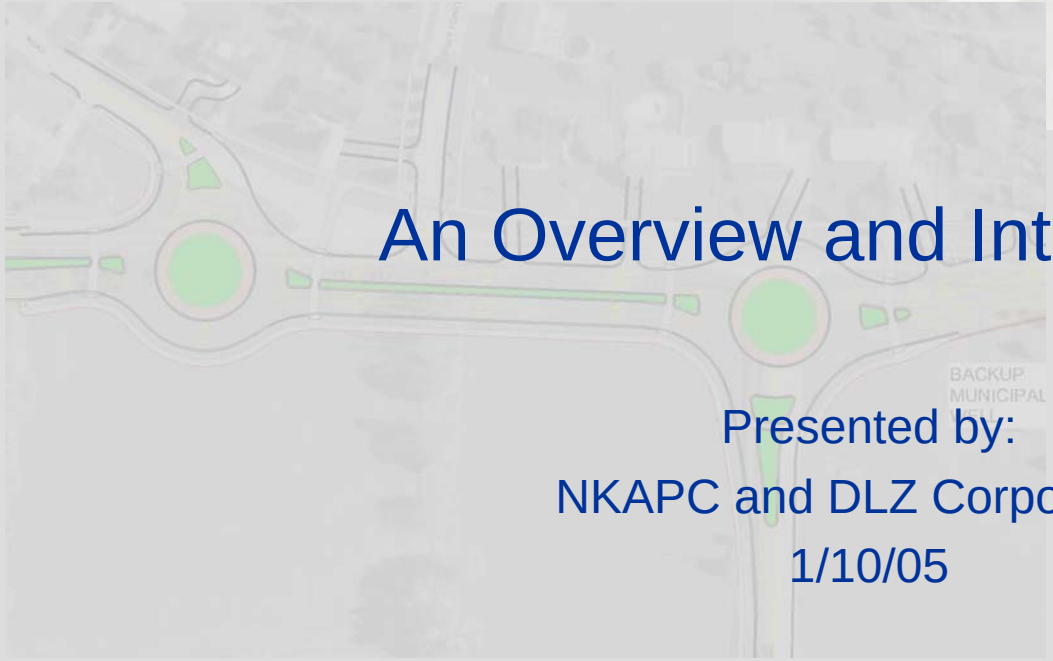
What is a Modern Roundabout?



An Overview and Introduction

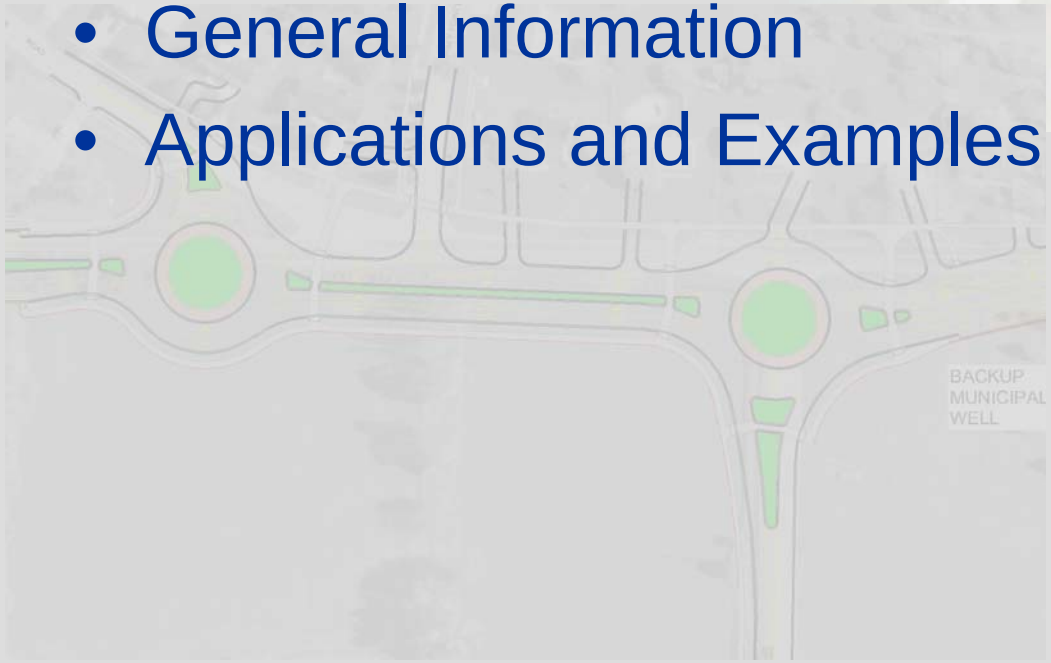
Presented by:

NKAPC and DLZ Corporation

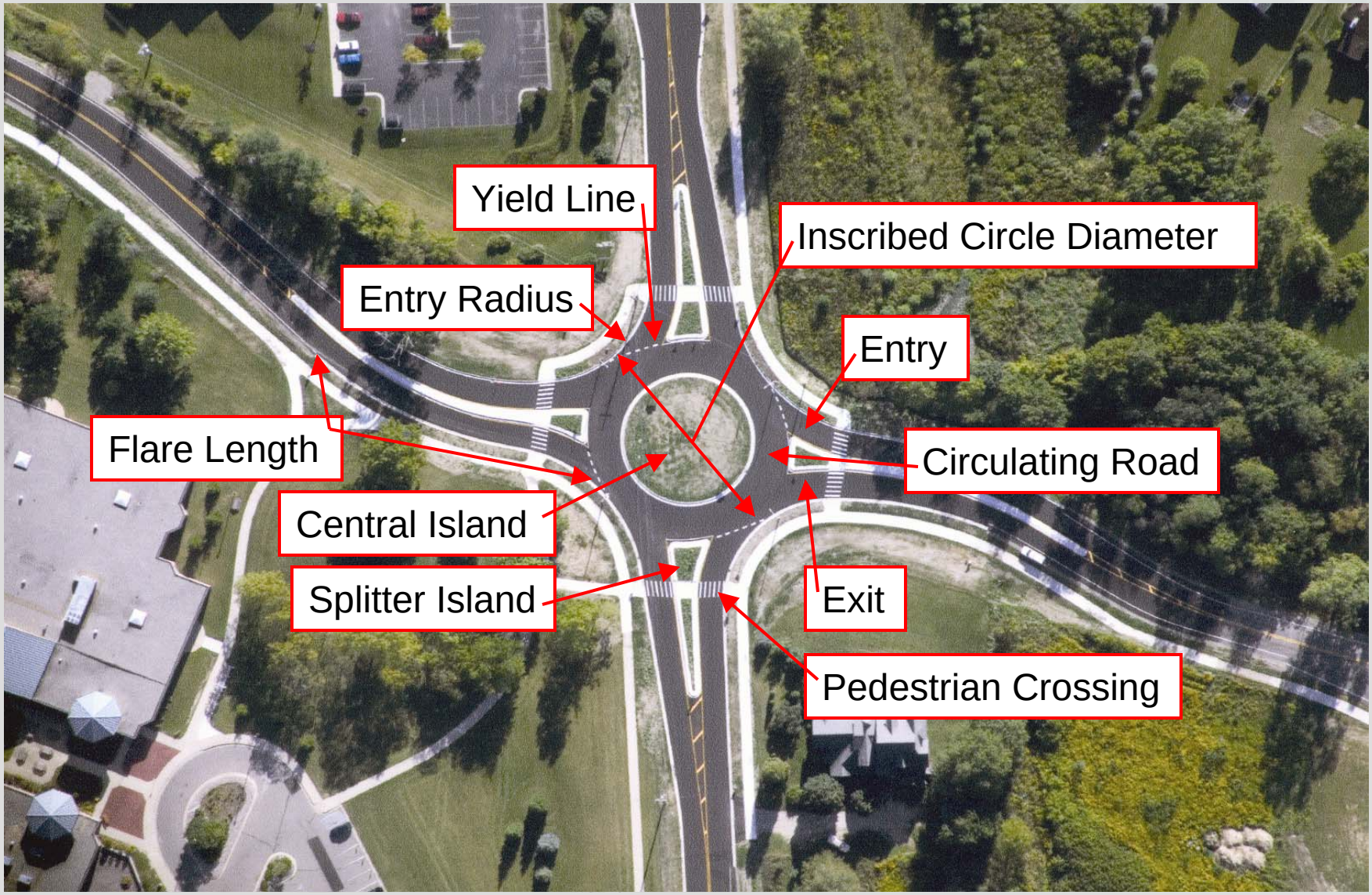
1/10/05

Topics

- General Terminology
- Comparison to Traffic Circles
- Video Clips
- General Information
- Applications and Examples



Roundabout Terminology

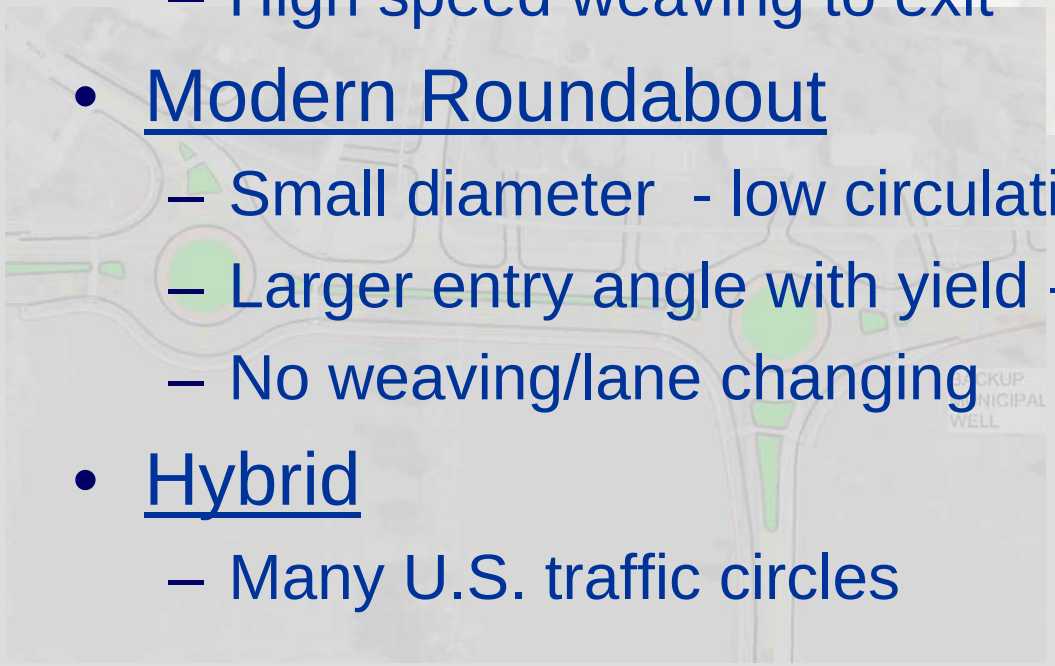


What is a Modern Roundabout?

