

TRAFFIC SIGNAL OPERATIONS AT DIAMOND INTERSECTIONS

*TEXITE WINTER MEETING
FRISCO, TX*

JANUARY 28 – 30, 2010

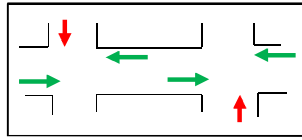


Curtis Jarecki, P.E. (City of Dallas)
Michael Wobken, P.E., PTOE (DKS Associates)

Presentation Outline

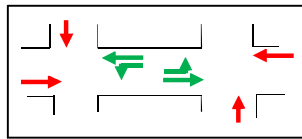
- 3 Phase Diamond Sequence
 - ▣ Pros & Cons
 - ▣ Safety Audit Recommendation
- 4 Phase (TTI) Diamond Sequence
 - ▣ Pros & Cons
 - ▣ Safety Audit Recommendation
- Lead/Lag
 - ▣ Pros & Cons
 - ▣ Safety Audit Recommendations
- Collision Diagram Examples

3 Phase – Pros and Cons



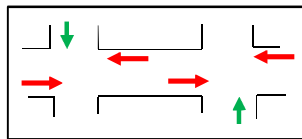
Pros

- Maximizes Overall Green Time
- Fewer Phases = Less Red Time
- Satisfies Demand with Lower Cycle Length



Cons

- Serves Limited Number of Left Turns
- Cycle Length Limited by Left Turn Storage



Three Phase – Cons

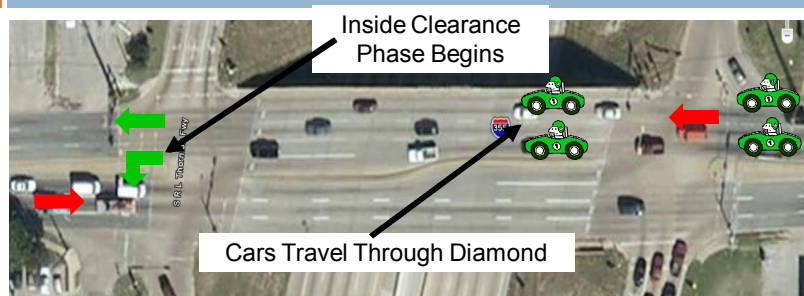


- Cycle Length Limited by Left Turn Storage
 - ▣ Once Left Turn Lane is Full Enter Clearance Interval

