level system design
  - Assessed fixed signing and in-vehicle warning messages

Purpose of ConOps

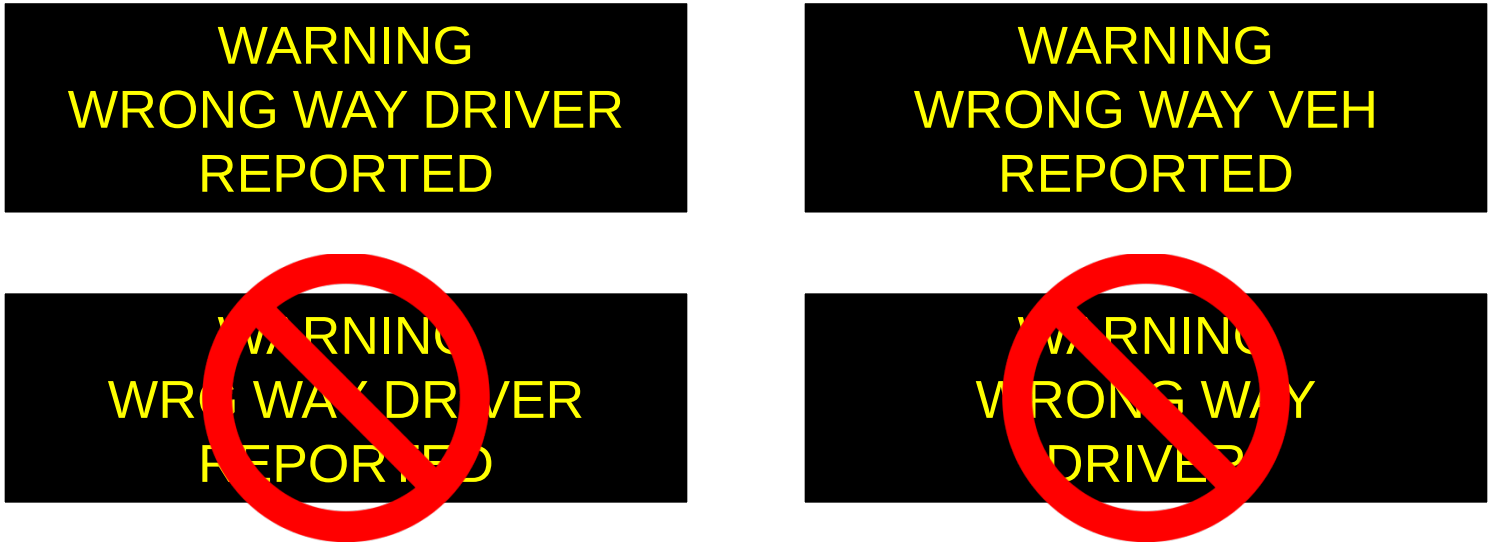
- High-level goals and objectives of the system
- Identifies user needs for the system
- Details design criteria for the system
- Describes the needs for a WWD system from the stakeholder perspectives

Who, what, why,
where, when, and how!

WWD System Perspective



Warning Messages for DMS



- Some evidence VEH initially misunderstood
- “Ahead” implied
- Non-specific driving actions inferred

In-Vehicle Warning

- Roadside Alert (RSA) messages
  - Provide warning information to drivers of nearby hazards
  - Not just any information can be sent
  - Rigid structure and integer codes must be used
- Does not represent final form of message

Phase 2

- April 2016 – October 2017
- Research tasks
  - Finalize design
  - Develop validation test plan
  - Procure equipment
  - Deploy prototype system on closed-course
  - Conduct validation testing
  - Identify information needs of right-way drivers
  - Consider Phase 3 model field deployment

Contact Information

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