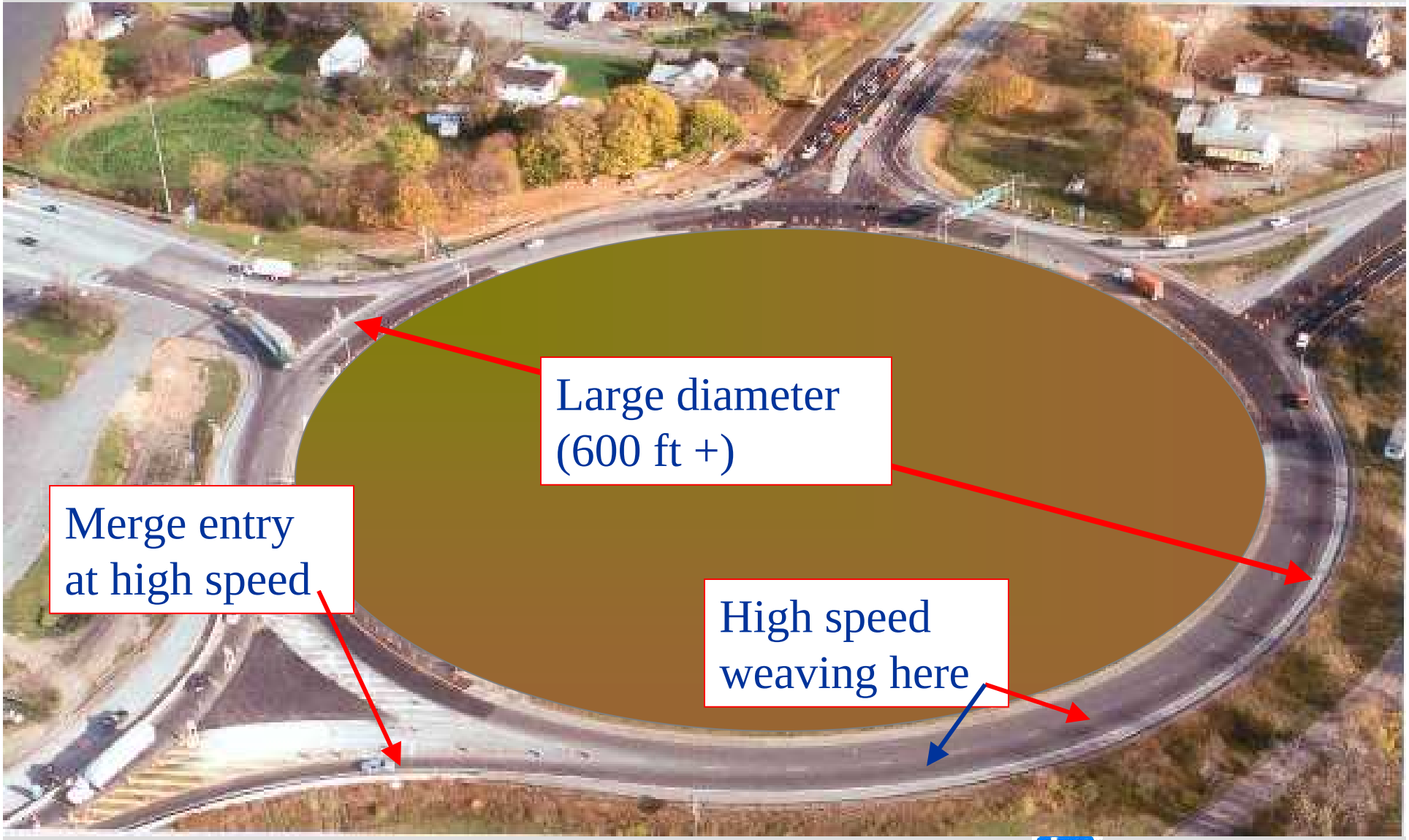
- Many misperceptions
- Not simply a circular intersection
- All **true** roundabouts include:
  - Circular roadway
  - Yield at entry
  - Low speeds due to curvature
  - Precisely designed based on local peak hour traffic volumes
- Great variety
- **Not the same as traffic circles**

What are the Differences?

- Classic Traffic Circle ("Rotary")
  - Large diameter - high circulating speeds
  - Shallow angle entry merge - high entry speeds
  - High speed weaving to exit
- Modern Roundabout
  - Small diameter - low circulating speeds
  - Larger entry angle with yield - lower entry speeds
  - No weaving/lane changing
- Hybrid
  - Many U.S. traffic circles



Kingston, NY – Traffic Circle



Kingston, NY – Traffic Circle Conversion to Roundabout

Example of Modern Roundabout

Practical Differences

- Traffic Circles:
  - More crashes when volumes increase – can exceed signal
  - Congestion (capacity determined by weave/merge)
  - Gridlock
- Roundabouts:
  - Opposite of traffic circles
  - Low crashes
  - No congestion (capacity determined by geometry)
  - Promising at many intersections

Marsh - Hamilton Roundabout

Colorado Roundabout

Please Note:

- 2 lanes
- Downstream gaps available
- Low speeds – real time
- Minimal delays/backups
- Signal platoon arrival
- Aesthetic enhancements

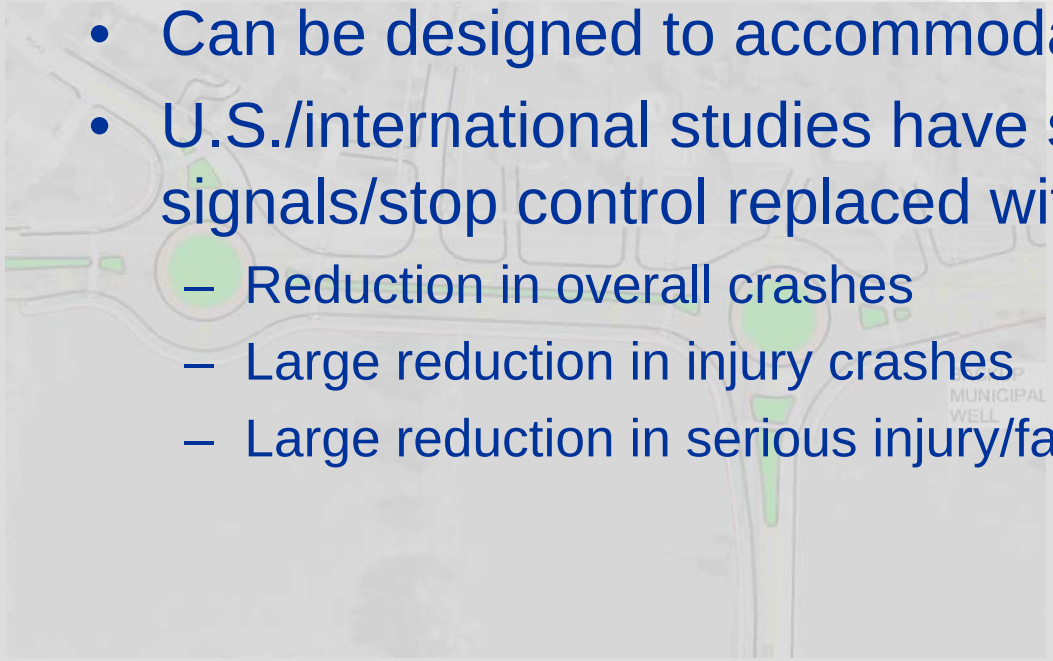
Traffic Circle Video Clip

Roundabouts: Pros and Cons

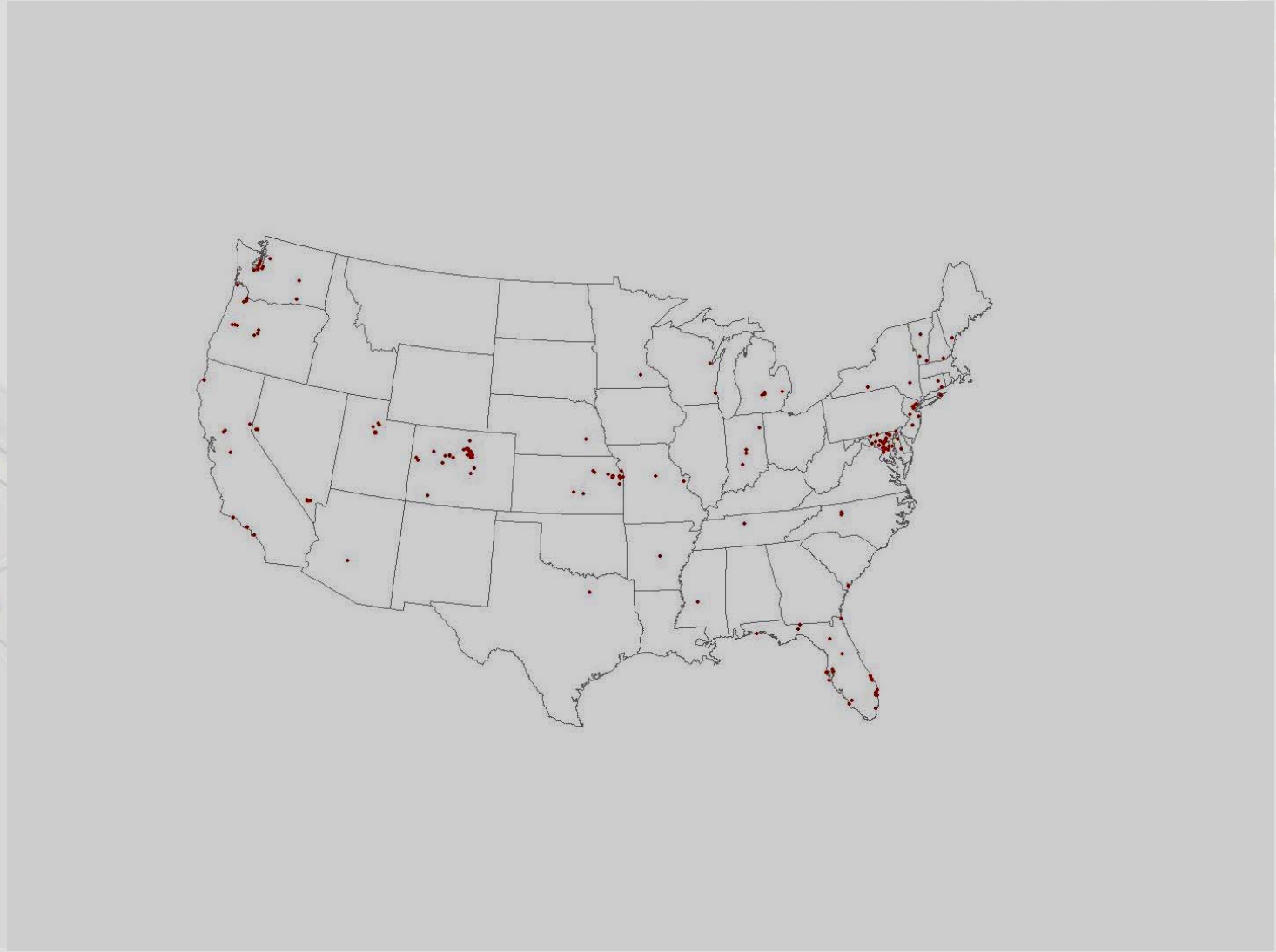
- Pros
  - Good traffic operations/low delays
  - Very safe when designed properly
  - Look attractive
  - Slows all traffic - calming effect
  - Low maintenance cost
  - Easily modified
  - Construction cost (no need to widen approach roads)
- Cons
  - Bicyclists should not circulate in roundabout
  - Blind pedestrians have expressed concern
  - Construction cost/ROW requirements at intersection
  - Learning curve for drivers – uncertainty
  - Improper design can cause problems

