



U.S. Department  
of Transportation  
Federal Highway  
Administration



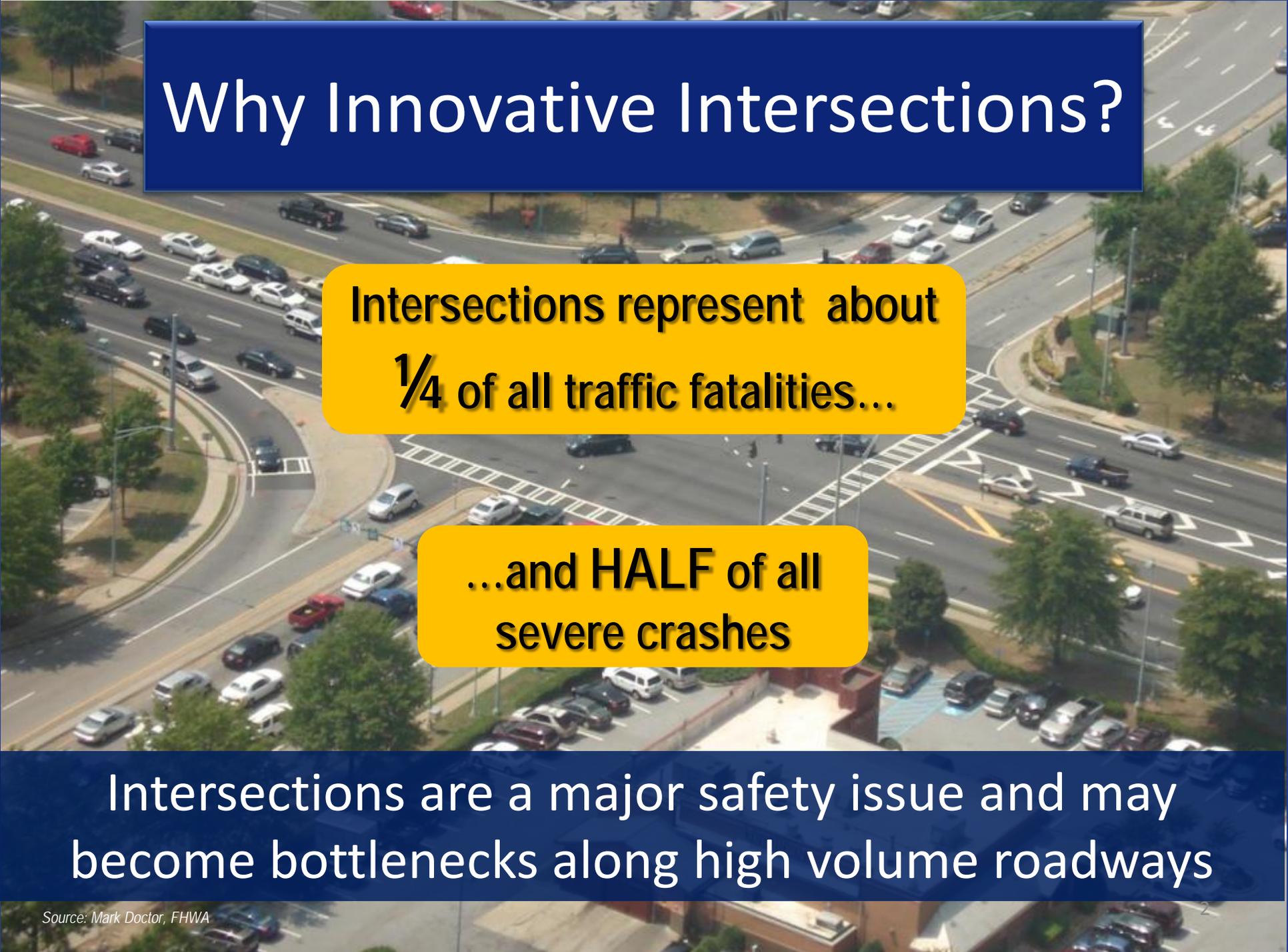
# Why Innovative Intersections?

*Illinois Route 13 Public Meeting*

Jeffrey Shaw

FHWA Office of Safety Technologies

# Why Innovative Intersections?



Intersections represent about  $\frac{1}{4}$  of all traffic fatalities...

...and **HALF** of all severe crashes

Intersections are a major safety issue and may become bottlenecks along high volume roadways



# Intersection Safety Facts

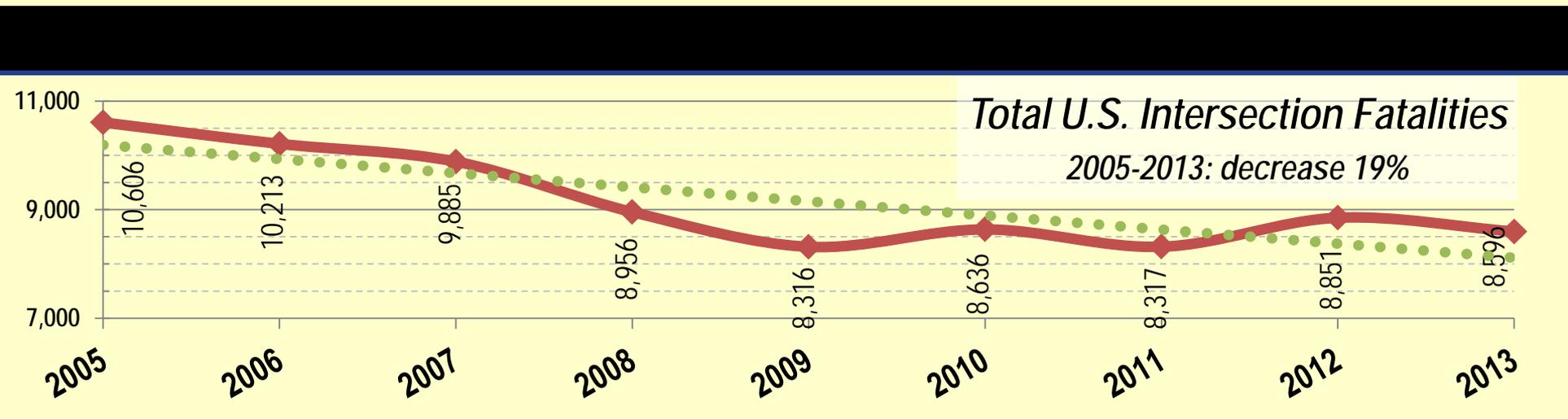
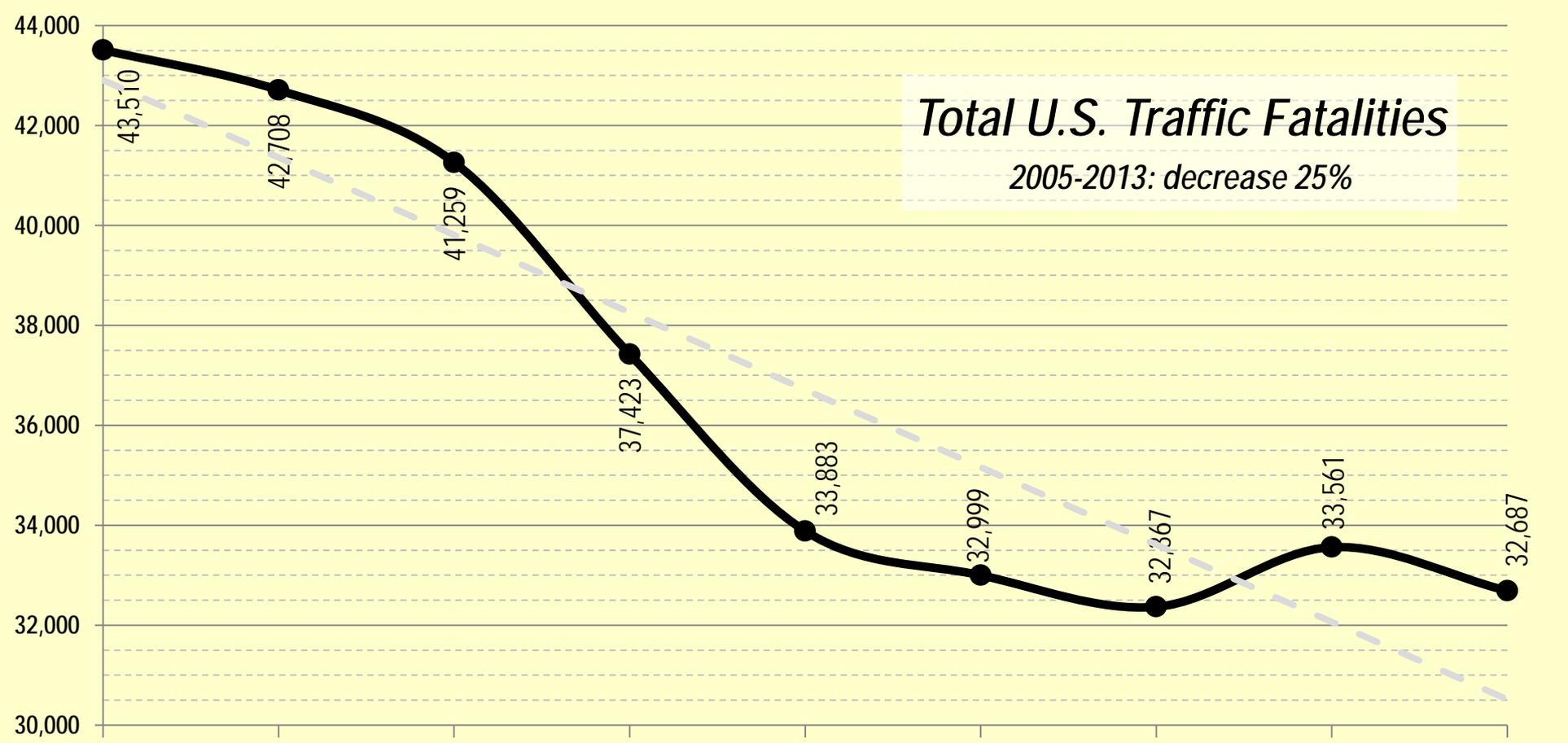
- » Angle crashes account for over 40% of fatal crashes at intersections
- » Left turn crashes account for over 20% of fatal crashes at intersections
- » Ped/Bike crashes account for 25% of fatal crashes at signalized intersections