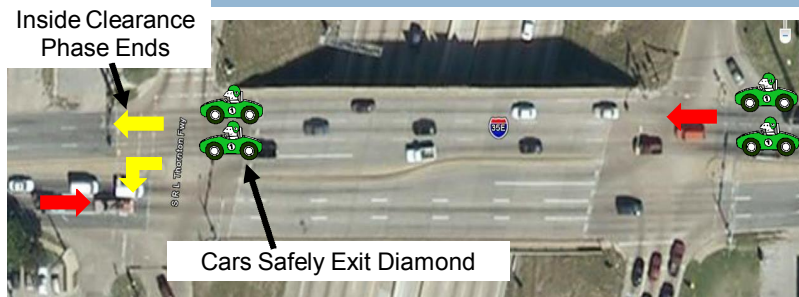
3 Phase – Safety Audit



3 Phase – Safety Audit



3 Phase – Safety Audit

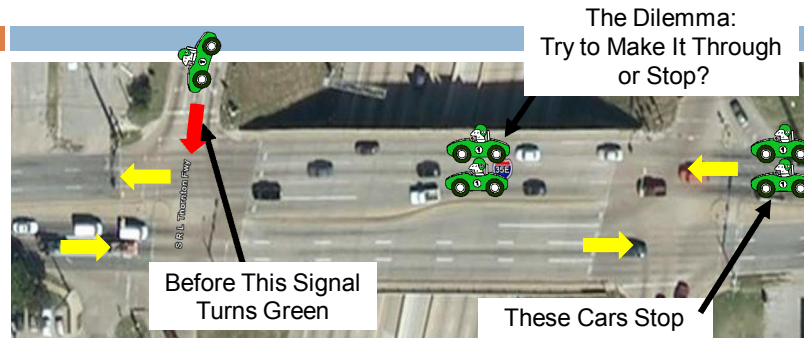


3 Phase – Safety Audit



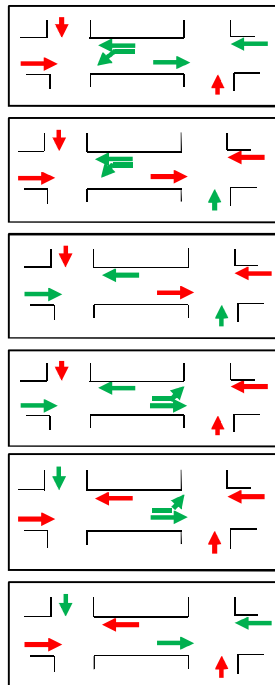
- Provide inside clearance at all times
- Check late night and/or free mode settings

3 Phase – Safety Audit



- Provide inside clearance at all times
- Check late night and/or free mode settings

4 Phase (TTI) Pros and Cons



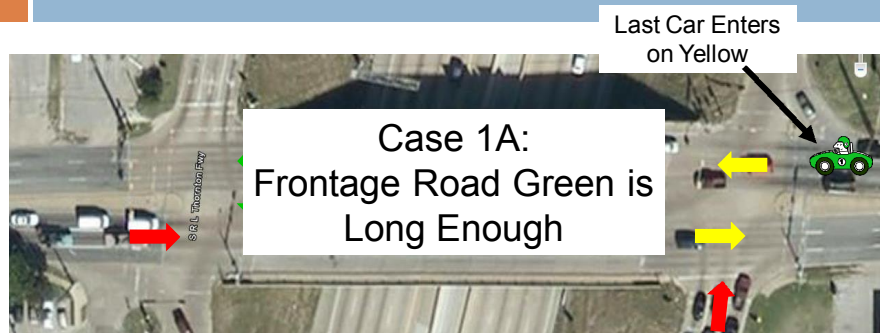
Pros

- No Stops Inside Diamond
- No Left Turn Storage Needed
- Narrow Diamonds

Cons

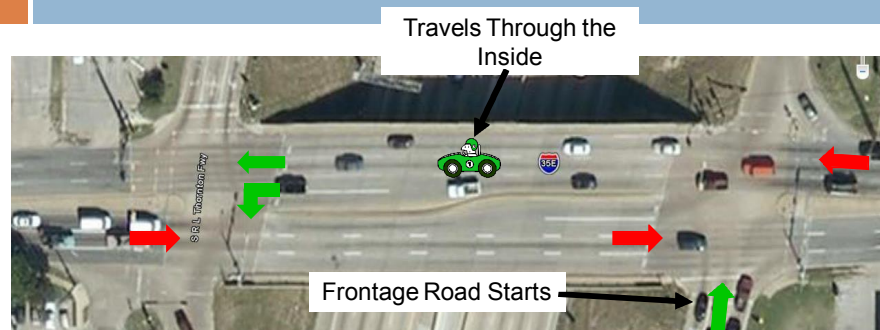
- One Approach Green at a Time
- Least Efficient
- Pedestrian Delay

