Alternatives to Turbo Roundabouts

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What led to the interest in Turbo roundabouts in Europe?

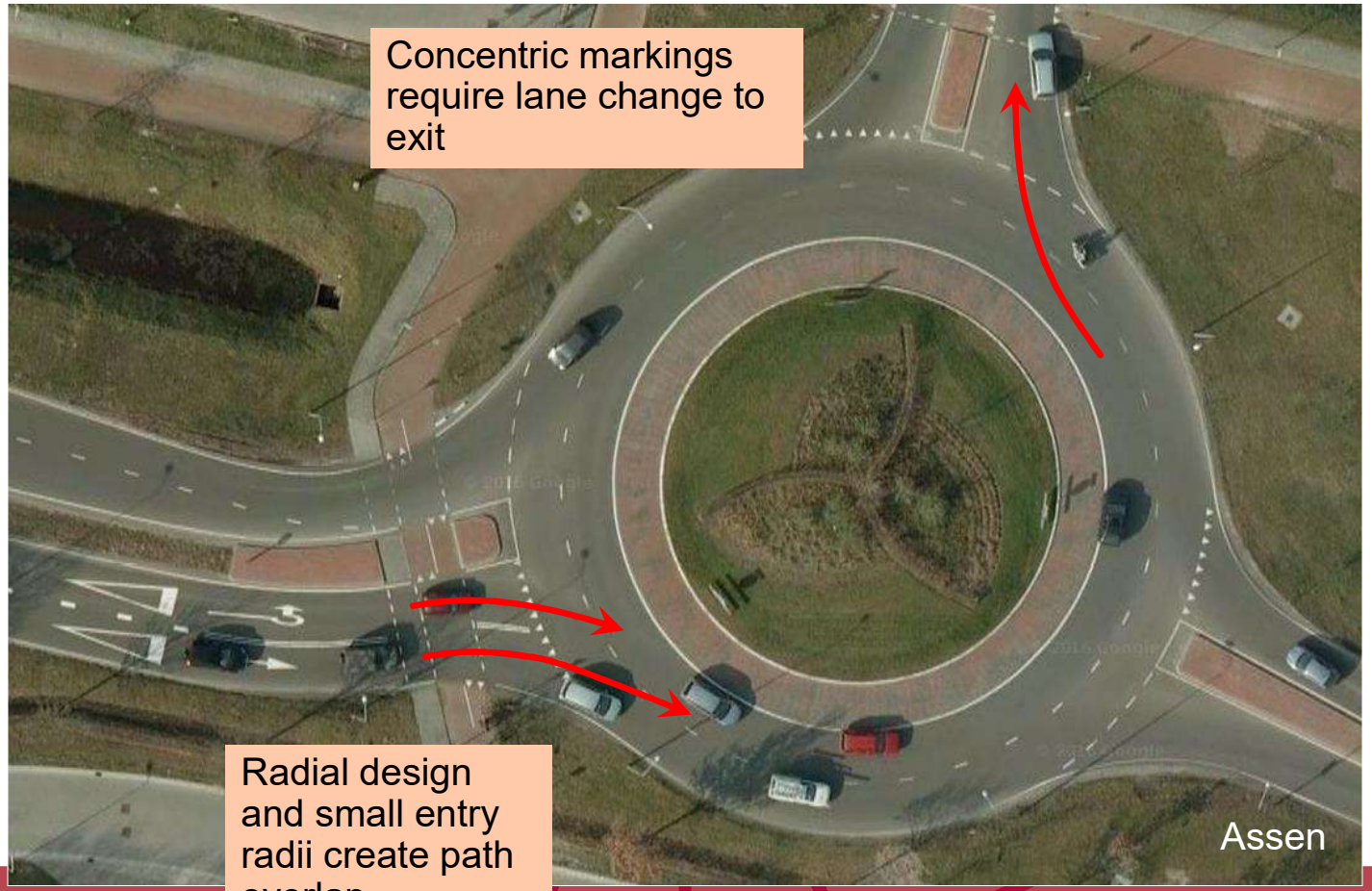
- Radial design without natural entry path tangents between lanes
- Multilane PDO crash incidence was higher than expected
- Uncoordinated designs: geometry, signs, markings
- Predisposed to more control and more devices (like Europe) vs. less (Like the U.K.)

Turbo Roundabout in Europe (2005)

Fig. 9: Typical driver behavior at a compact two-lane roundabout: unused left lane on a two-lane entry

- Due to interactions of circulating flows with fast vehicles leaving the circle from the inner lane, these two-lane exits often are a reason for injury accidents.
- Therefore, multilane roundabouts are not recommended for application in Germany. Especially 2-lane exits are completely banned.

Early Pre-Turbo Multi-Lane Roundabouts In Europe (2000 – 2005)



What is prompting the use of Turbo Roundabouts in the U.S.

- Multilane PDO crash incidence was higher than expected
- Uncoordinated designs: geometry, signs, markings
- Predisposed to more control and more devices (like Europe) vs. less (Like the U.K.)
- Very few examples or case studies to date, but lots of enthusiasm. Is it a solution looking for a problem?

Entry/Exit Path Alignment (N. America)

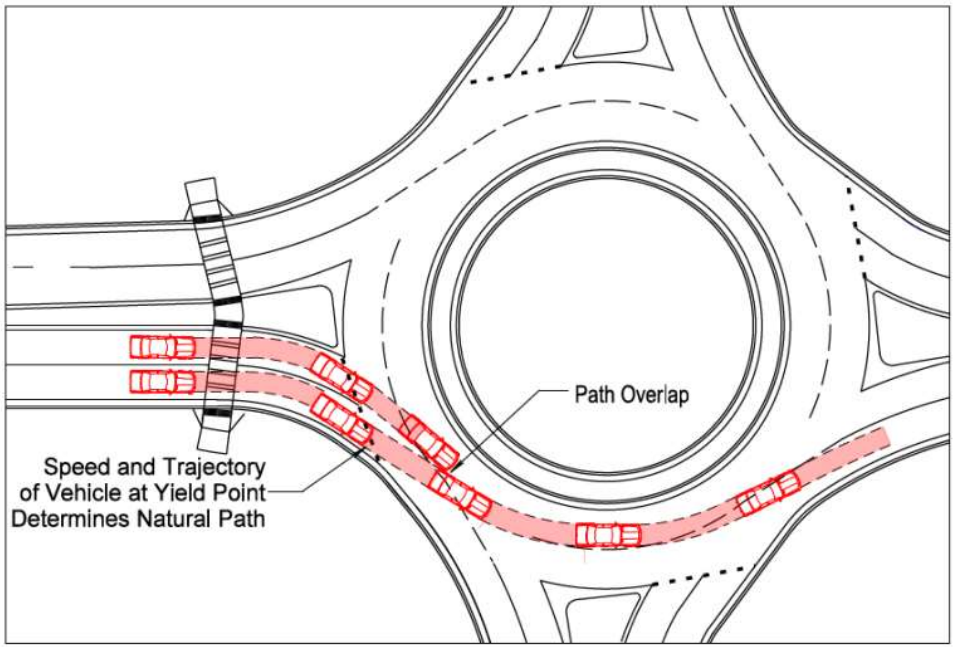


Figure 3-29. Entry Path Overlap (Avoid)