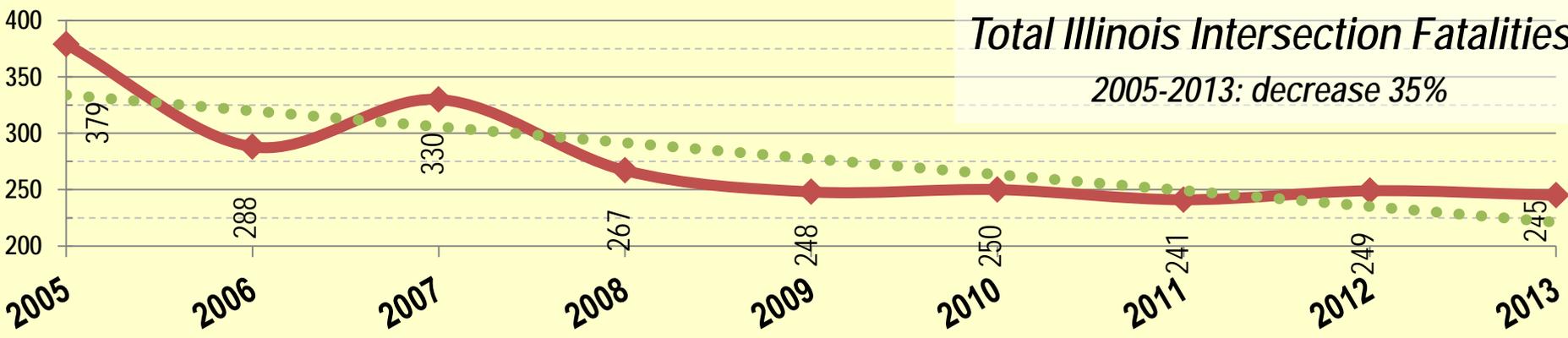
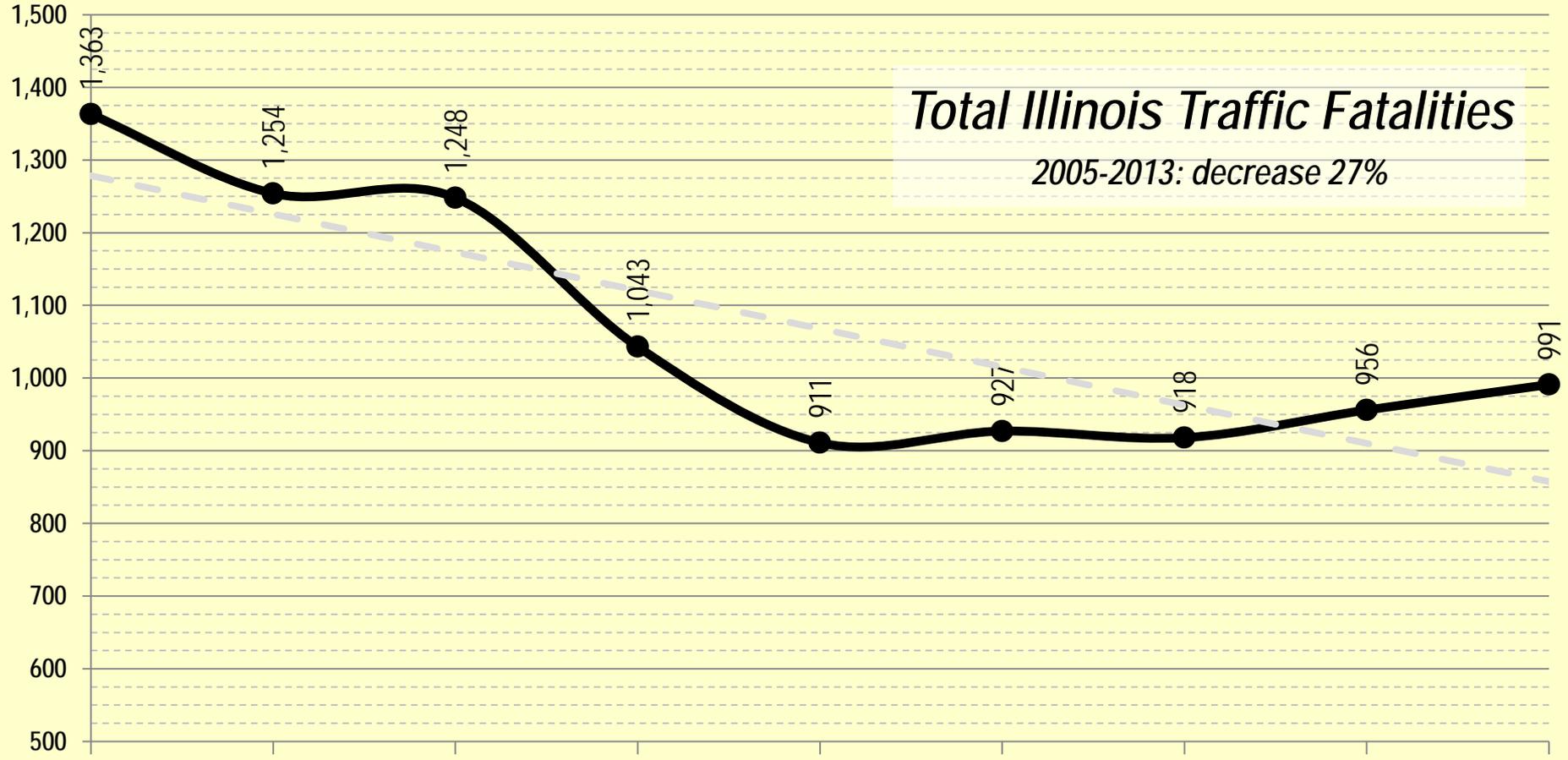


Source: Mark Doctor, FHWA



Source Isebrands, FHWA







# Safer, Balanced Intersection Designs

Must achieve the following:

- Improve the way people move across intersections
- Provide access, but reduce conflict
- Strategically optimize traffic control (less intrusive, more flexible)
- **Each project (intersection) is an incremental improvement in the system/network**



*“cho·re·og·ra·phy”*



# Benefits of Innovative Intersections

## SAFETY

- Fewer, less severe conflict points
- Speed management potential
- Significant crash reductions

## MOBILITY

- Less delay
- Reduced congestion
- New/more pedestrian and bike opportunities



## VALUE

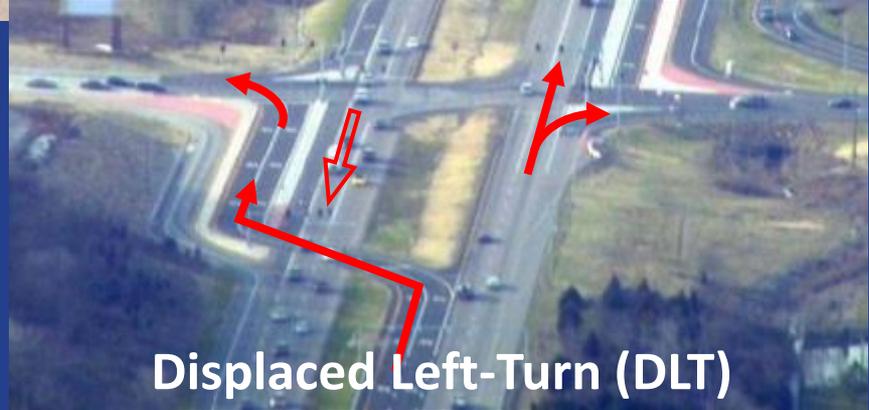
- Smaller footprints
- Less ROW
- Decreased costs
- Quicker construction