4 Phase – Safety Audit



- Provide minimum frontage road service

4 Phase – Safety Audit



- Provide minimum frontage road service

4 Phase – Safety Audit



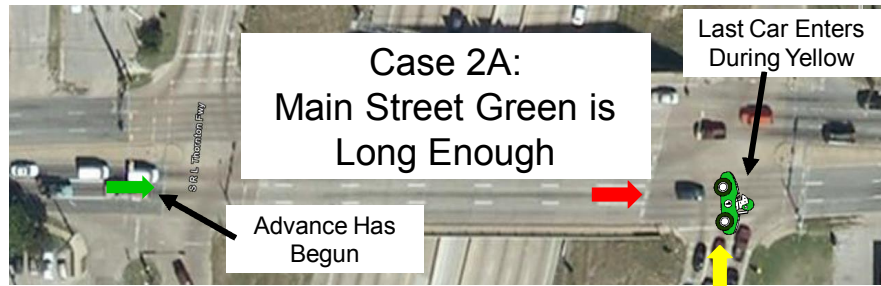
- Provide minimum frontage road service

4 Phase – Safety Audit



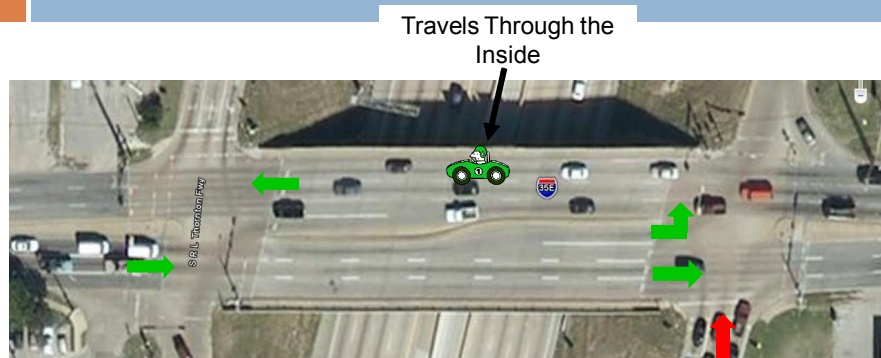
- Provide minimum frontage road service
 - ▣ Clear Last Left Turn Vehicle
- Short Cycle Lengths/Free Mode

4 Phase – Safety Audit



- Provide Minimum Main Street Service

4 Phase – Safety Audit



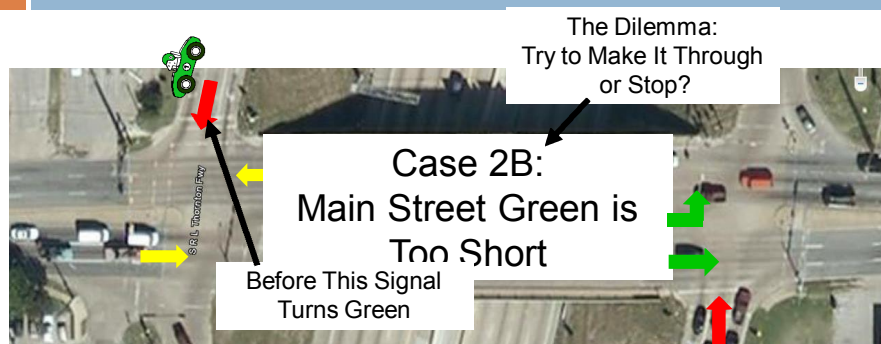
- Provide Minimum Main Street Service

4 Phase – Safety Audit



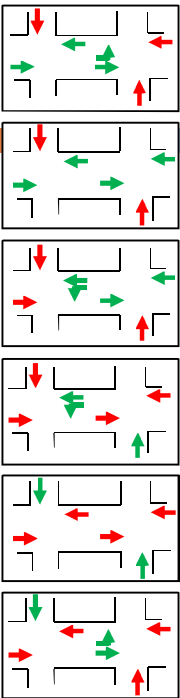
- Provide Minimum Main Street Service

4 Phase – Safety Audit



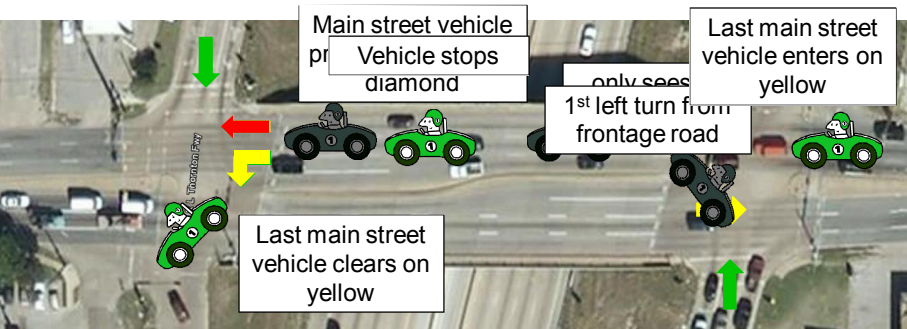
- Provide Minimum Main Street Service
 - ▣ Clear Last Left Turn Vehicle from the Frontage Road
- Short Cycle Lengths/Free Mode