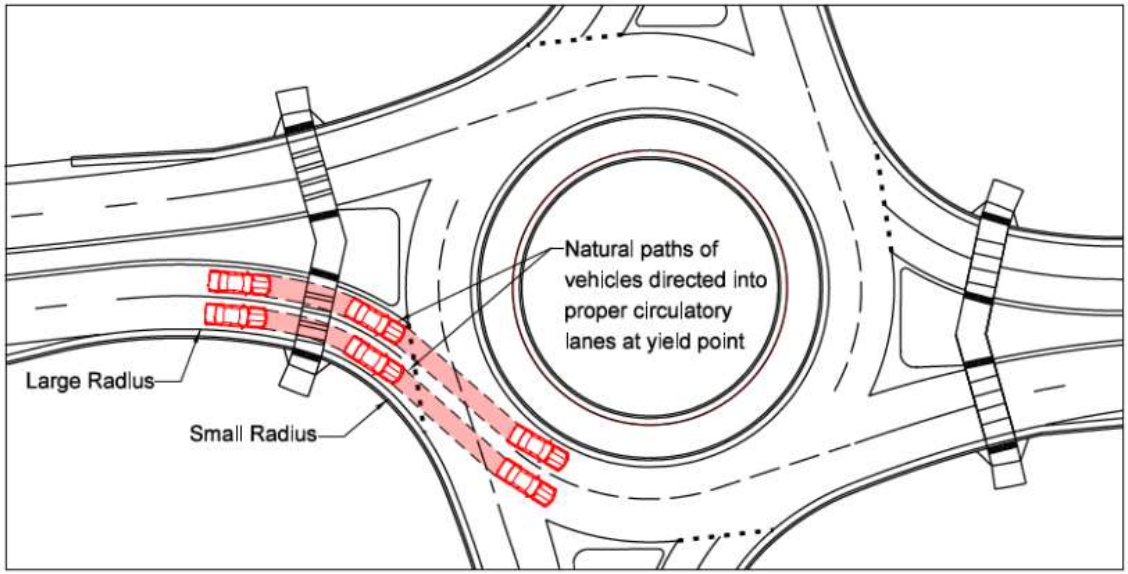


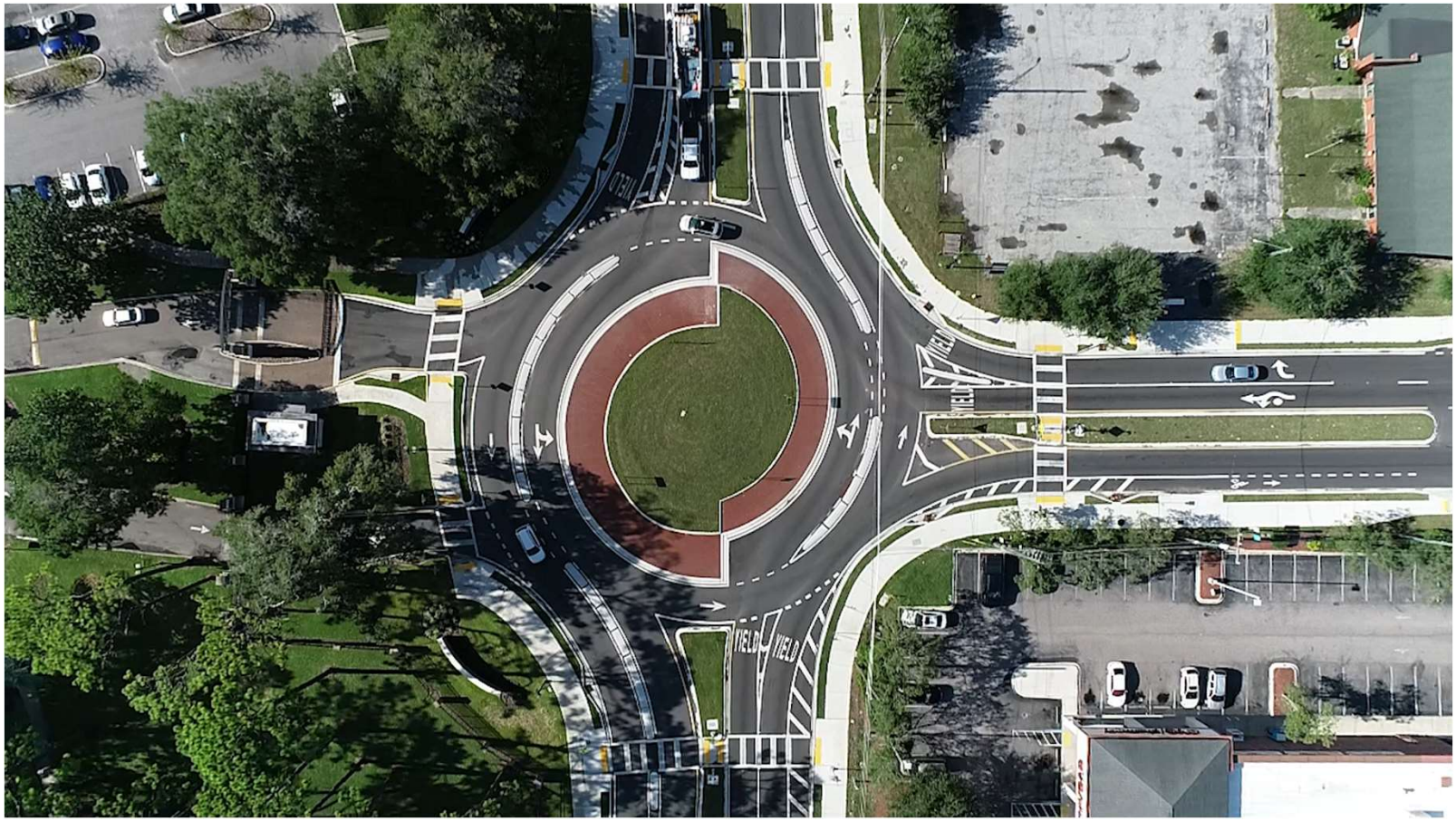
Figure 3-30. Multilane Entry Design to Minimize Path Overlap

Without natural entry path design, the response:

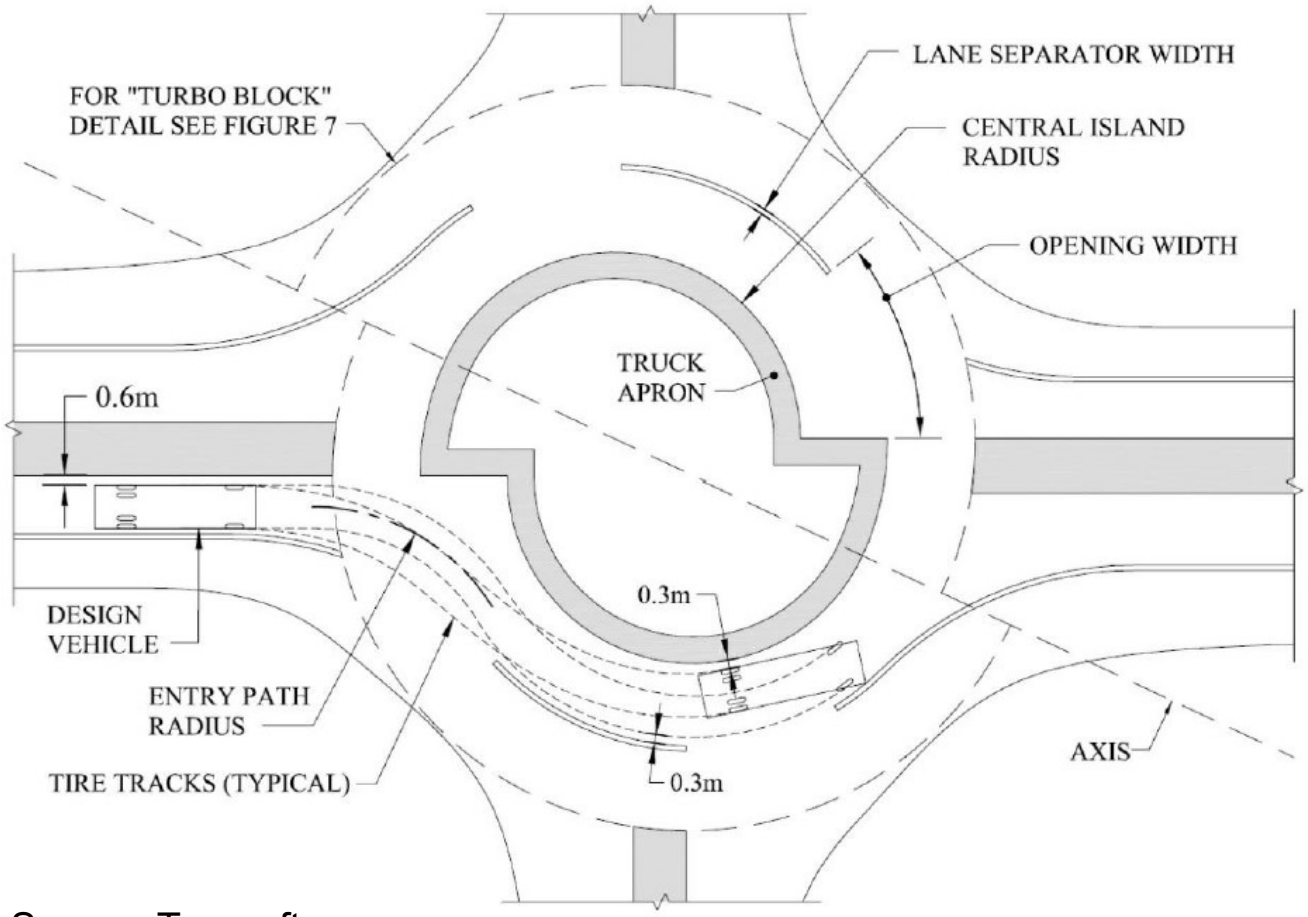
Turbo Roundabouts

FHWA is looking into Turbos

First U.S. Turbo Roundabout (Jacksonville, FL)



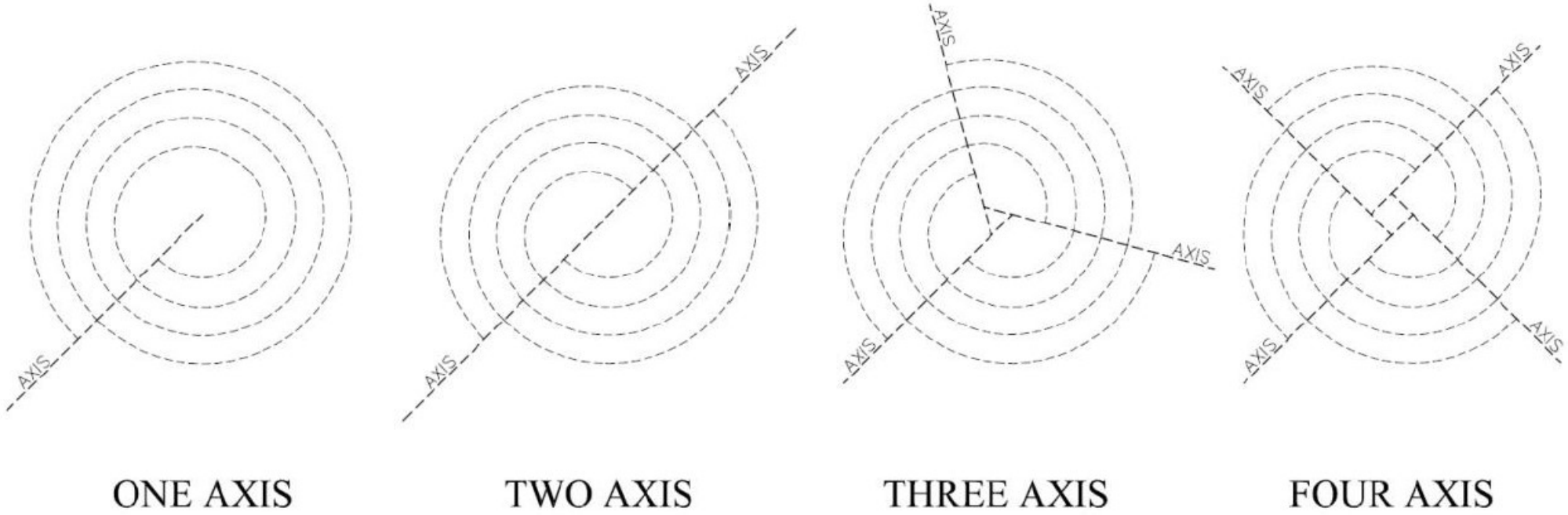
Geometric design parameters of a turbo-roundabout



Source: Transoft

Wal-Mart

Turbo-blocks detail with one to four axes



ONE AXIS TWO AXIS THREE AXIS FOUR AXIS

Source: Transoft

Some Differences in Geometric Design Composition

Turbo

- Radial alignment (fits r.o.w. well)
- Conformance based design
- Poor transitional geometric speed control
- Wide lanes
- Mainly single lane exits
- Lower capacities
- Constrained for trucks and OSOW
- Fairly rigid constraints on geometric design
- Raised dividers place motorcyclists at risk
- **Consistent speeds near roundabout x-walks**

Conventional Multilane

- Left-offset alignment
- Performance-based Design (lane demands, speed, space, sight)
- Most flexible & adaptable design method – deep toolbox
- Relies on all aspects of design (lane configuration, geometry, markings, signs being complementary)
- Fewer constraints on performance-based design
- Inconsistent speeds near roundabout crosswalks

Expanding the Toolbox

Two Lane Roundabout Toolbox

Left Offset

More Radial

No Lane Buffer

Raised Lane divider

Conventional (NCHRP672)