Other General Information

- Hundreds of roundabouts constructed over last 10 years in U.S.
- One, two, and three lane entries (complexity varies)
- Drivers have quickly adapted where constructed elsewhere in U.S. (including older drivers)
- Can be designed to accommodate large trucks
- U.S./international studies have shown when signals/stop control replaced with roundabouts:
  - Reduction in overall crashes
  - Large reduction in injury crashes
  - Large reduction in serious injury/fatality crashes

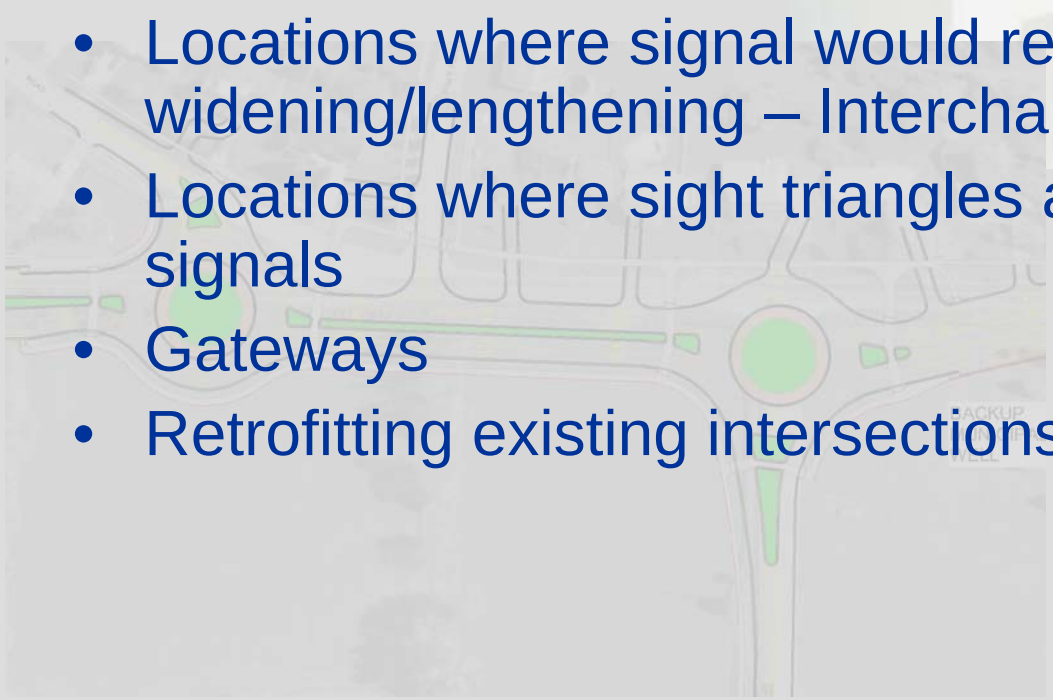


Roundabout Locations



Useful Applications

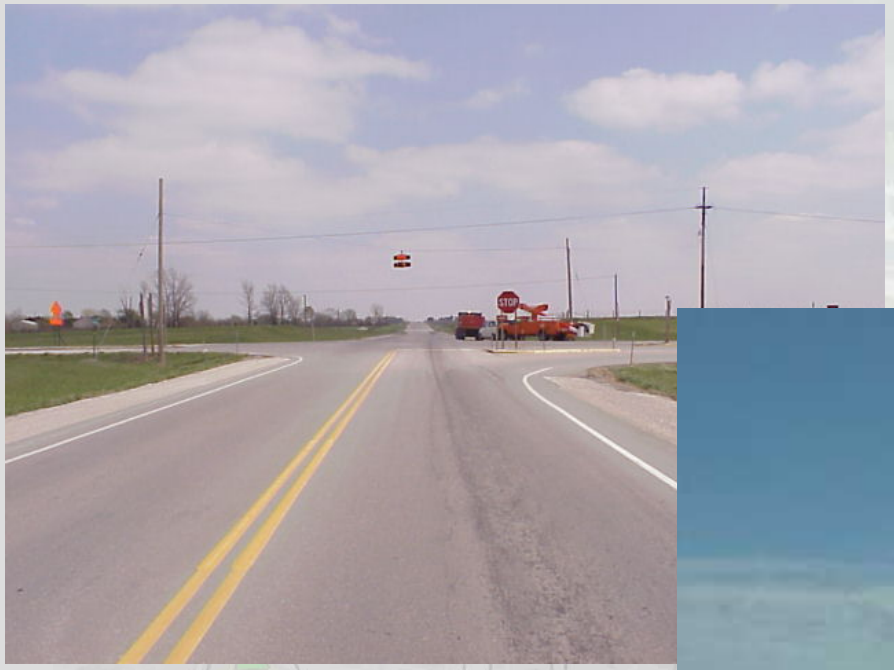
- Safety problems
- Capacity problems
- Closely spaced intersections
- Unusual geometry
- Residential areas – traffic calming
- Locations where signal would require bridge widening/lengthening – Interchanges and rail
- Locations where sight triangles are obscured for signals
- Gateways
- Retrofitting existing intersections



High Speed Rural Locations
Maryland Roundabout Tour

- MD 213 at Leeds Road
- AADT 8,125 (1997)
- Complete in Aug 1995 - first roundabout
- High speed rural
- Single Lane
- Landscape maintained by father of child killed before roundabout