Lead-Lag



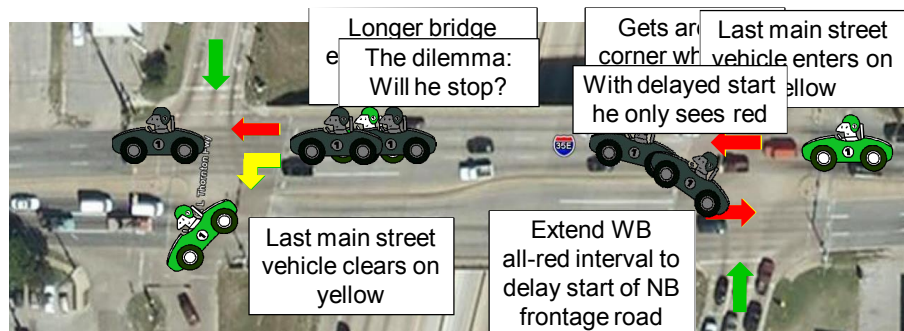
- Pros
 - Best sequence for directional volumes
 - Flexibility to meet wide variety of demand combinations
- Cons
 - Requires sufficient left turn storage
 - Additional delay for minor movements
 - Left turns from frontage roads stop twice

Lead-Lag – Safety Audit



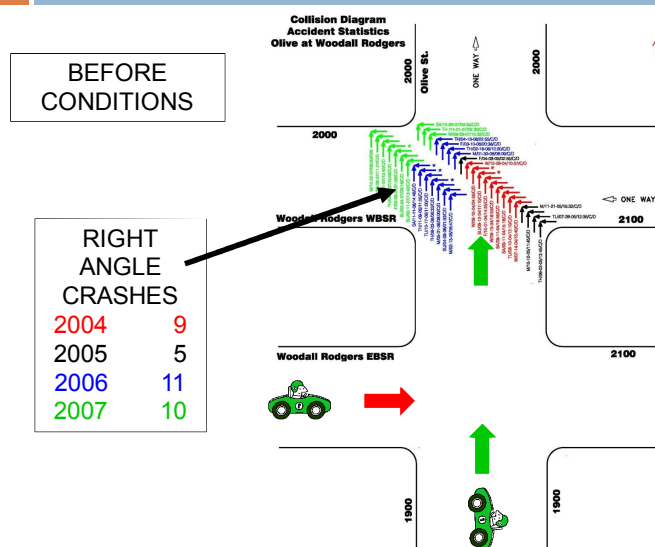
- Provide a precise inside clearance
 - Clear last main street left-turn vehicle
 - Display red for the first frontage road vehicle

Lead-Lag – Safety Audit

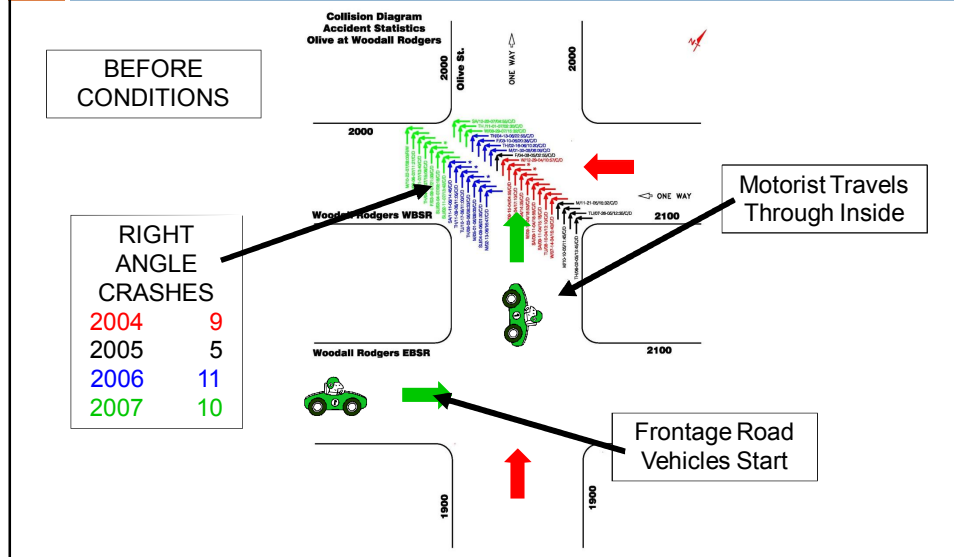


- Provide a precise inside clearance
 - Clear last main street left-turn vehicle
 - Display red for the first frontage road vehicle