# Innovative Intersections Family



*These designs REDUCE severe crashes while IMPROVING efficiency*





# Rural Divided Hwy Intersections

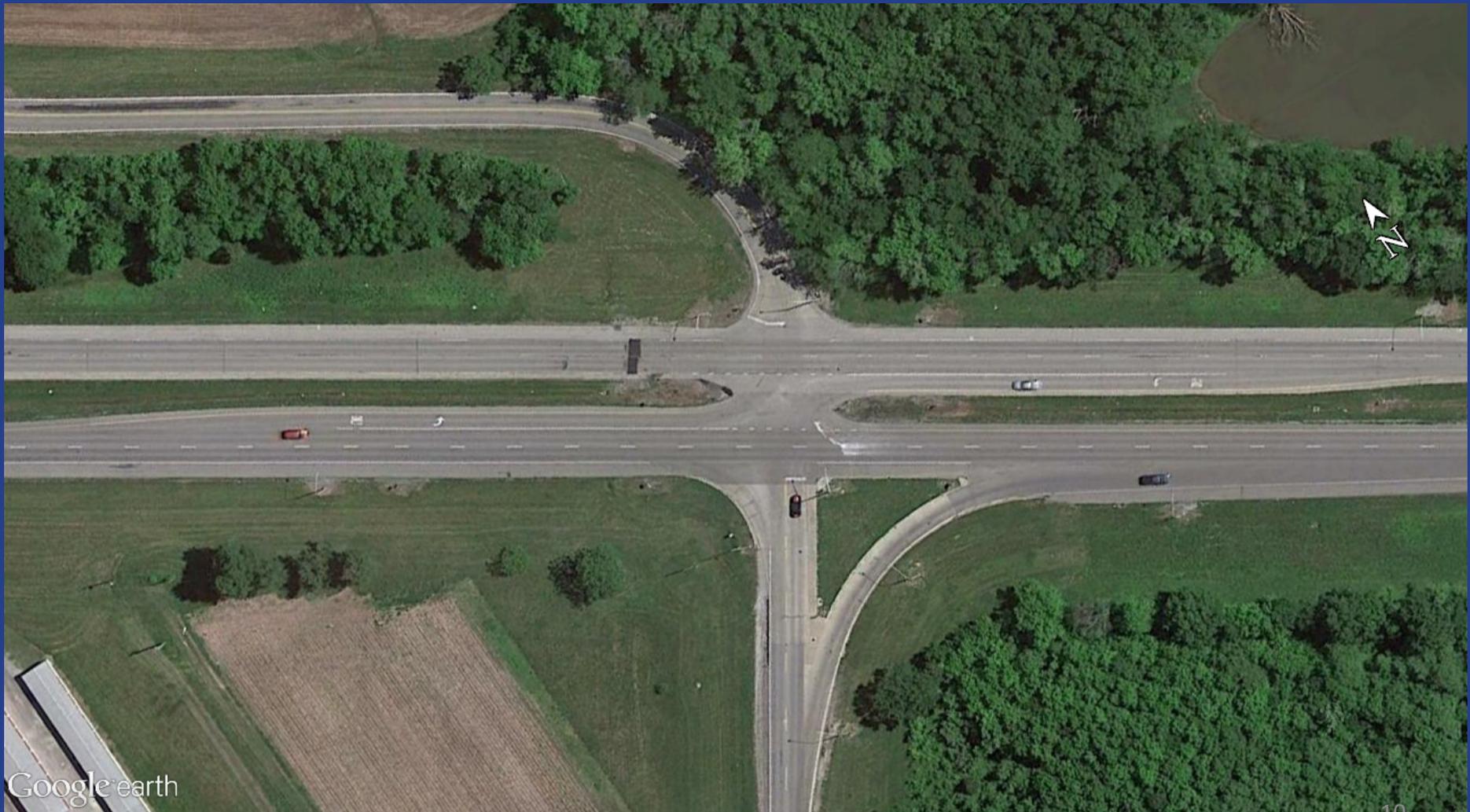
## Challenging Safety Characteristics

- High Speeds
- Intersection areas at divided highways can be large and chaotic
- Diverse Mix of Users (Lg Trucks, Cars, Agricultural Equipment, and Non-Motorized)
- Varying dimensions/characteristics – median width, turn lanes, etc.
- Varying control –stop, yield, signals (...and sometimes combinations of)





# State Route 113 at E Main St/Norman Rd





# SR13/Main-Norman Characteristics





# SR13/Main-Norman Characteristics

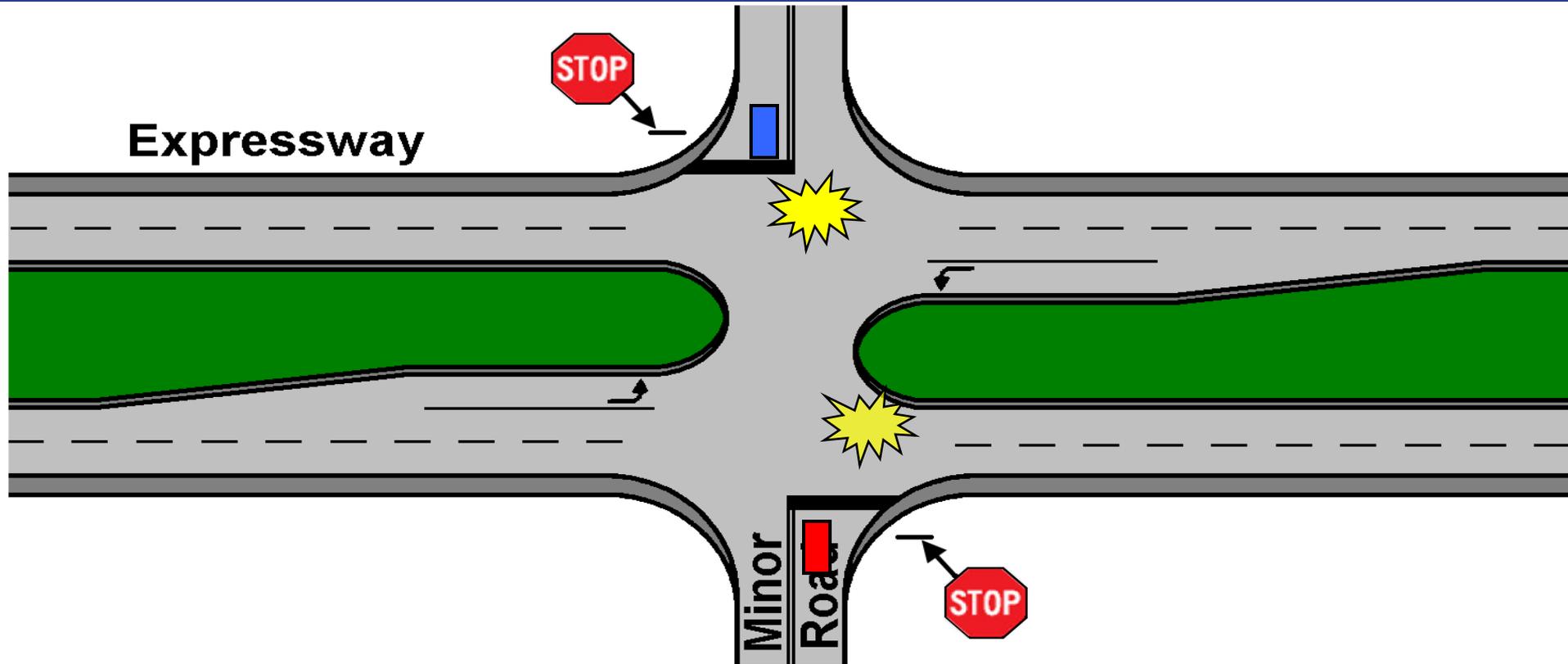




# Safety Challenge

With Traditional Divided Highway Intersection Design

## Angle and Left-Turning Collisions



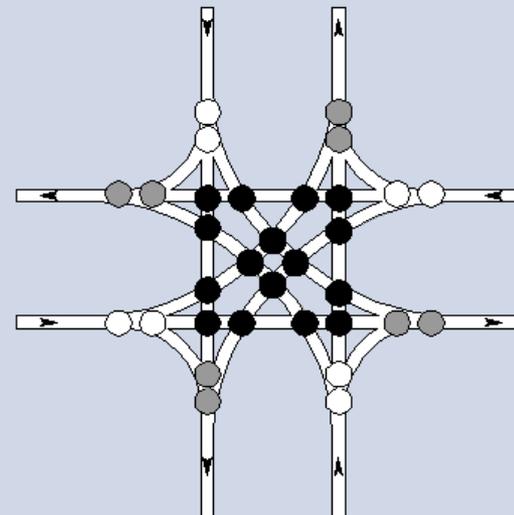


# Intersection Basics

## Conflict Points for Basic Intersection (2X2)

Conflict Type	Conventional
Merging/Diverging	16
Crossing (left turn)	12
Crossing (angle)	4
<b>Total</b>	<b>32</b>