Conventional Spiraled

Conventional Case 2

Buffered Roundabouts Nonspiraled

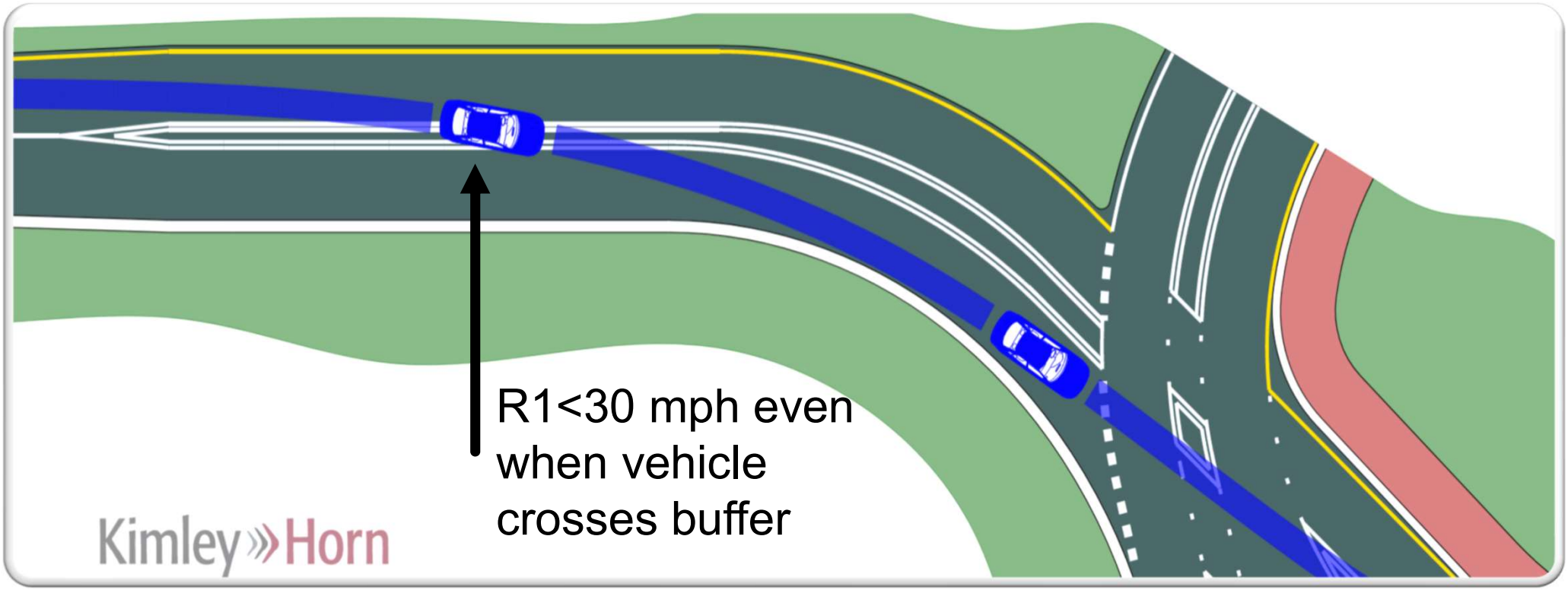
Buffered Roundabouts Spiraled

Dutch Turbo

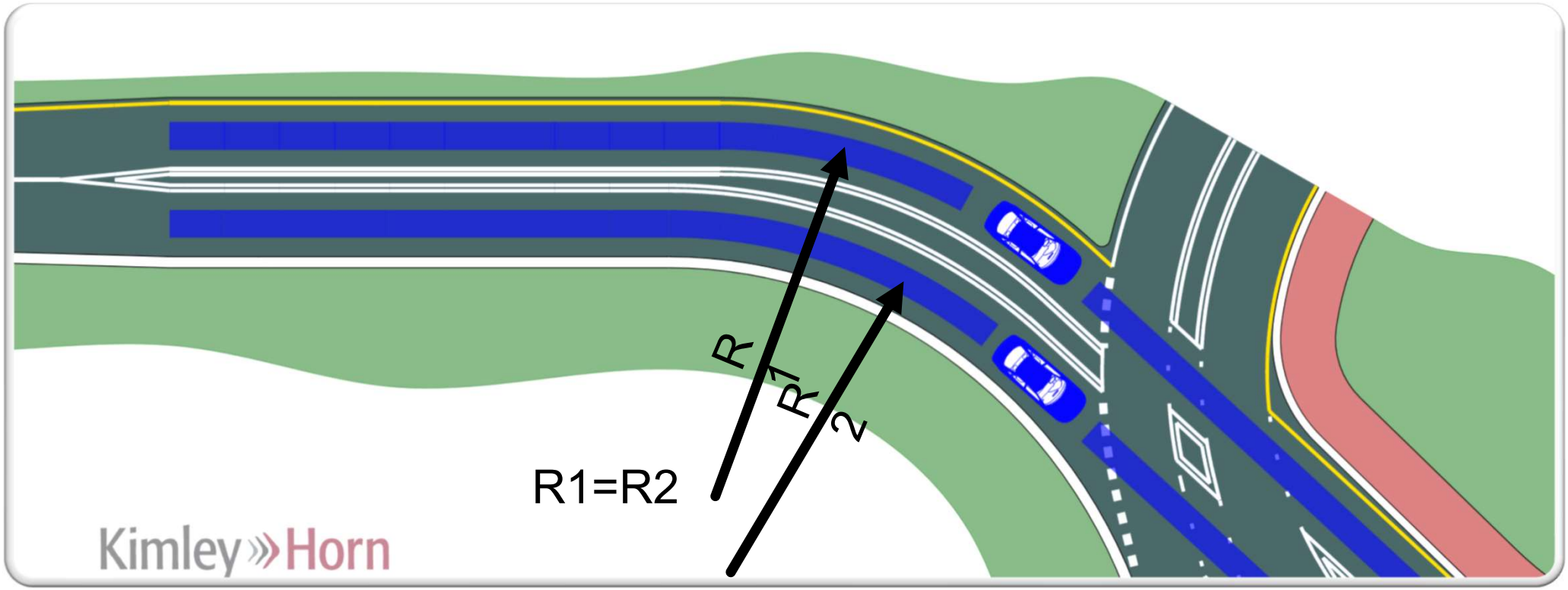
Context: Retrofit a crash-prone RAB or address difficult geometry and R/W in design (skews)

Context: Fully radial for R/W preservation & difficult geometries

Fast Path Discouraged but still left-offset

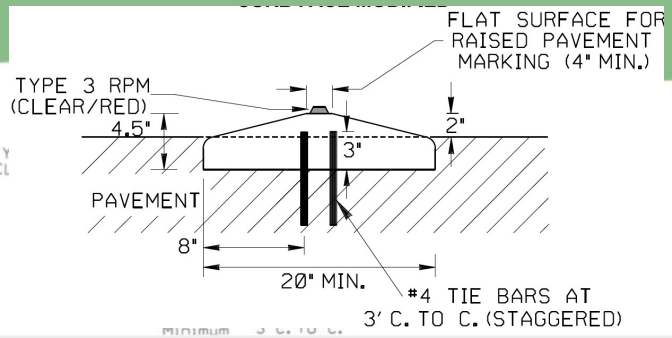


Consistent Speeds at Crosswalks = Predictability



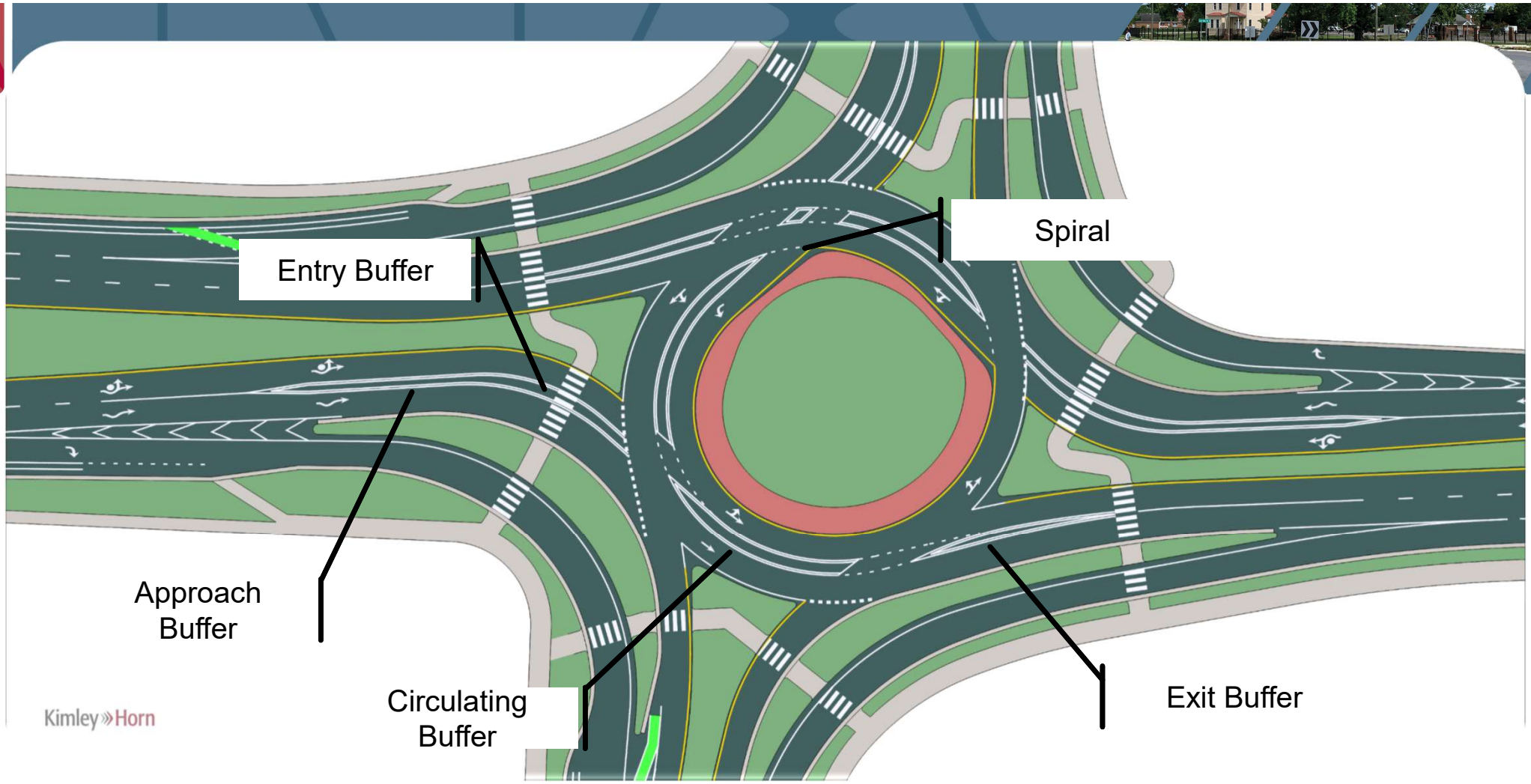
Fast Path – Mitigations (if needed)