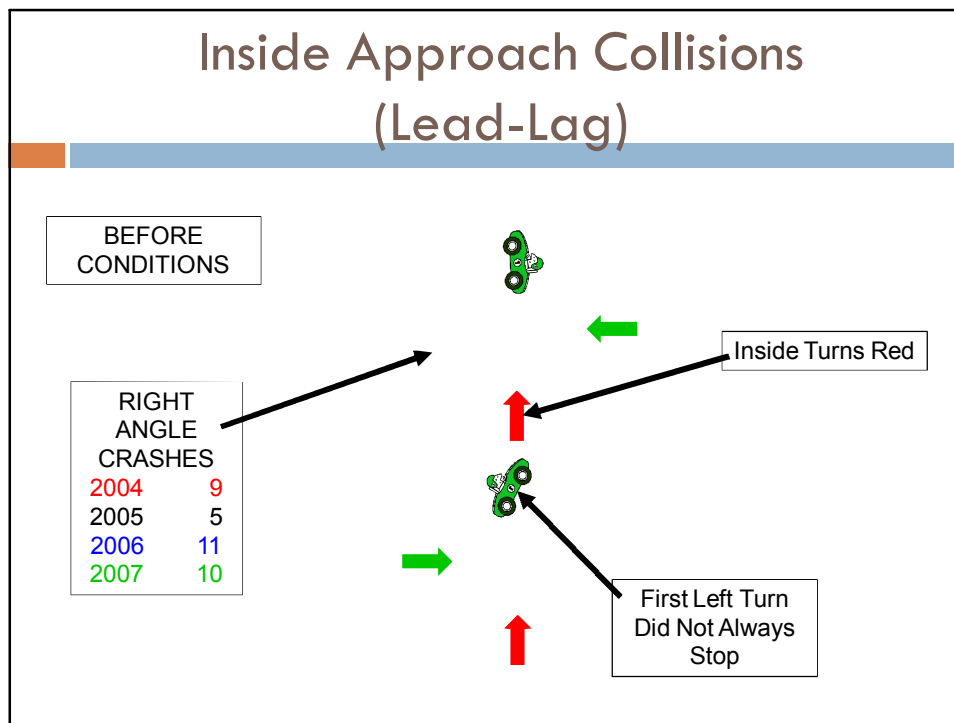
Inside Approach Collisions (Lead-Lag)



Inside Approach Collisions (Lead-Lag)



Inside Approach Collisions (Lead-Lag)



Inside Approach Collisions (Lead-Lag)

BEFORE
CONDITIONS

Result: Right
Angle Crashes

RIGHT
ANGLE
CRASHES

2004	9
2005	5
2006	11
2007	10

Inside Approach Collisions (Lead-Lag)

BEFORE
CONDITIONS

Fewer Right
Angle Crashes

9 Per Year
To
2 Per Year

RIGHT
ANGLE
CRASHES
ON LAGGING
NBLT

2009	2
------	---

Solution: Add 1
Second of All
Red on South
Side

Inside Approach Collisions (Lead-Lag)

BEFORE
CONDITIONS

Left Turn Crashes

RIGHT ANGLE
CRASHES ON
INSIDE
APPROACHES

2007 7
2008 7

Recommendation:
Use Flashing Yellow Arrow
Alerts Drivers When
Permitted

Inside Approach Collisions (Lead-Lag)

BEFORE
CONDITIONS

Right Angle Crashes

RIGHT ANGLE
CRASHES ON
INSIDE
APPROACHES

2007 7
2008 7

Step One: Increased All Red
Step Two: Changed to 4 Phase

Inside Approach Collisions (4 Phase - TTI)

AFTER
CONDITIONS

RIGHT ANGLE
CRASHES ON
INSIDE
APPROACHES

2009 1

Inside Approach Collisions (Lead-Lag)

Only 2 Right Angle
Crashes

- Common features at lead-lag diamonds:
 - Heavier traffic on frontage roads
 - Overpass instead of underpass
 - Good signal visibility
 - Wider diamonds

Recommended Practice

- Implement a diamond audit procedure
 - ▣ Prepare collision diagrams
 - ▣ Review diamond sequences
 - ▣ Review all coordination plan settings
 - Minimum greens
 - Recalls
 - Detector settings
 - ▣ Implement Safety Recommendations
 - ▣ Follow up with collision diagram (3-4 months)

Questions?