**Highest Severity  
Crash Types**

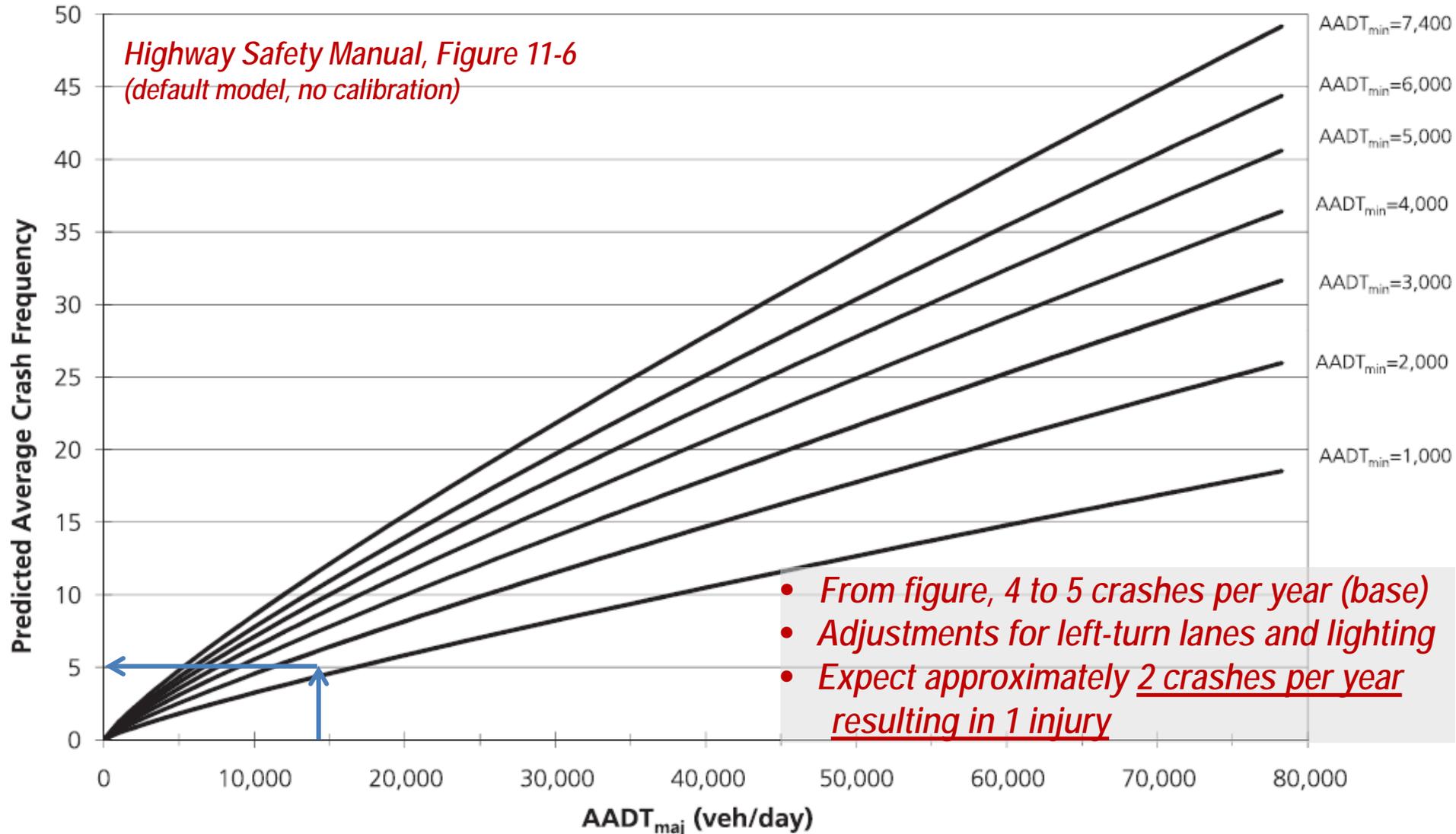


- Crossing
- Merging
- Diverging



# Assessing Safety Performance

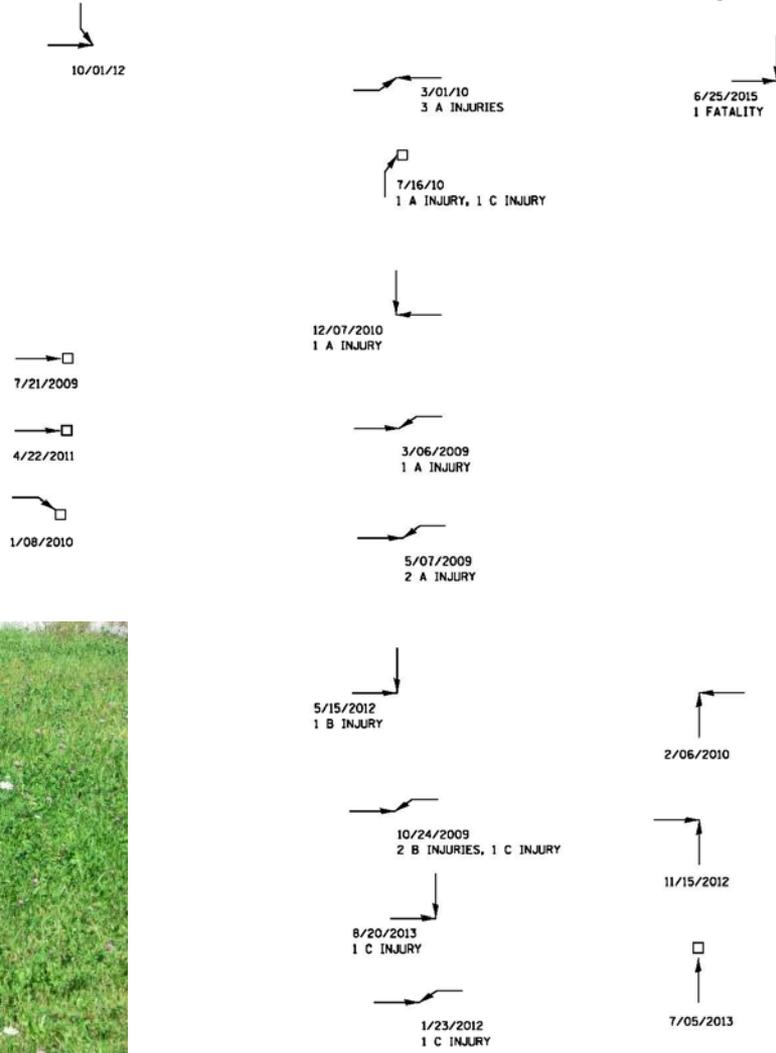
## Rural Multilane Divided, 4-leg, TWSC





# IL 13 & NORMAN ROAD

17 CRASHES 2009 - 2013 = 3 to 4 crashes  
15 INJURIES per year  
1 FATAL 2015

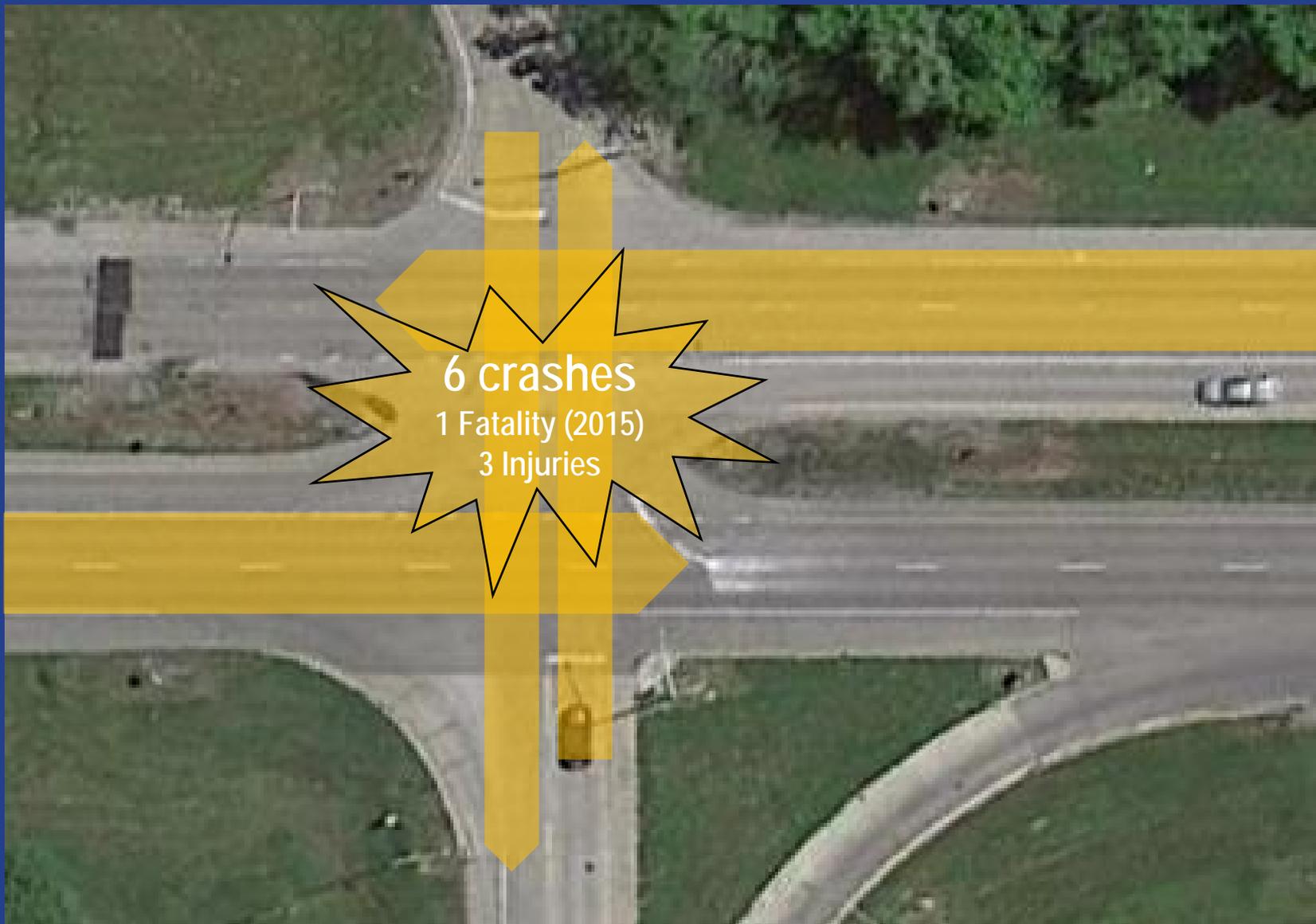


- LEGEND:**
- ← STRAIGHT
  - ⇐ STOPPED
  - ⇐ UNKNOWN
  - ⇐ BACKING
  - ⇐ OVERTAKING
  - ⇐ SIDESWIPE
  - ▭ PARKED
  - ⚡ ERRATIC
  - ⚡ OUT OF CONTROL
  - ↘ RIGHT TURN
  - ↙ LEFT TURN
  - ↻ U-TURN
  - ↻ OVERTURN
  - ⊗ PEDESTRIAN
  - ⊗ BICYCLE
  - ⊙ FATALITY
  - 🌙 NIGHTTIME
  - 🚗 DUI
  - △ 3RD VEHICLE
  - \* EXTRA DATA
- FIXED OBJECTS:**
- ▣ GENERAL
  - ▣ SIGNAL
  - ▣ TREE
  - ▣ POLE
  - ▣ CURB
  - ⊕ ANIMAL