Raised Pavement Markers
Rumble Strips
Mountable Median

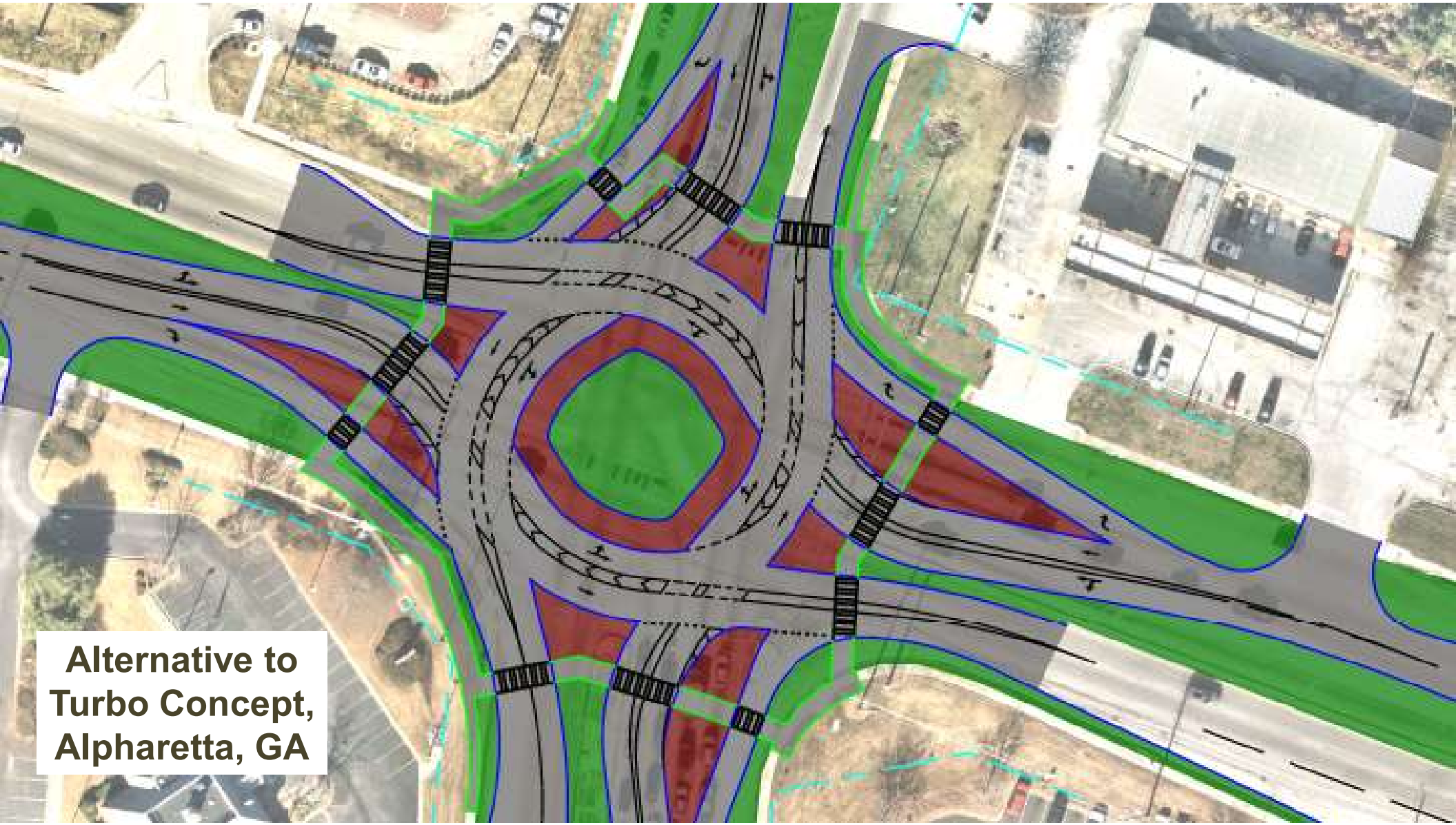


Okay for snow climate – raised divider is on tangent

Kimley»Horn



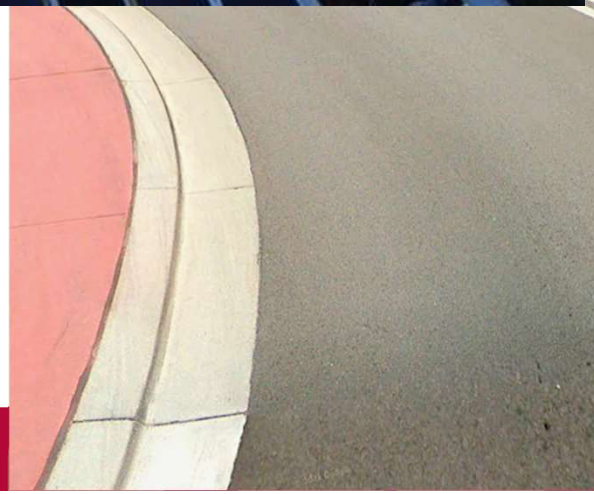
Buffered Lanes Roundabout Components


Alternative to
Turbo Concept,
Alpharetta, GA

No raised dividers

Buffered Lane Design
RAB
Sarasota, FL

Source: Ken Sides



Case Study

- Multi-Lane Roundabout
  - Rural / Suburban
  - Approximately 5 years operations
  - Higher than expected crashes
- In-Service Review
  - Drones assisted in diagnostics
  - Tiered improvements
- Tier 1 Improvement
  - Buffered Lanes
  - Sign modifications
  - Completed May 2022