High Speed Rural - Kansas



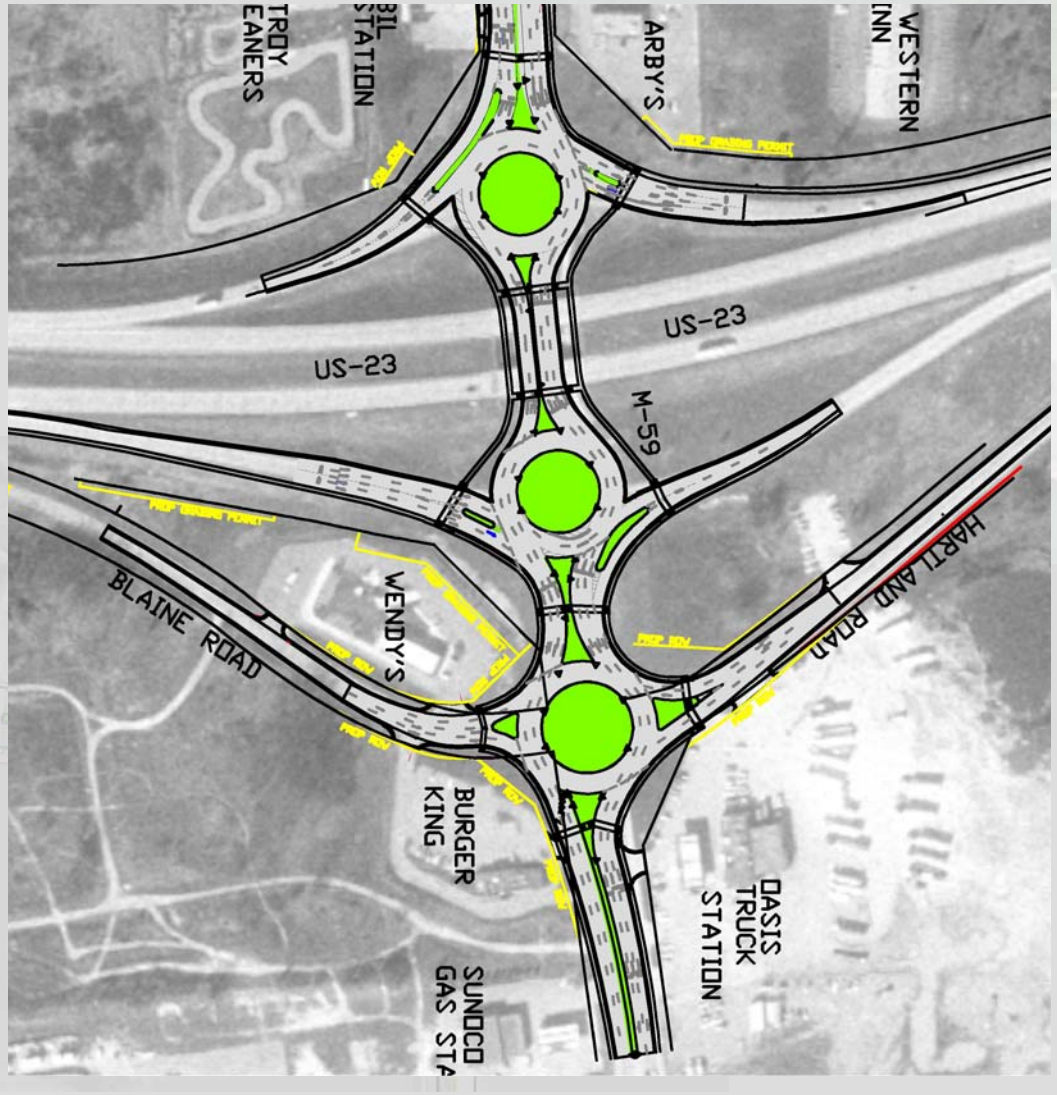
Skewed Intersections - Safety

Congested Intersections

Urban 2 Lane

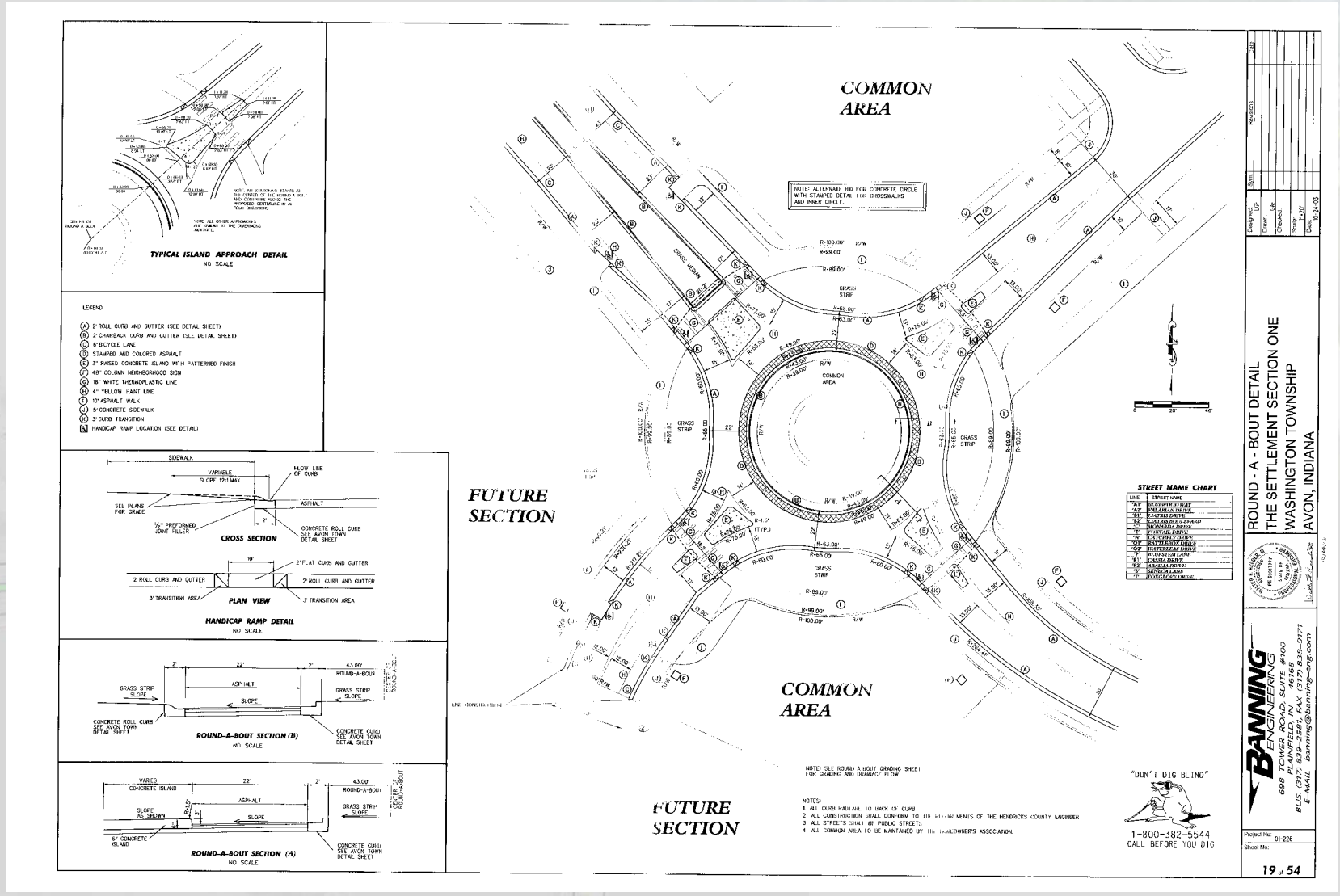
- Aesthetic improvements
- Context sensitive – partner with community
- Lots of landscaping and lights
- ADA pedestrian facilities

Closely Spaced Interchange



Residential Areas

Residential Areas



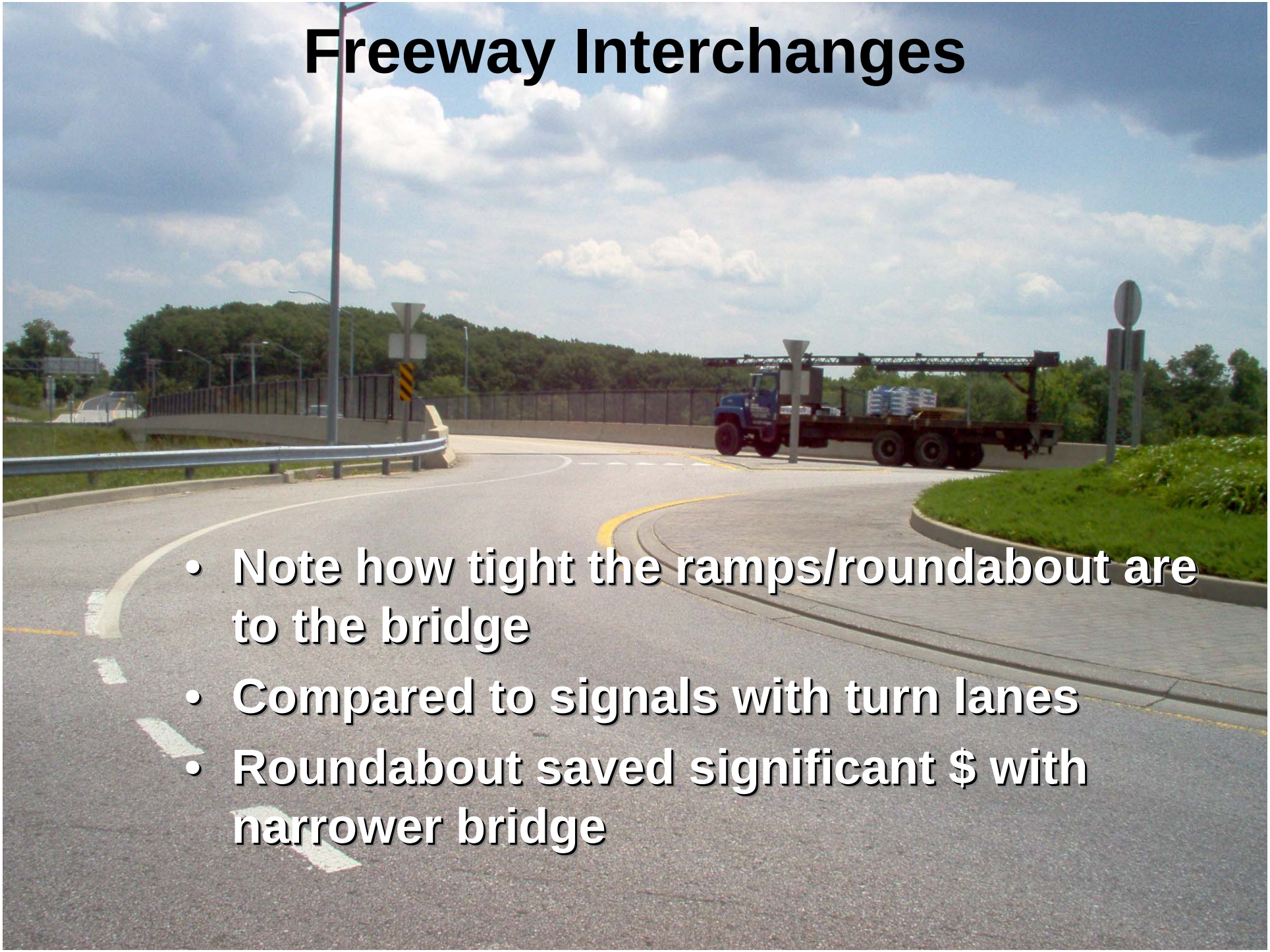
Gateway Entrance

Unusual Geometry

Freeway Interchanges

Constraint – Interchange Bridge

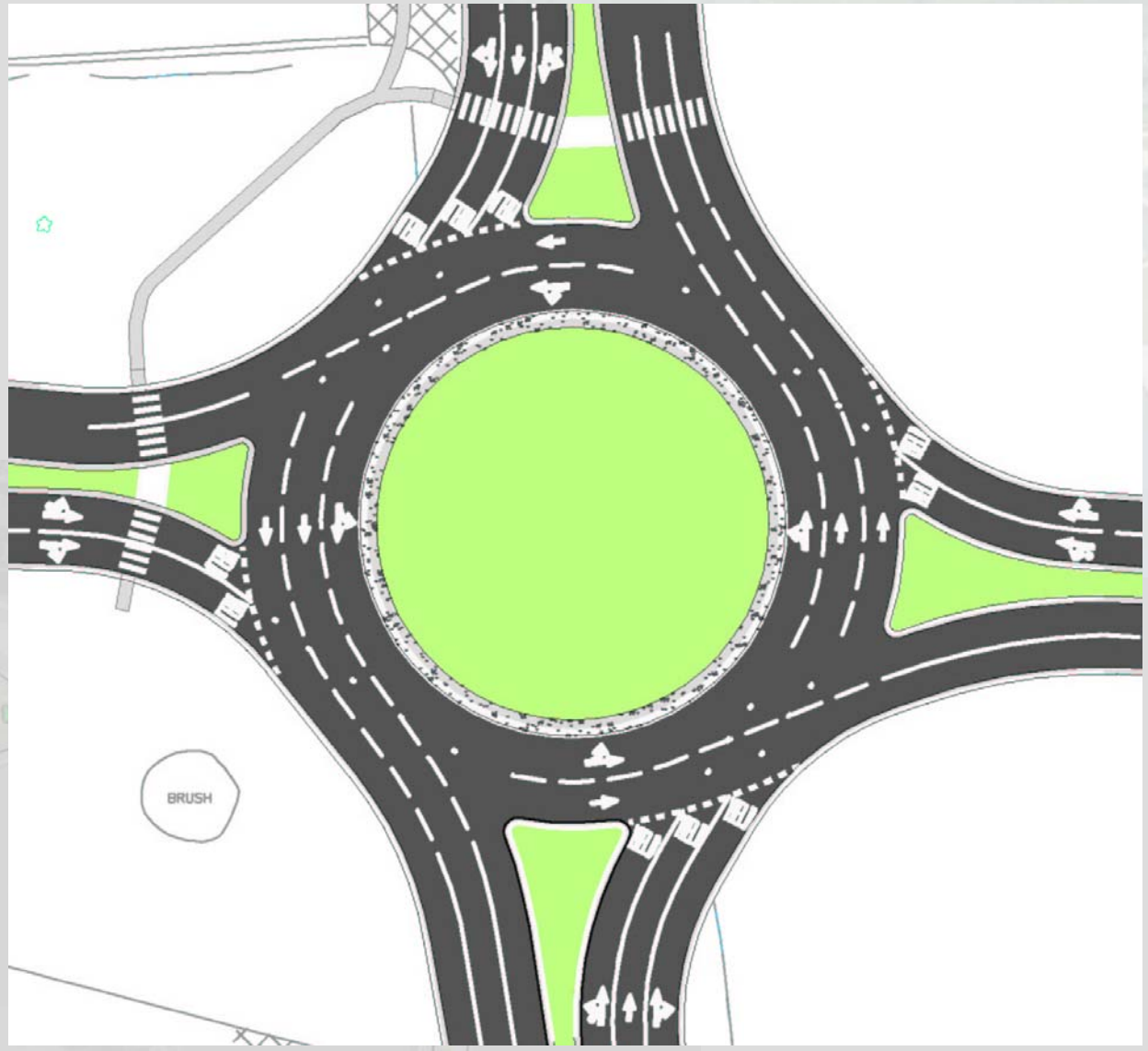
Freeway Interchanges



- Note how tight the ramps/roundabout are to the bridge
- Compared to signals with turn lanes
- Roundabout saved significant $ with narrower bridge