# SR13/Main-Norman Angle Crashes



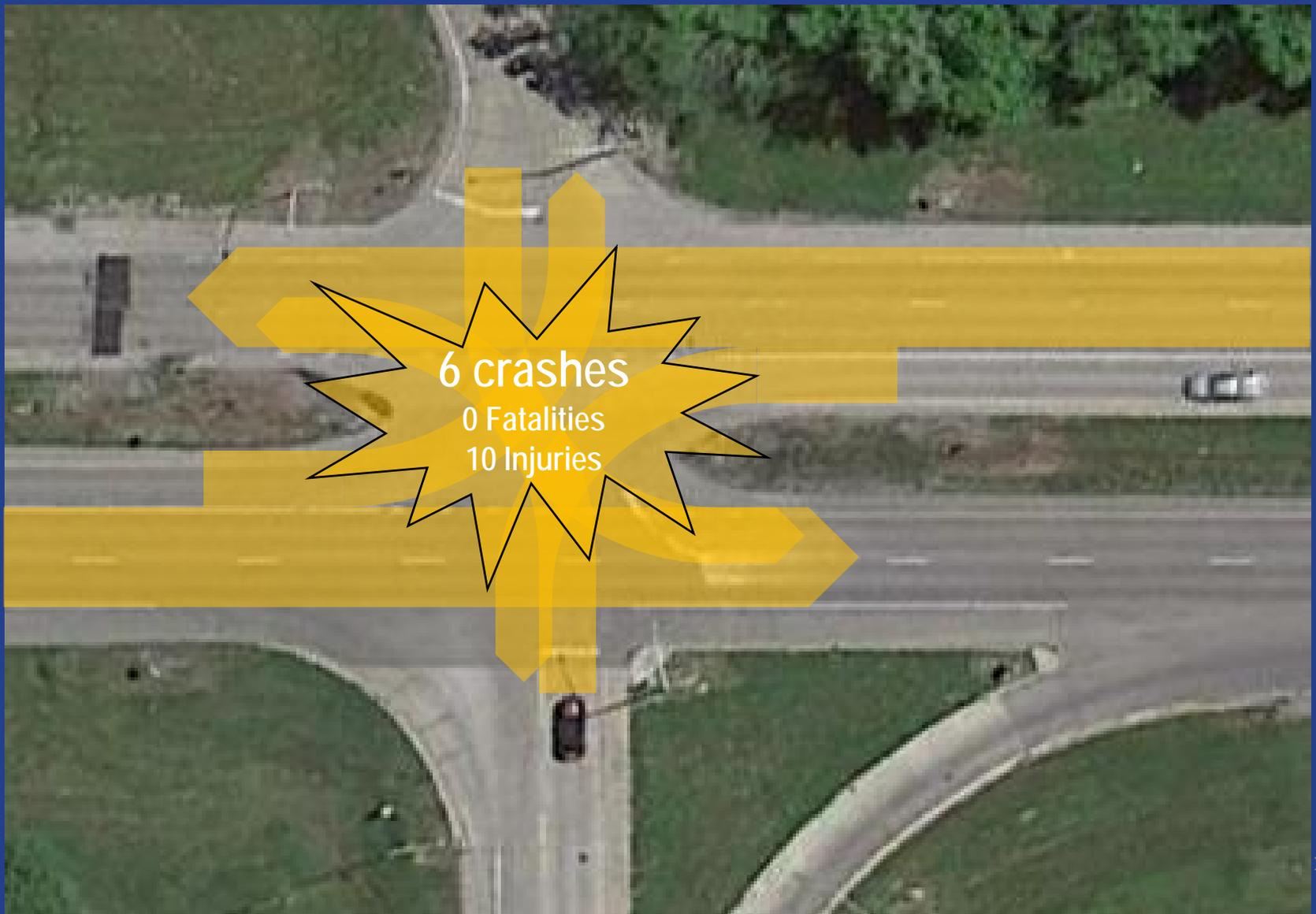
6 crashes

1 Fatality (2015)

3 Injuries



# R13/Main-Norman Left Turn Crashes



6 crashes  
0 Fatalities  
10 Injuries



# Tragic Consequences





# Assessing Safety Performance

## Rural Multilane Divided, 4-leg, Signal



50

*Highway Safety Manual, Figure 11-7*

AADT = 18,500



0      5,000      10,000      15,000      20,000      25,000      30,000      35,000      40,000      45,000

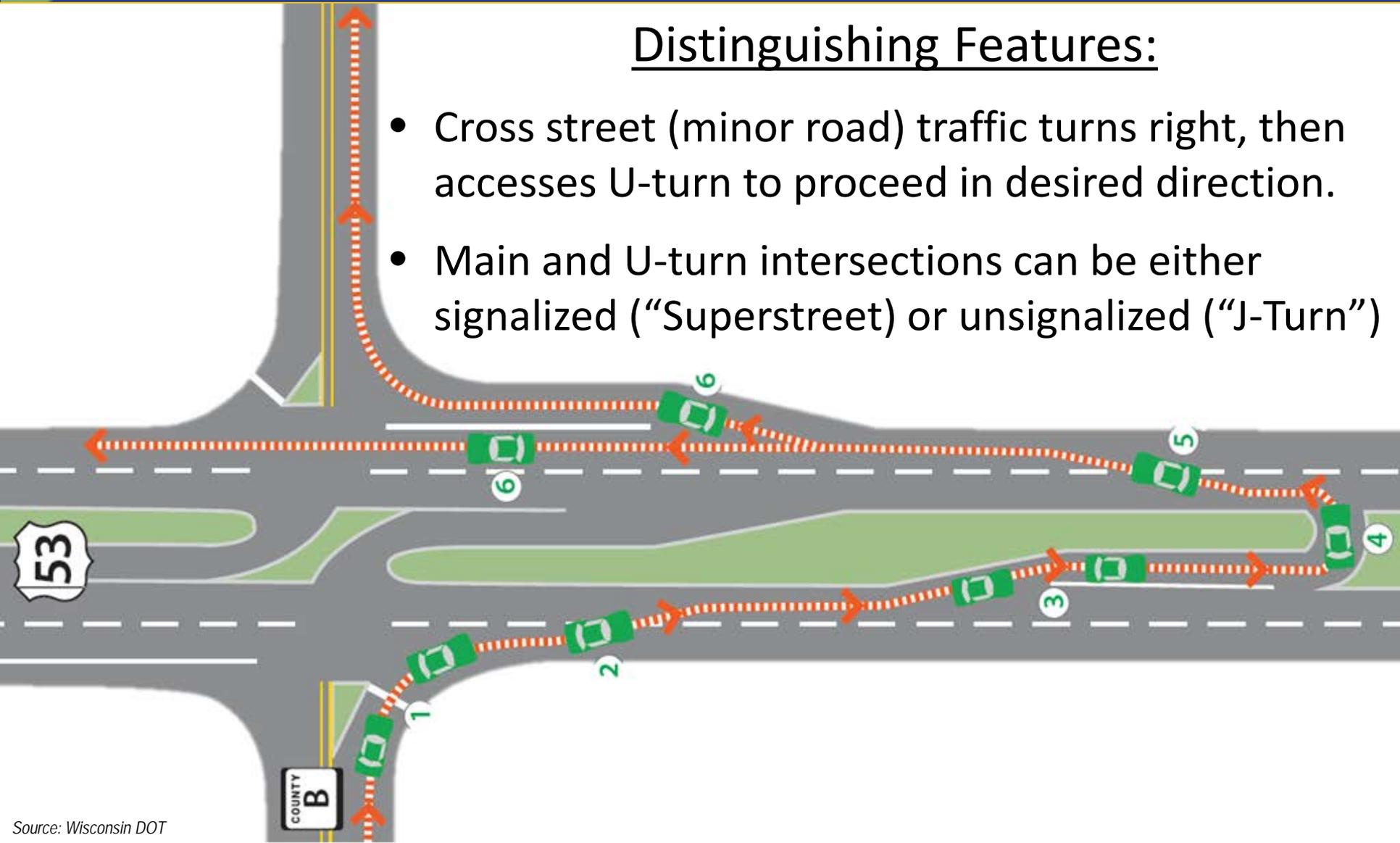
AADT<sub>maj</sub> (veh/day)



# Restricted Crossing U-Turn

## Distinguishing Features:

- Cross street (minor road) traffic turns right, then accesses U-turn to proceed in desired direction.
- Main and U-turn intersections can be either signalized (“Superstreet”) or unsignalized (“J-Turn”)