Recent Collision History

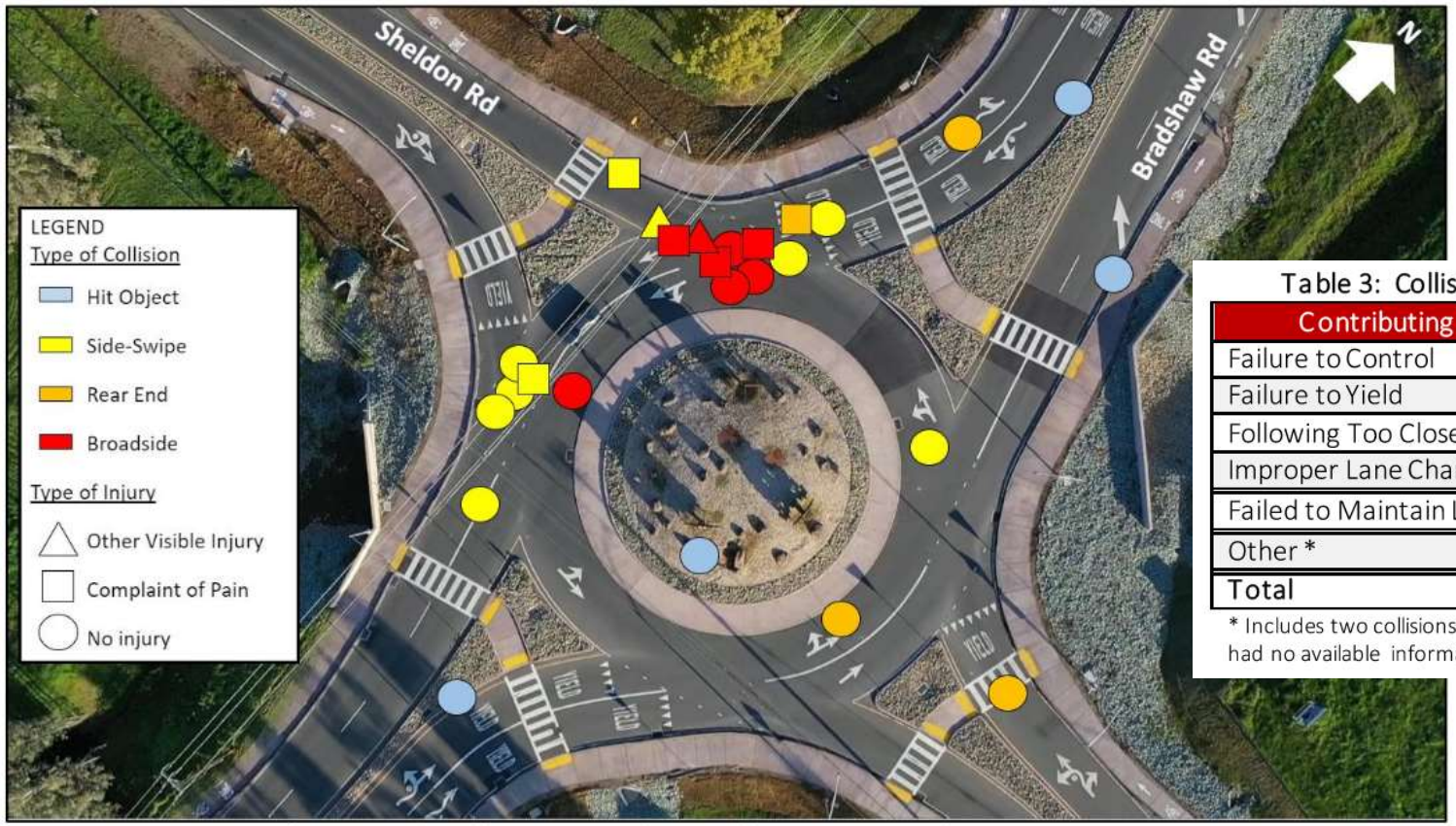


Table 3: Collision Totals by Contributing Factor

Contributing Factor	Number of Collisions
Failure to Control	4
Failure to Yield	13
Following Too Close	1
Improper Lane Change/Passing	4
Failed to Maintain Lane	1
Other *	5
Total	28

* Includes two collisions (collision numbers 19-005446 and 19-006599) that had no available information on their contributing factors.

Figure 1: Location of Historical Collisions Based on Collision Type and Injury Severity Note: Information on collision location was not available for collision numbers 19-005446 (broadside with no injury) and 19-006599 (hit object with no injury)

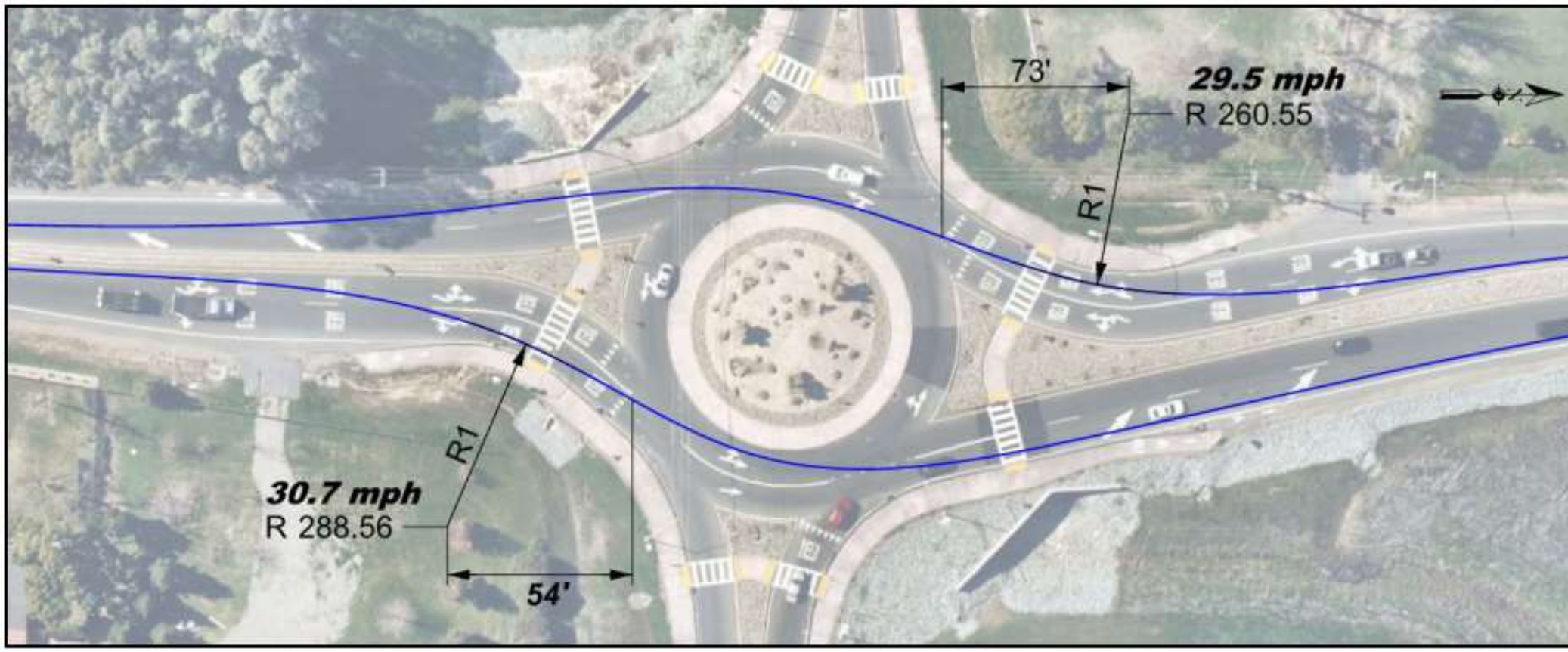
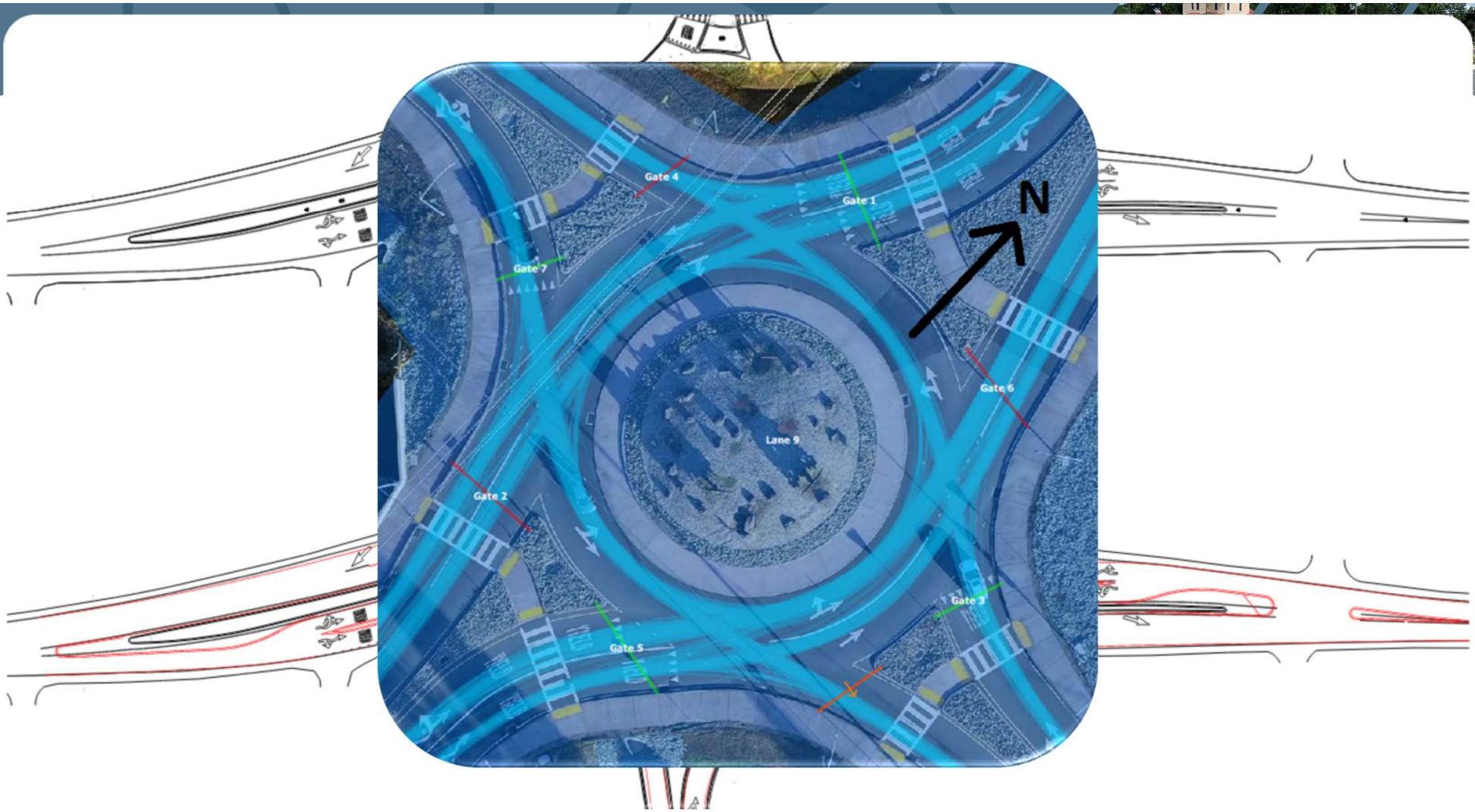