Freeway Interchanges

3-Lane Roundabout at Interchange

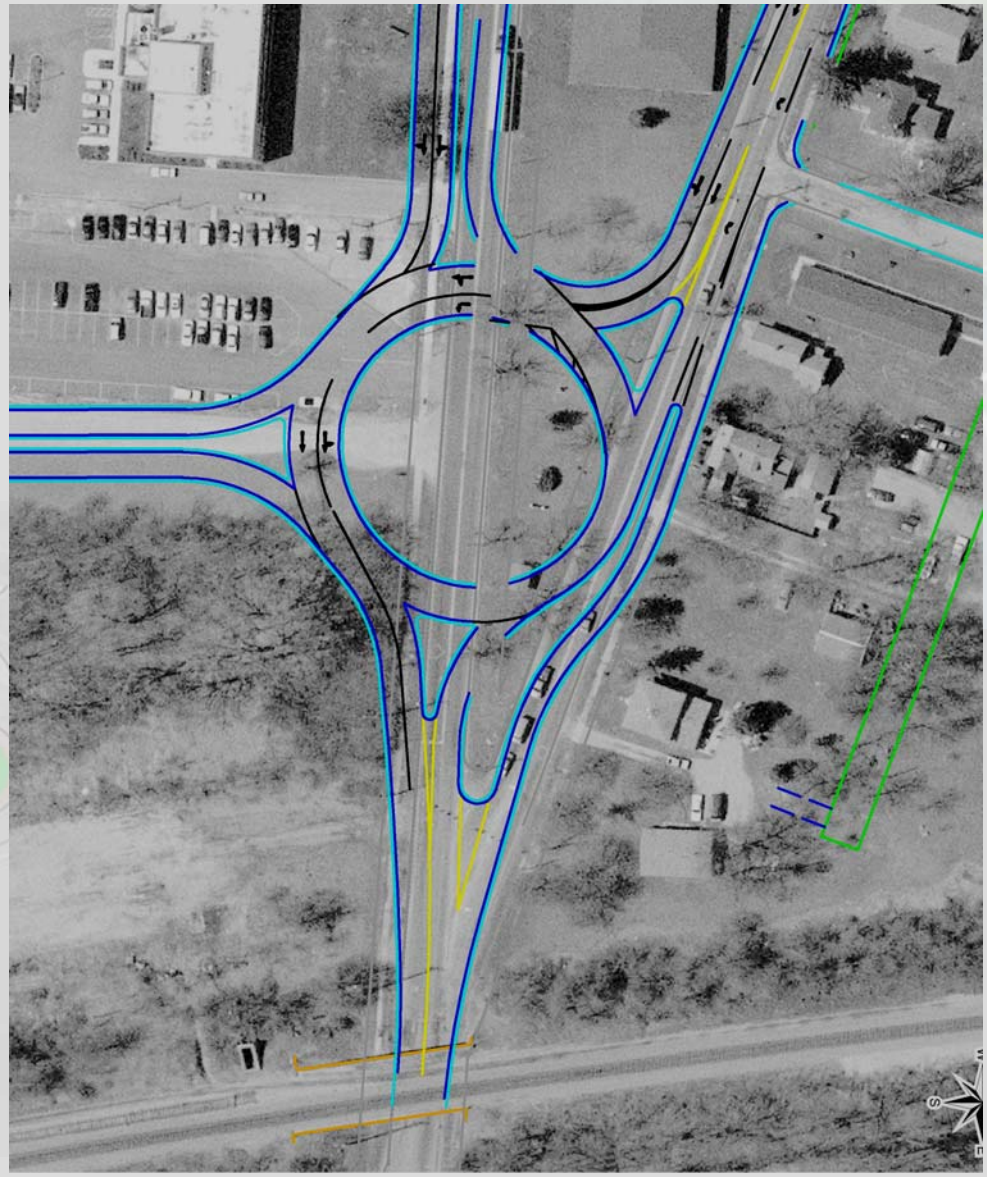


3-Lane Roundabout at Interchange

Freeway Interchanges

Single Lane Roundabouts at Diamond Interchange in Maryland – Similar to MDOT's concept for M-81 and I-75 Interchange near Saginaw

Tight Constraint – Rail Bridge



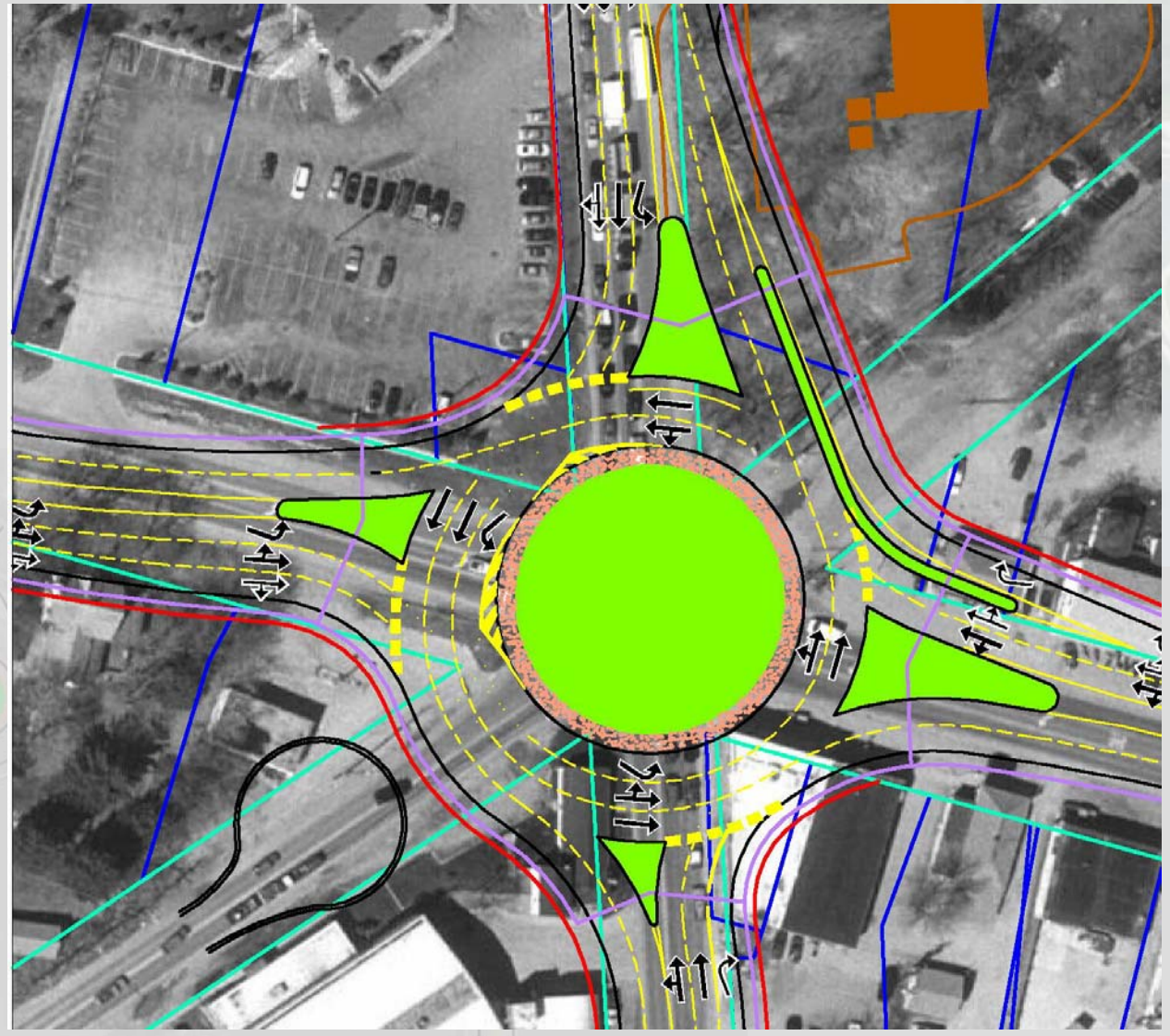
Tight Constraint – Mini Roundabout

Longton Old Rd Mini/Urban Compact

Tight Constraints – Urban Compact

Context Sensitive – Light Rail

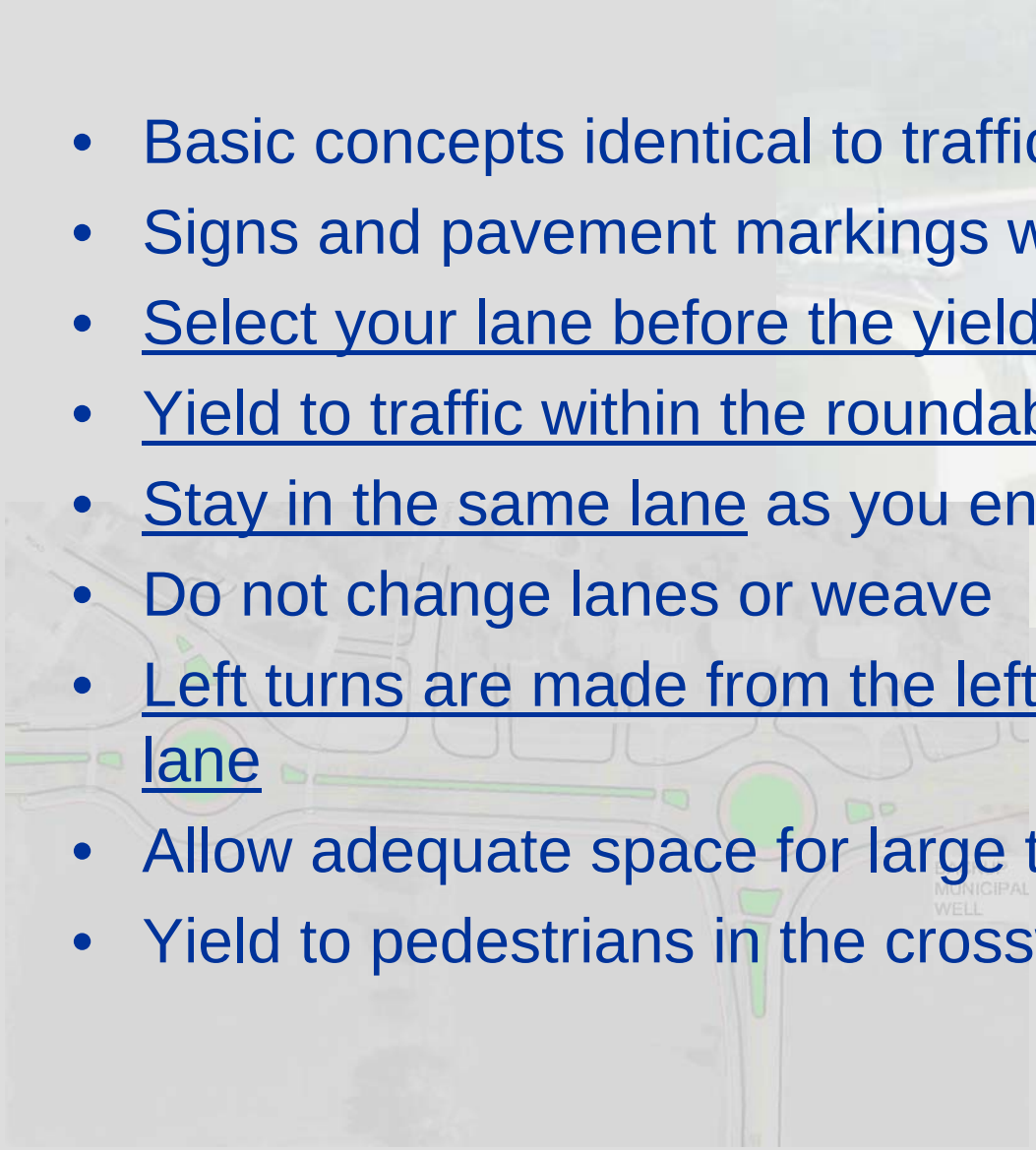
Bypass Lanes – 3 Lane Roundabout



How Not to Drive a Roundabout

How to Drive a Roundabout

- Basic concepts identical to traffic signal
- Signs and pavement markings will guide you
- Select your lane before the yield line
- Yield to traffic within the roundabout before entering
- Stay in the same lane as you enter, circulate and exit
- Do not change lanes or weave
- Left turns are made from the left (inside) approach lane
- Allow adequate space for large trucks
- Yield to pedestrians in the crosswalks