RCUTs at rural,  
unsignalized  
intersections are  
nicknamed  
**“J-Turns”**





# What is a J-Turn Intersection?



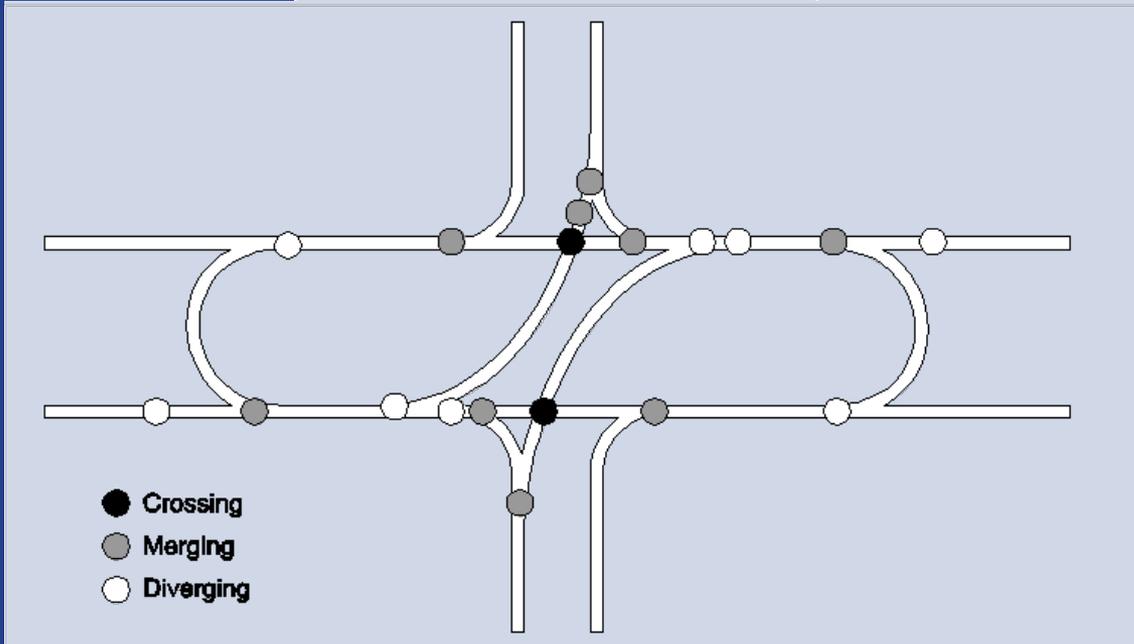


# U-Turn Intersection Basics

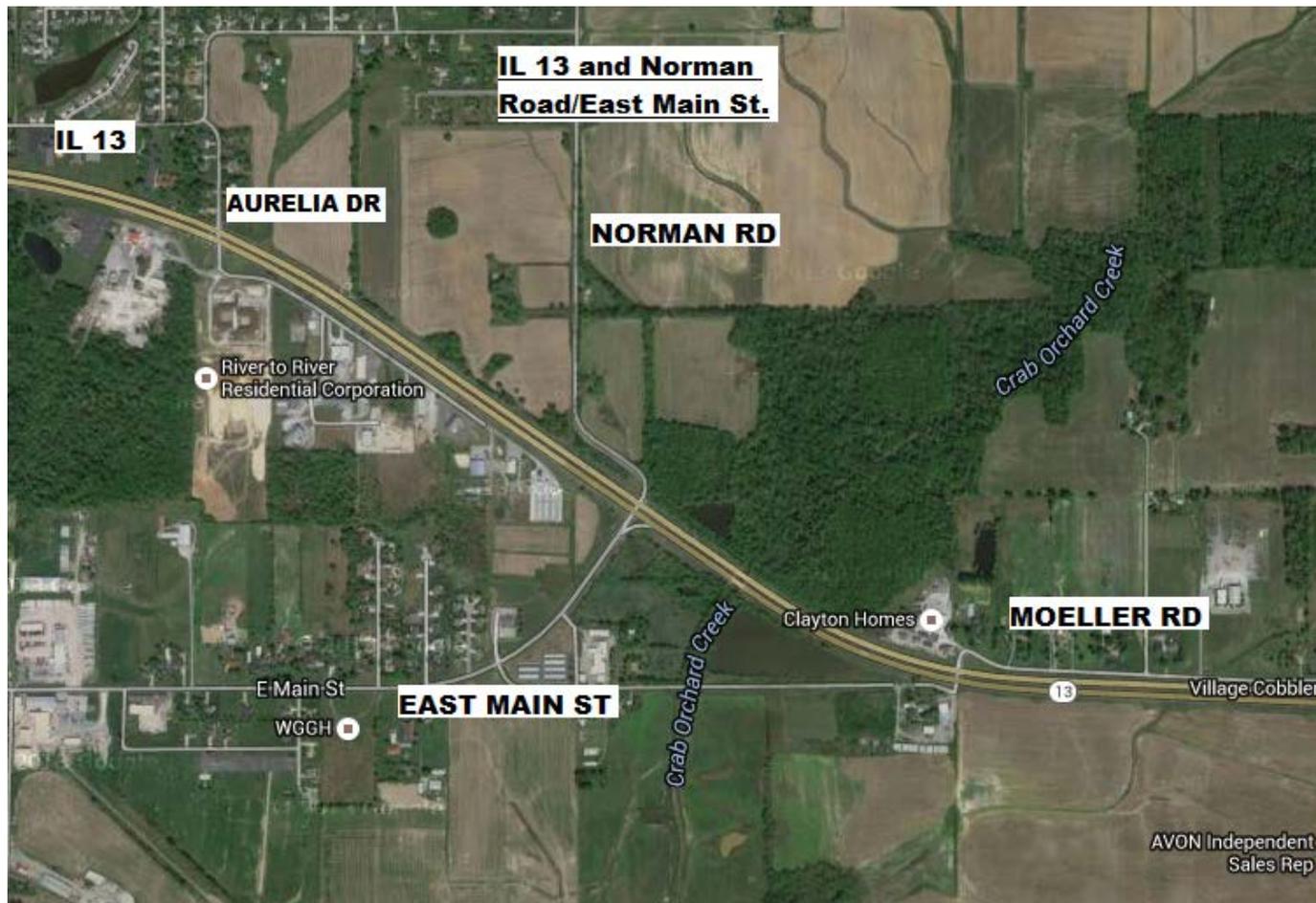
## Conflict Point Comparison for Basic Intersection (2X2)

Conflict Type	Conventional	RCUT
Merging/Diverging	16	16
Crossing (left turn)	12	2
Crossing (angle)	4	0
<b>Total</b>	<b>32</b>	<b>18</b>

**Highest Severity  
Crash Types**



# Intersection of IL 13 with Norman Road and East Main Street



EXISTING 2015 AVERAGE DAILY TRAFFIC  
NORMAN ROAD

850

197 (3 TRUCKS)  
168 (3 TRUCKS)  
67 (3 TRUCKS)

IL 13 EASTBOUND

193 (5 TRUCKS)  
**13,750** 6074 (405 TRUCKS)  
197 (16 TRUCKS)

A

60 (3 TRUCKS)  
D 6975 (371 TRUCKS) **15,100**  
969 (63 TRUCKS)

IL 13 WESTBOUND

129 (9 TRUCKS)  
163 (0 TRUCKS)  
967 (27 TRUCKS)

B

2,600

EAST MAIN STREET

# CRASH HISTORY (2009 - 2013)

CRASH TYPE	NORMAN ROAD AND EAST MAIN STREET	
	NUMBER	NUMBER OF
	OF	INJURIES & SEVERITY
	CRASHES	
FIXED OBJECT	5	1A, 1C
ANGLE (Crossing IL 13 from side road)	6	1A, 1B, 1C, 1 FATALITY (2015)
ANGLE/TURNING (Left turn from side road)	1	
ANGLE/TURNING (EB left turn from IL 13)	4	3A, 2B, 2C
ANGLE/TURNING (WB left turn from IL 13)	1	3A
Totals 17 Crashes 15 injuries (8A, 2B, 5C) 1 Fatality (2015)		

## INJURY SEVERITY INDEX -

A = Severe or incapacitating, prevents person from walking, driving, or normally continuing

the activities they were capable of performing before the injury (severe abrasions, broken limbs)

B= Moderate Injury, an injury that is evident to observers at the scene (abrasions, bruises, minor cuts)

C=Minor Injury (pain, nausea, hysteria)

Crashes involving left or through movements from side road - 35% of total crashes, 20% of injuries

Crashes involving lefts from IL 13 - 35% of total crashes, 72% of total injuries

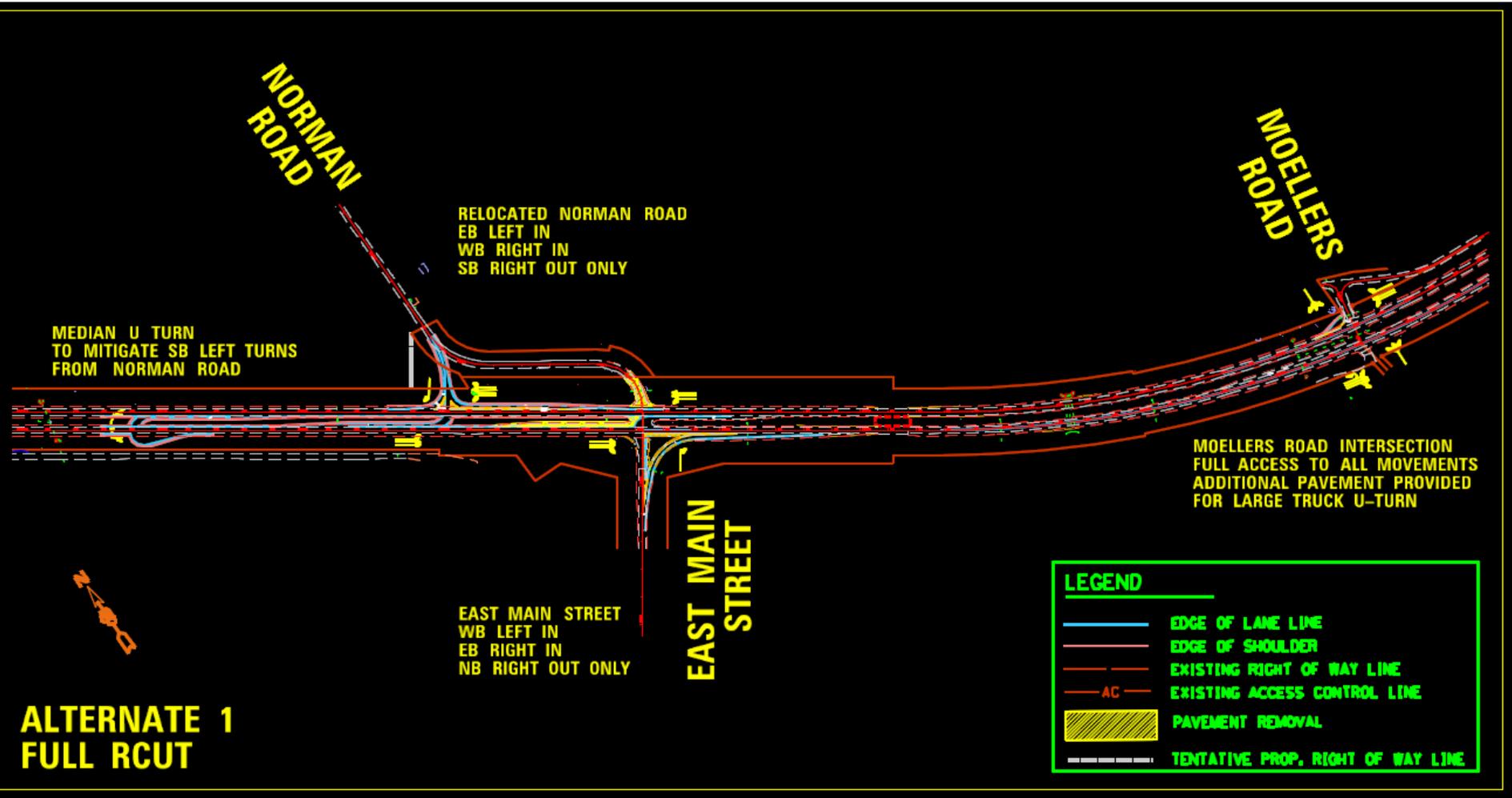
# Blocking of Sight Distance for IL 13 left turns