Figure 9: Estimated Fastest Paths

Figure 3: Driving Patterns

% Veh Over Target	7.3%	19.2%	4.9%	5.1%
Avg Thru Speed	24.8	21.9	23.0	20.6

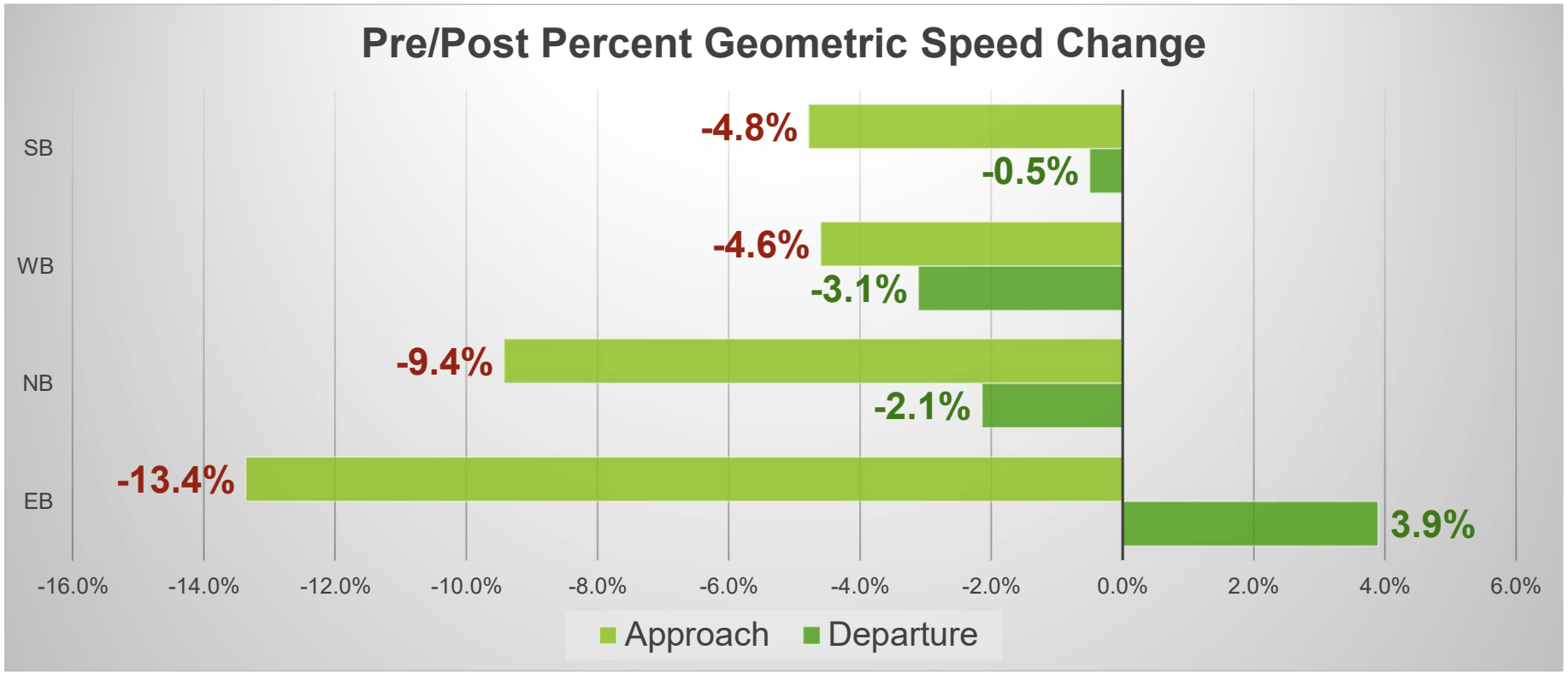


Buffered Case Study

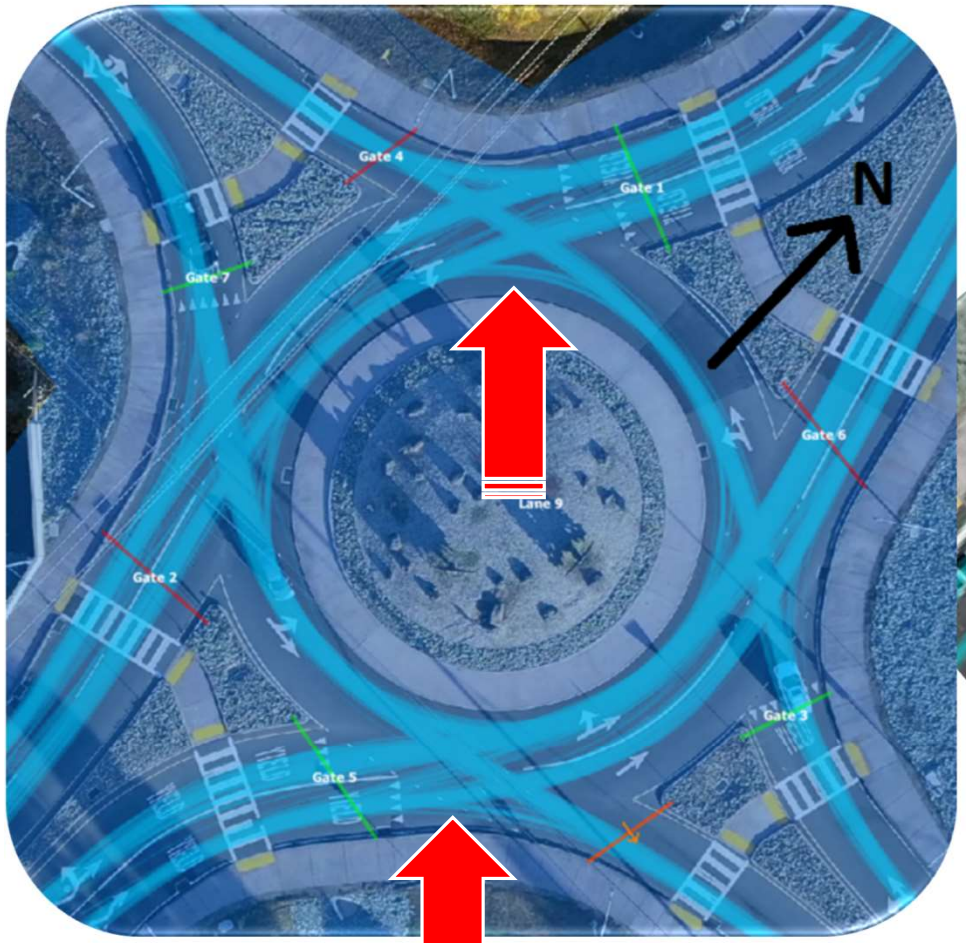
Kimley»Horn

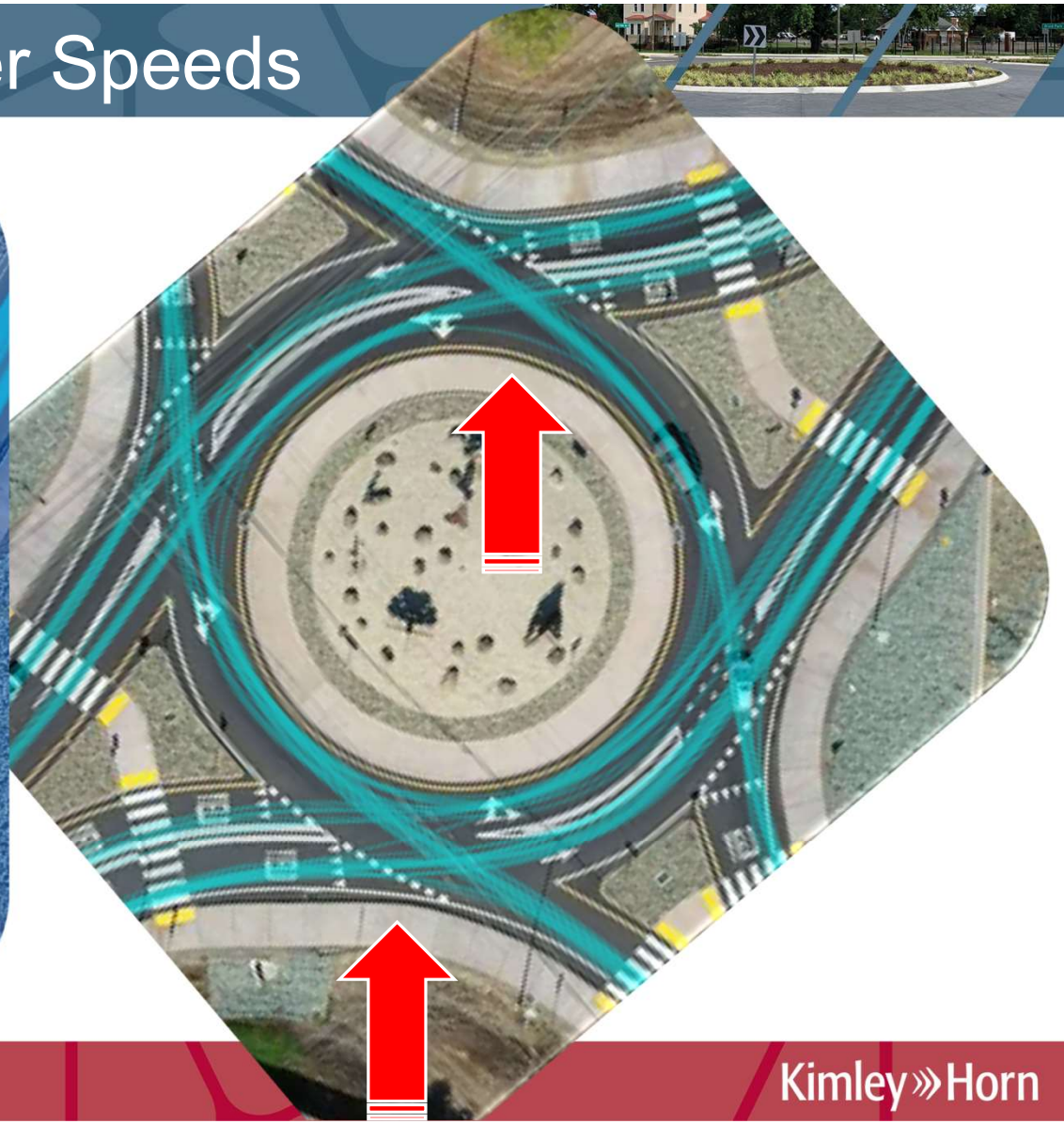
AFTER Conditions

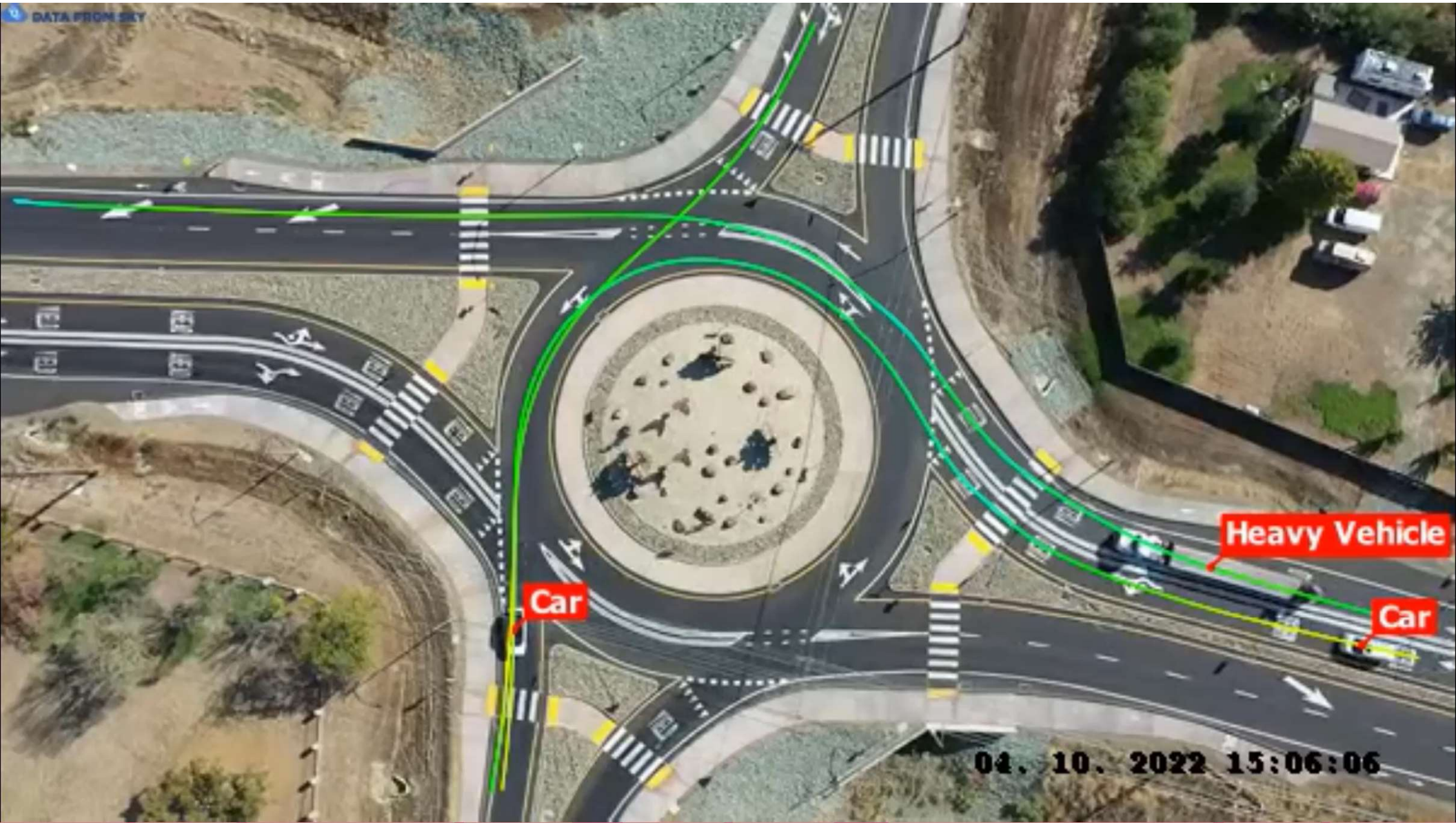
85th Percentile Speeds Reduced



Lane Discipline and Lower Speeds






DATA FROM SKY
Heavy Vehicle
Car
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FHWA Pooled Fund Study 2020 - Summary of Key Findings

- Key Crash Patterns of Interest
  - Drivers in the outside entering lane failing to yield to drivers in the inside circulating lane
  - Drivers making left-turns from the incorrect outside lane
  - Drivers maing right-turns from the incorrect inside lane
  - Drivers straddling lanes and crossing lanes lines when entering, circulating or exiting