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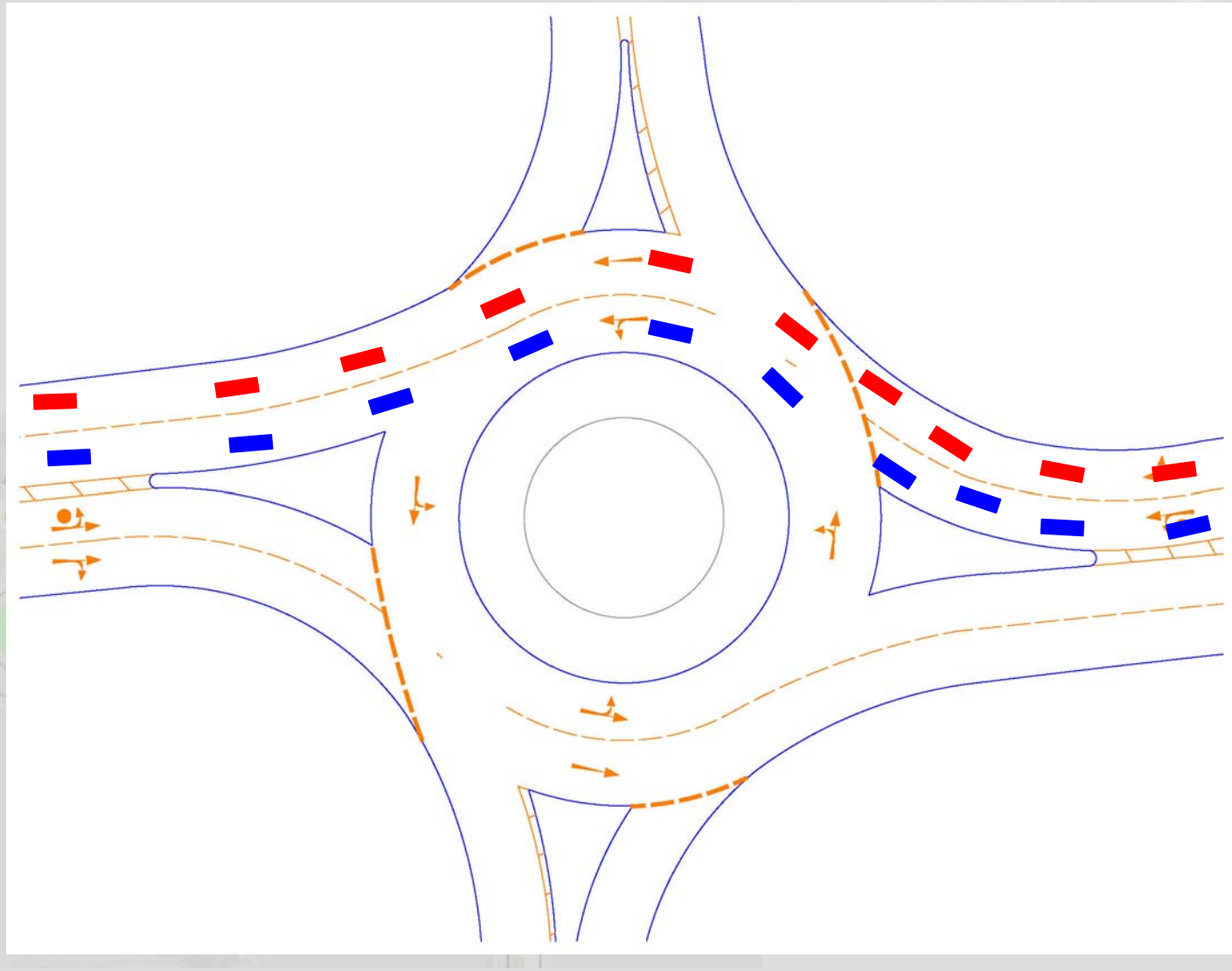
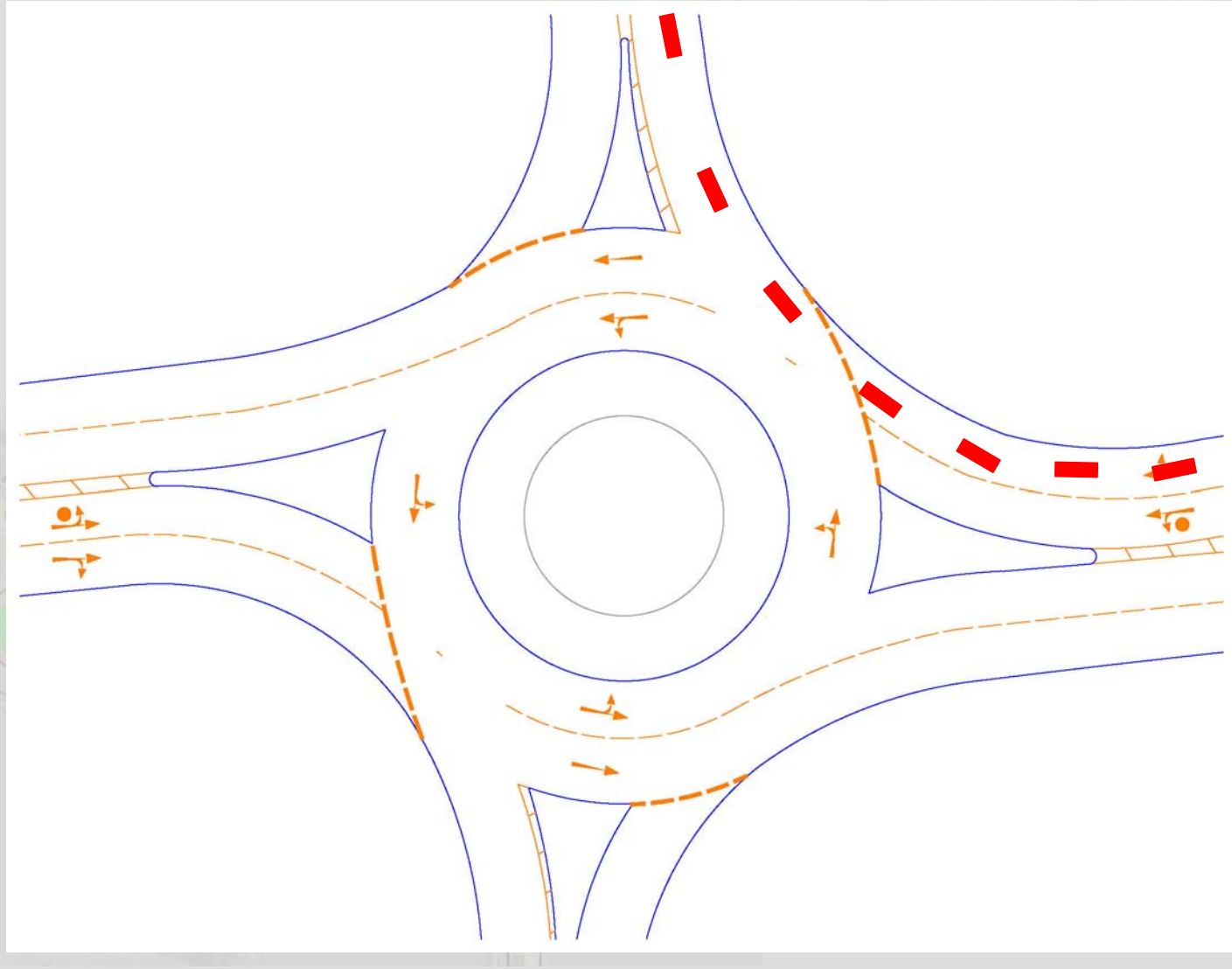
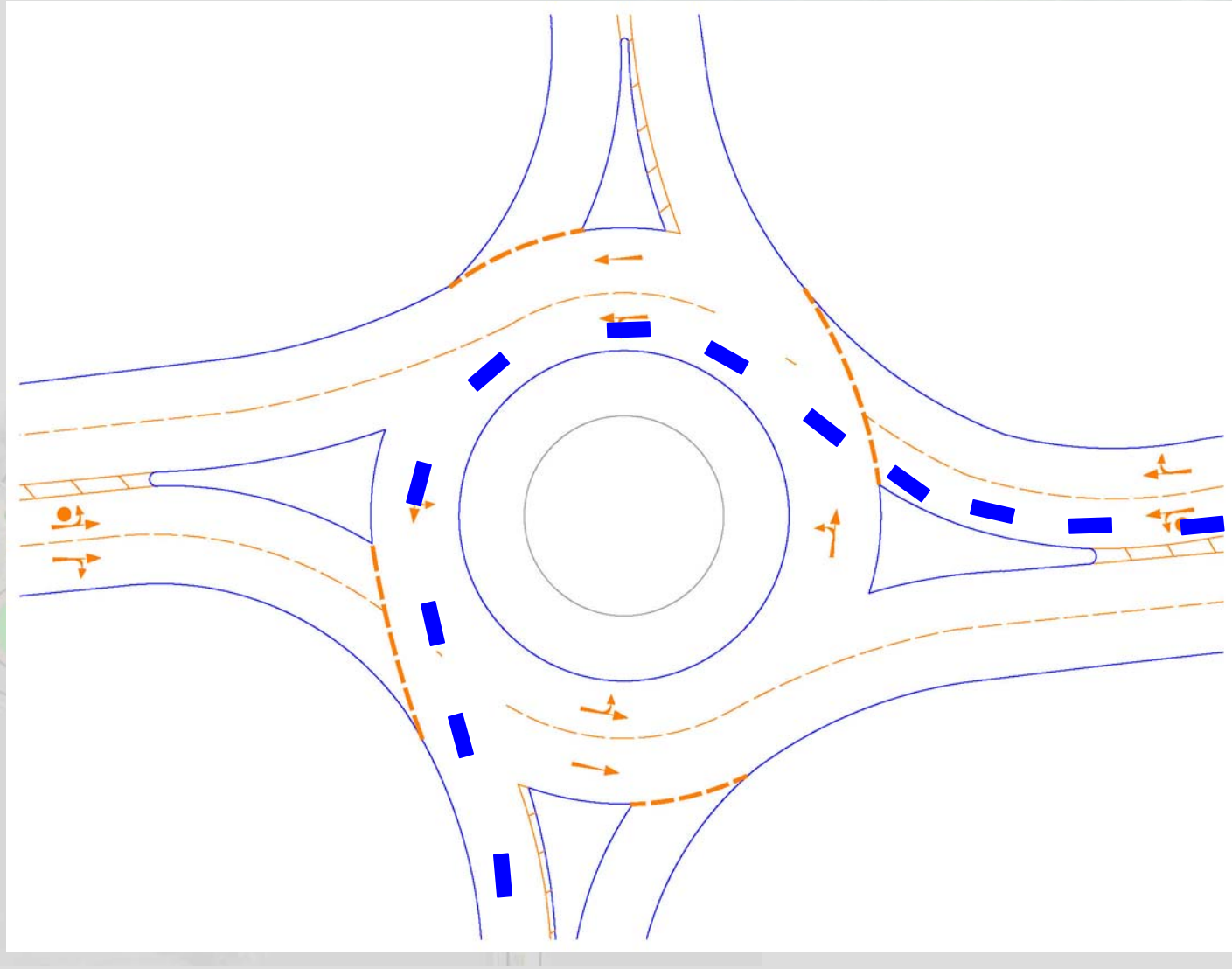
Through Movement