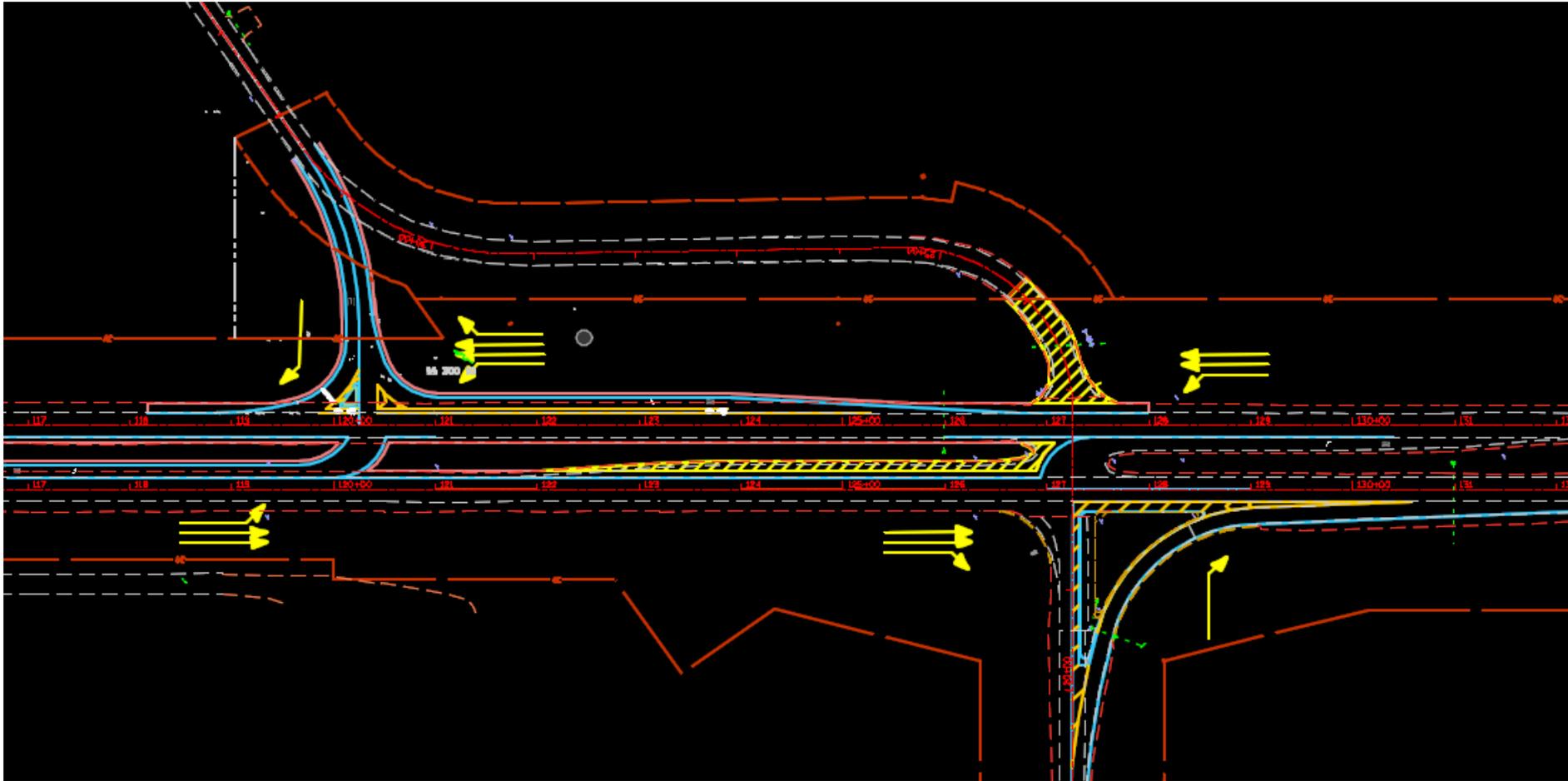
# Alternate 1

RCUT at Norman Road  
and East Main Street

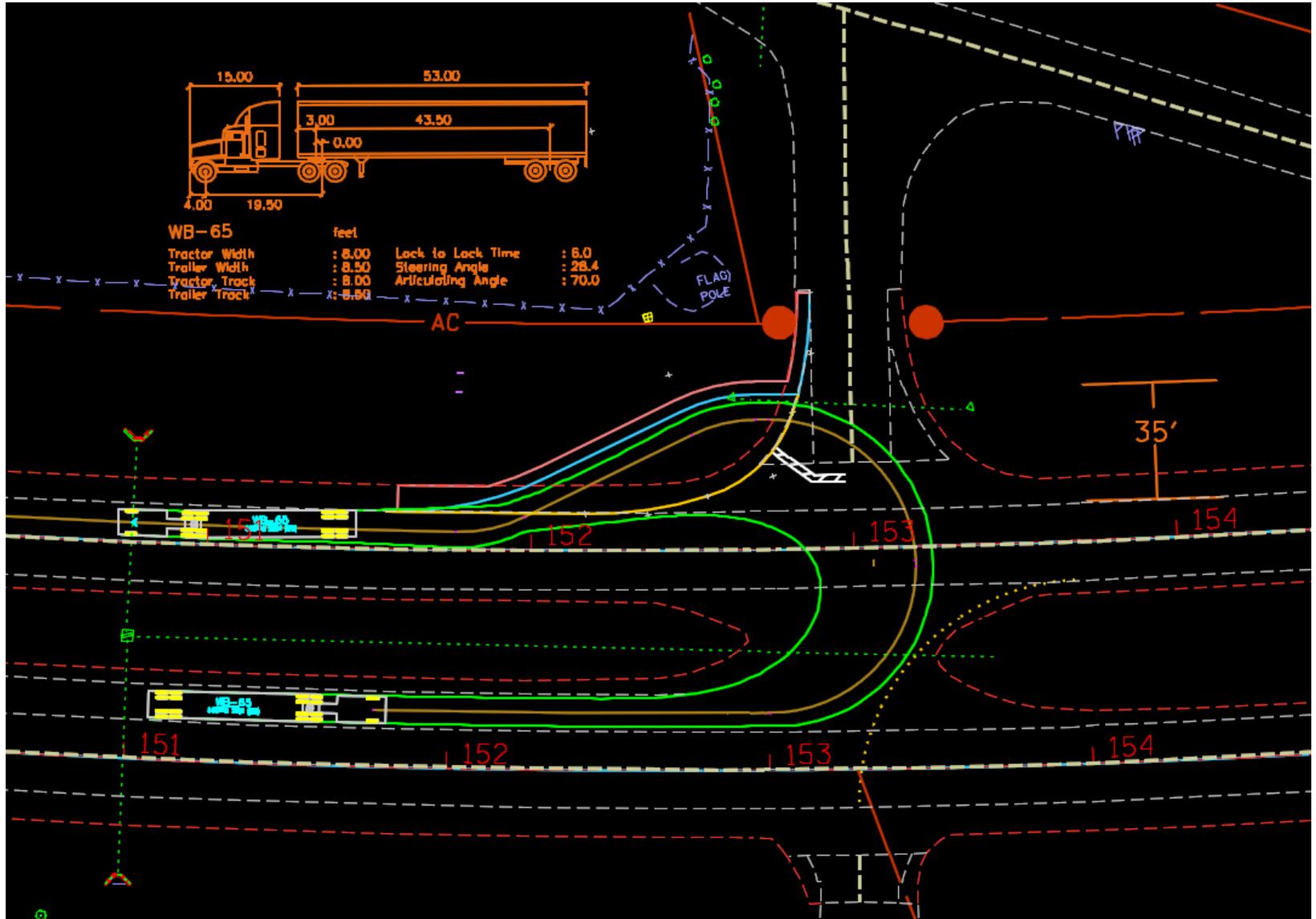
# Alternate 1



# Alternate 1



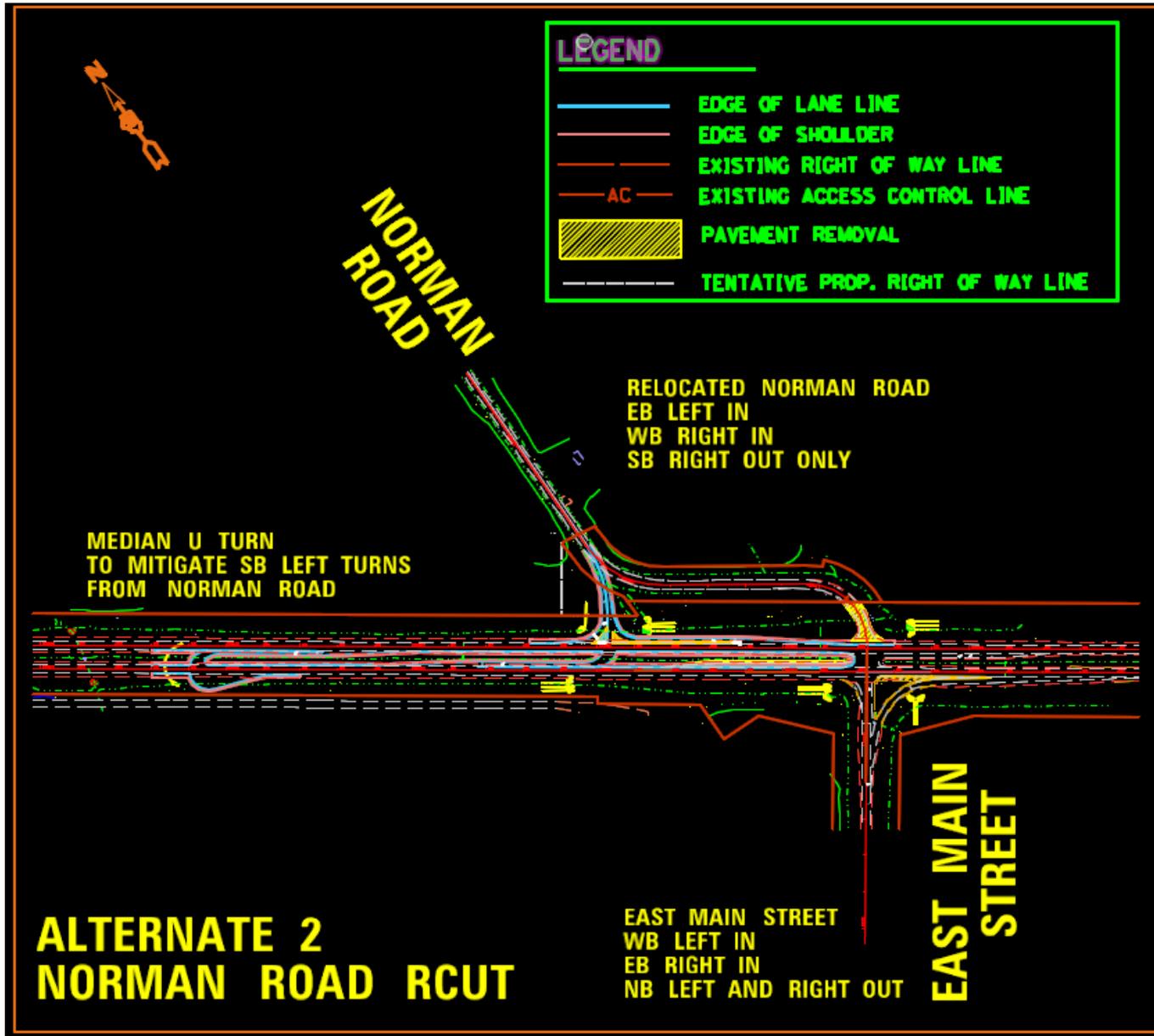
# WB-65 Design Vehicle



# Alternate 2

Partial RCUT  
at Norman Road only

# Alternate 2







# Key Features of J-Turns



Median Left-Turn  
Channelizing Island



Side Road Right-Turn  
Channelizing Island



U-Turn Lane  
and Signing



U-Turn "Loon"  
or bump-out



# Natural (Healthy?) Skepticism

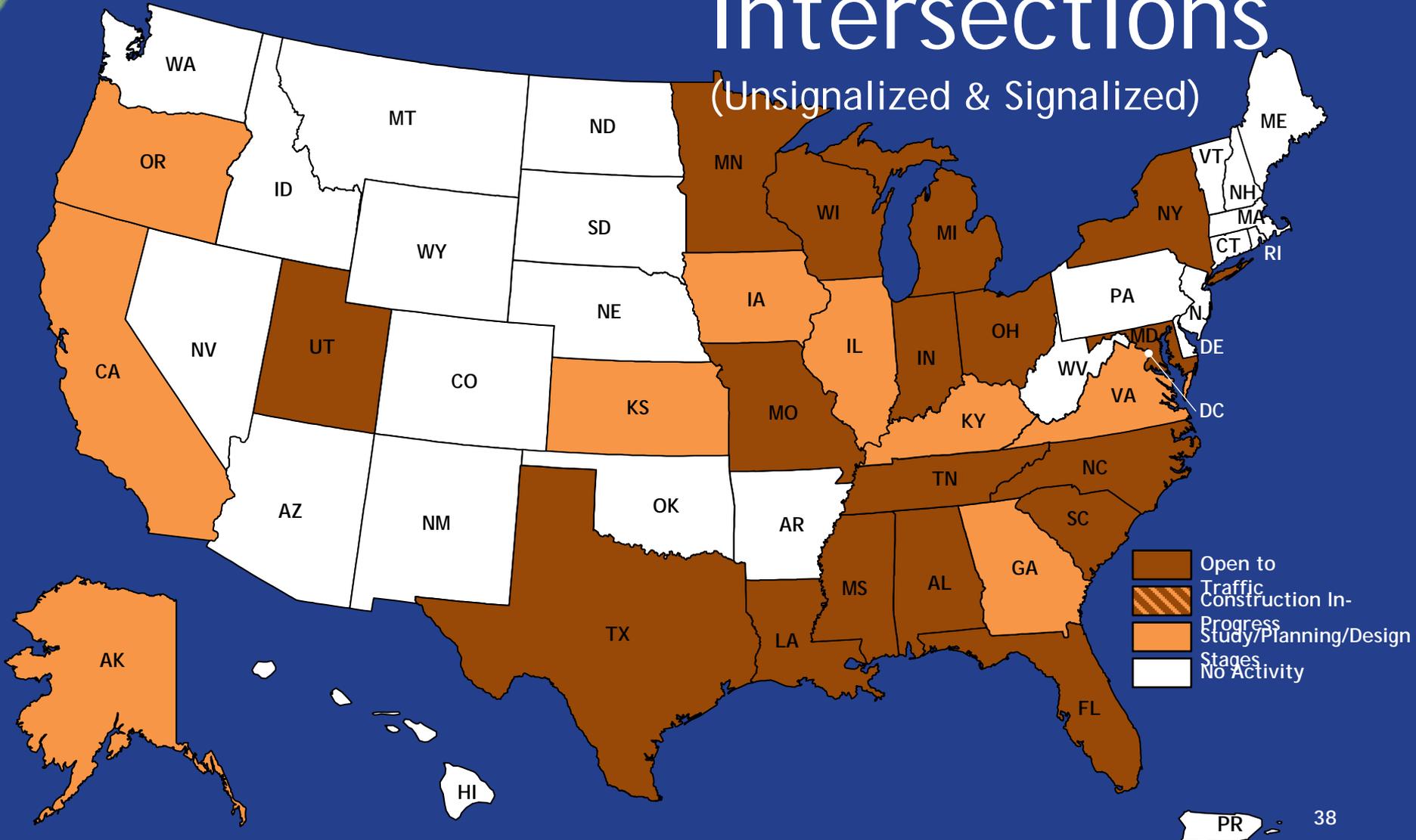
- “This idea is/you engineers are  [fill-in-the-blank] !!!”
- “This will never work, more people will be hurt.”
- “Why can’t you just add stop signs/traffic signals?”
- “People will avoid it and drive out of their way.”



# Estimated Current Deployment RCUT

## Intersections

(Unsignalized & Signalized)





# FHWA Video Case Study





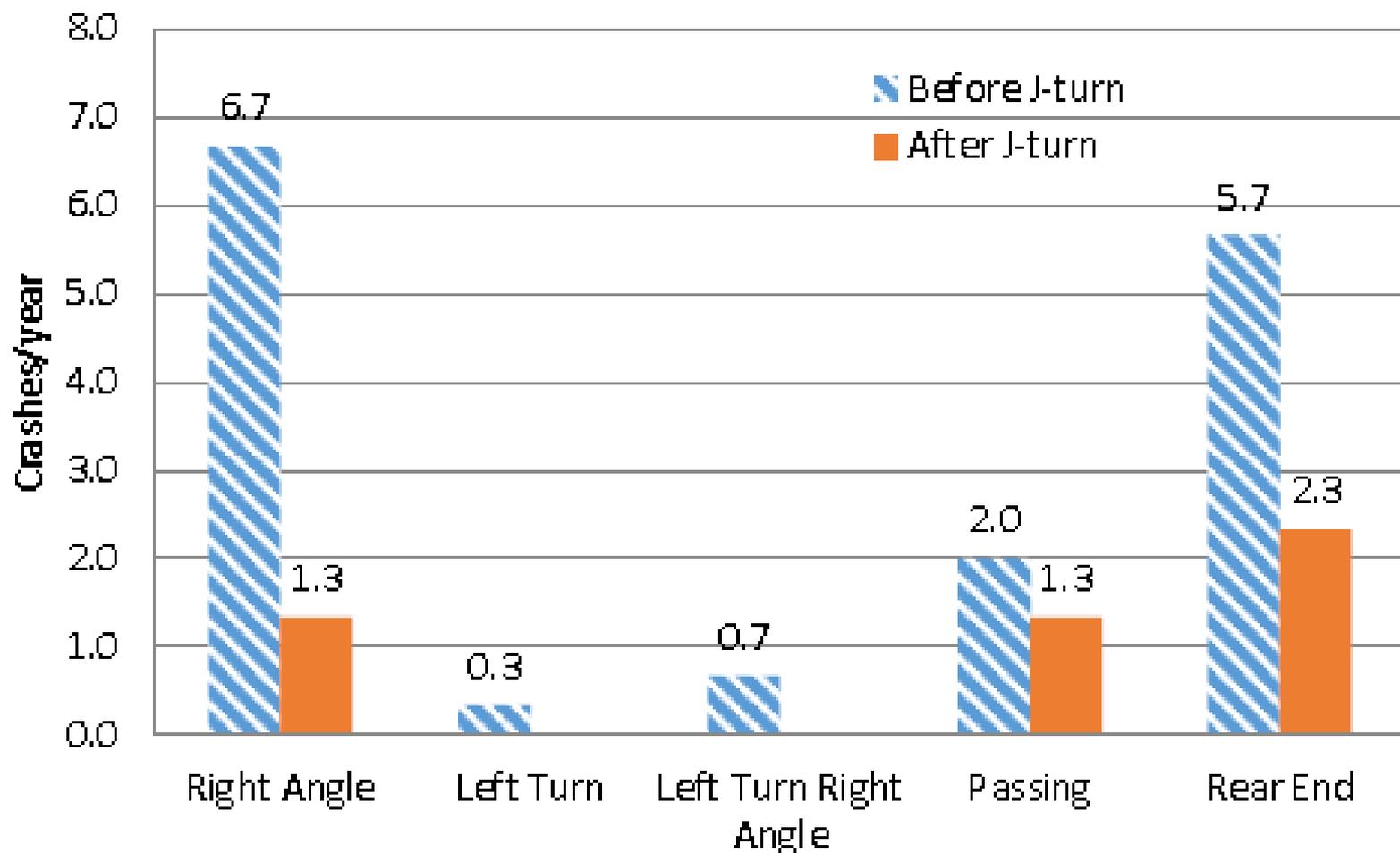
# J-Turn Safety Performance

## FORMAL STUDY EVALUATIONS

State (sites)	Reduction in Total Crashes	Reduction in Severe Crashes
North Carolina (13)	27%	51%
Missouri (5)	35%	54%
Maryland (9)	44%	42%

## OTHER (NAÏVE) EVALUATIONS

State (sites)	Change in Total Crashes	Change in Severe Crashes
Minnesota (6)	44%	67%
Tennessee (4)	81%	100%
Wisconsin (4)	TBA	TBA
South Carolina (3)	TBA	TBA
Indiana (1)	TBA	TBA



**Figure 4.10** Annual crash frequency by type before and after J-turn (sum of all five sites) 41



# J-Turn Real World Results

- Reduced wait times from crossroad by roughly 50%
- Added average 1-minute additional travel time for movements from minor road
- In a public survey with 423 responses:
  - Very small number (8%) expressed any confusion
  - Mixed results on “perceived” safety – slightly more than half did not feel safer
  - Majority (67%) indicated no adverse effect on overall trip