Right Turn



Left Turn

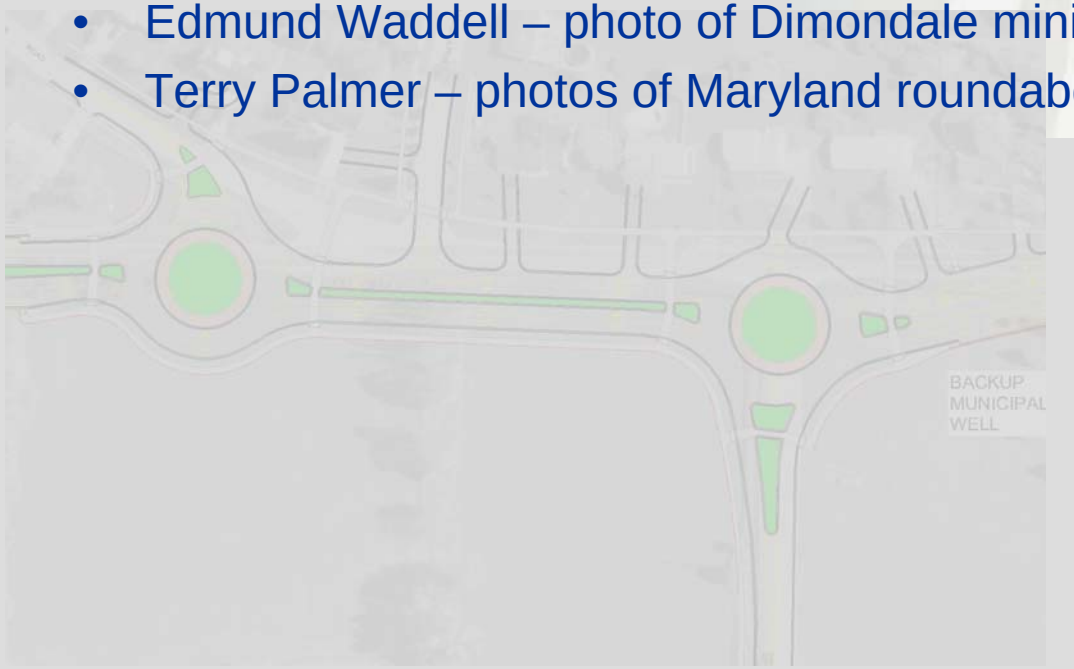


Roundabouts vs. Traffic Signals

- No simple answer … Hard to generalize
- Depends on cost / benefit analysis
- Sometimes one fits ROW far better
- Large left turn flows = Roundabout?
- Low turning flows = Traffic Signals?
- Safety = Roundabout (far less PIAs)
- Need to assess and compare alternatives
- Roundabouts & Signals are complimentary
- Roundabouts are not suited for all locations

Credits

- R. Barry Crown, Rodel Software Limited – miscellaneous information adapted for use in several slides
- NYDOT – photo of Kingston roundabout and map of roundabout locations
- Dave Sonnenberg – photo of Marsh – Hamilton roundabout
- Edmund Waddell – photo of Dimondale mini-roundabout
- Terry Palmer – photos of Maryland roundabouts



Select Topics

Presented by:
NKAPC and DLZ Corporation
1/10/05

Topics

- Safety
- Pavement Markings
- Trucks
- Pedestrians
- Public Education
- Madison Pike Preliminary Evaluation
- Questions

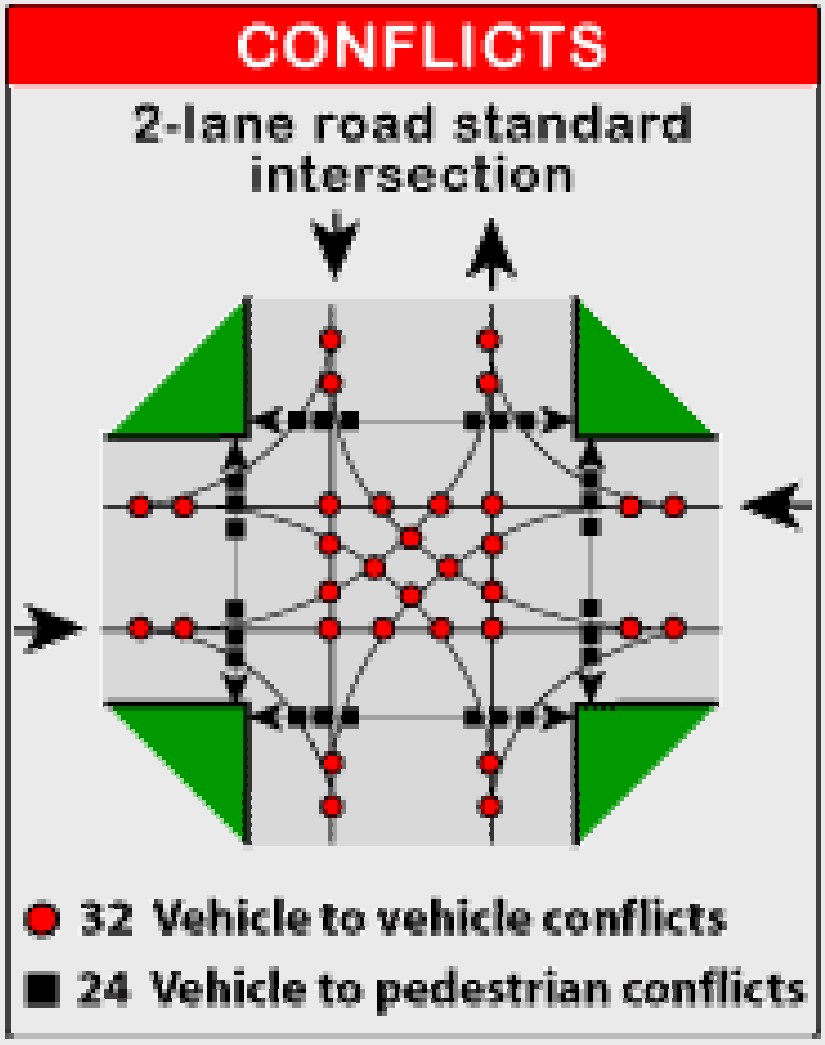
General Information

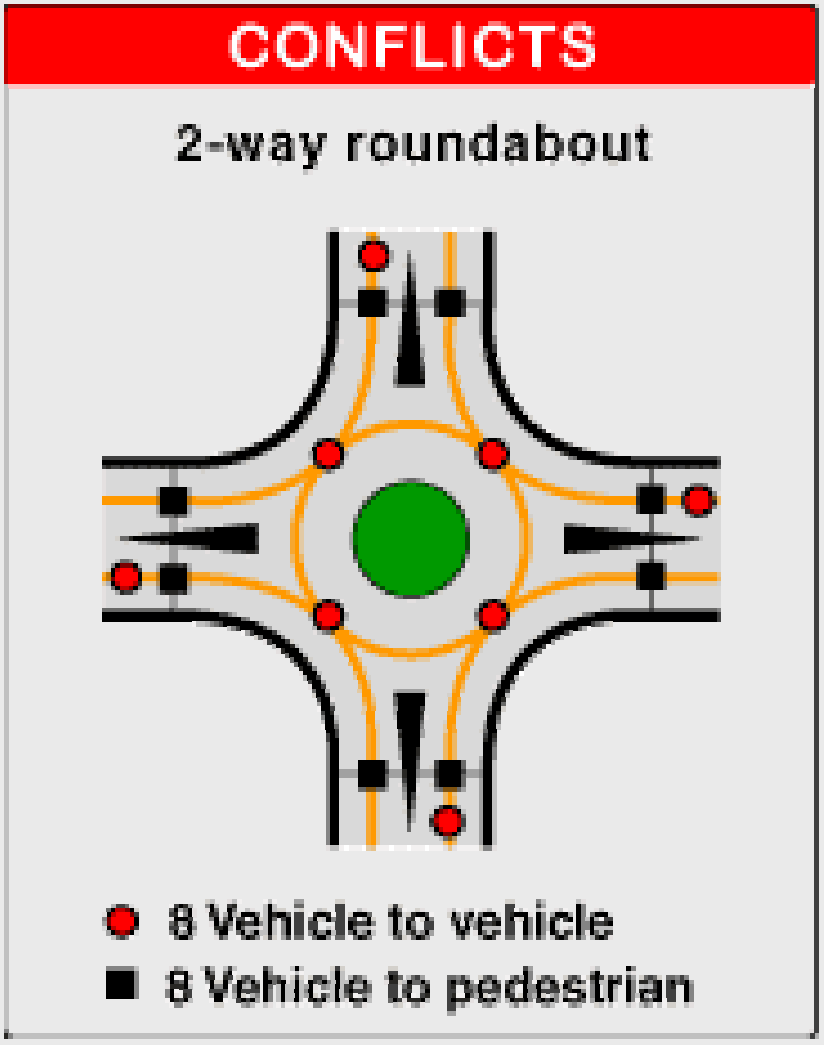
Type of Roundabout	Typical ICD	Typical Maximum Volume	Comments
Mini	< 95 feet	Varies	•Very high capacity for size •Only where speeds < 30 mph •Traversable central island •1-3 lanes
Compact Urban	< 130 feet	Varies	•Only where speeds < 30 mph •Central island not traversable •1-2 lanes
Conventional Medium and Large	> 130 feet	Varies	•Speeds up to 70 mph •Flared or parallel approaches •1-3 lanes, 4 lanes possible
Single Lane	100 – 160 feet	Up to 2,000 vph	•Most common in U.S. •Relatively simple to design
Two Lane	150 – 210 feet	Up to 4,000 vph	•Moderately to very complex
Three Lane	210 – 250 feet	4,000+ vph	•Very complex
Four Lane	210 – 250 feet	4,000+ vph	•Usually just one entry

Safety Statistics - Automobiles

- Conversion from stop/signal to roundabout
- Persaud et. al. (Insurance Institute for Highway Safety), 2000 (U.S.)
  - 23 US intersections studied
  - 40% reduction in total crash frequency
  - 80% reduction in injury crash frequency
  - 90% reduction in fatal and incap. injury crash frequency
  - Changes to rate similar
  - Avg age of drivers involved in crashes did not increase
- 2002 intersection statistics in Michigan
  - 373 fatalities (29% of all fatalities)
  - 4,000 incapacitating injuries (38% of all incapacitating inj's)
- Many other studies with similar results

Conflict Points



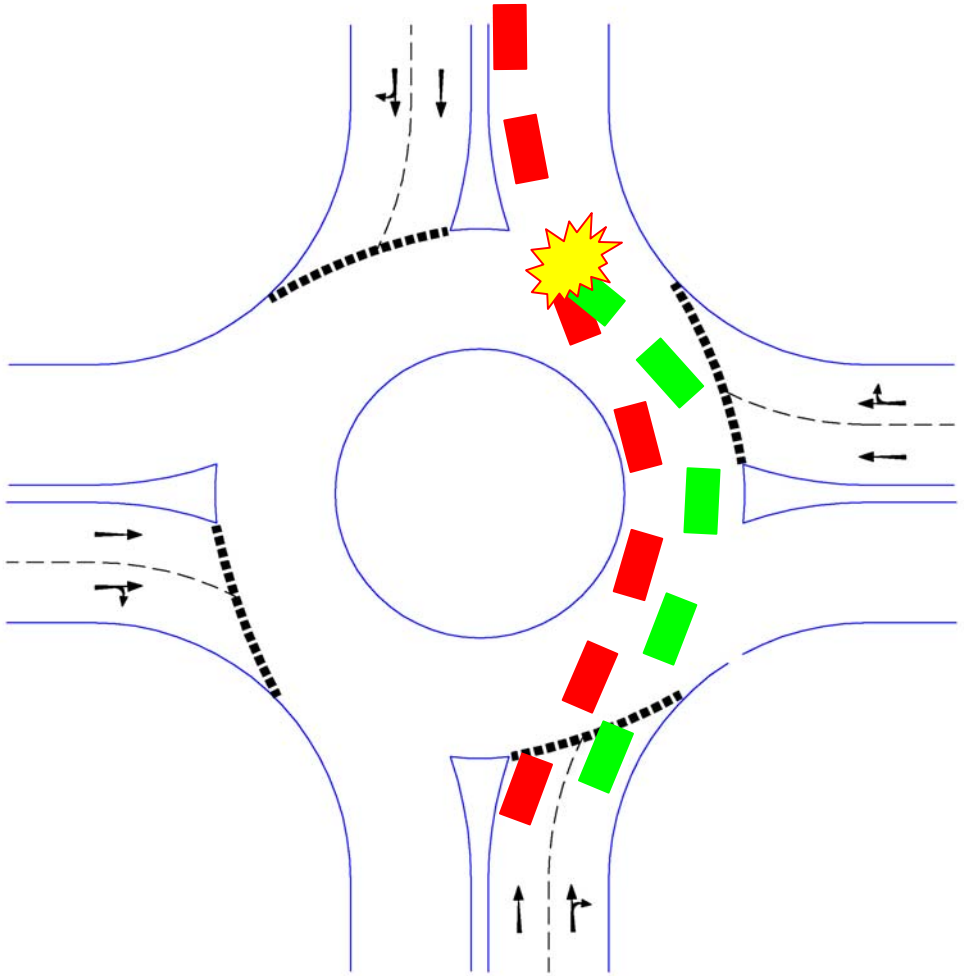


DLZ

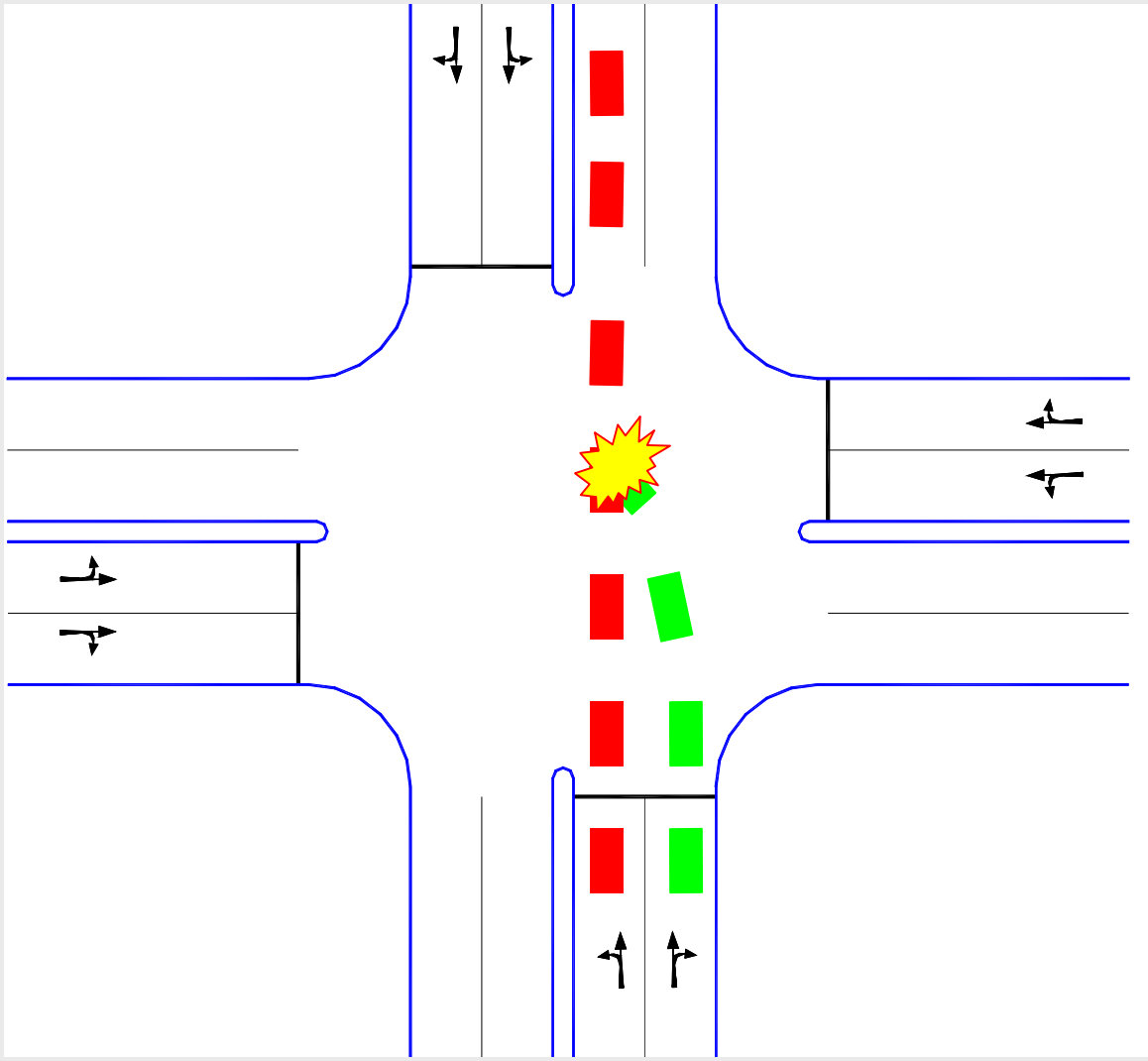
Safety and Lane Use

- Problem: Improper lane use at multi-lane roundabouts causes exit crashes
  - Most common crash problem at U.S. multi-lane roundabouts
  - no pavement markings or improper markings
  - Related to driver unfamiliarity
- Examples
  - Clearwater, Florida (highly publicized)
  - Converted traffic circle on MSU campus

Left Turn at Roundabout



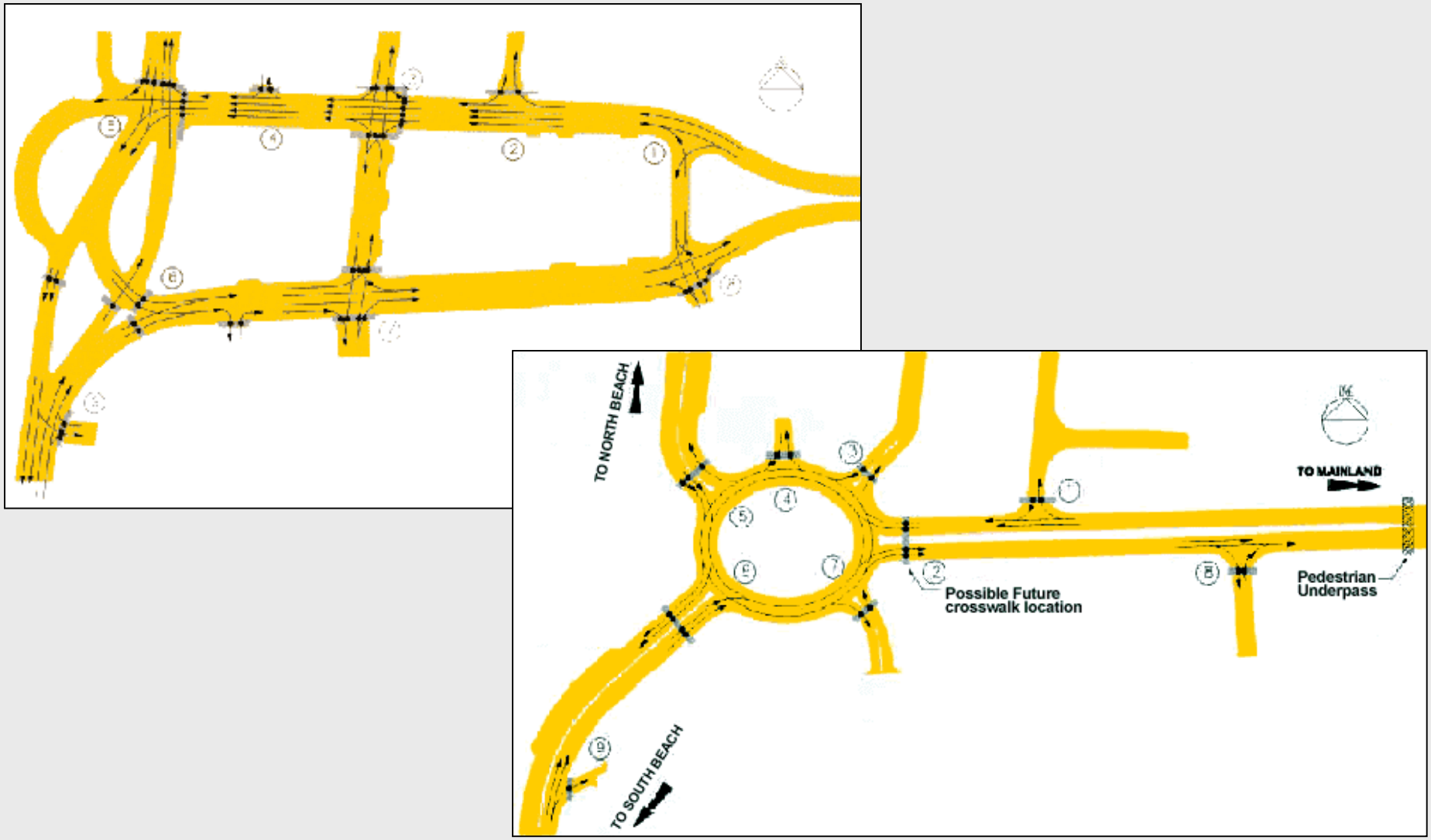
Left Turn at Traffic Signal



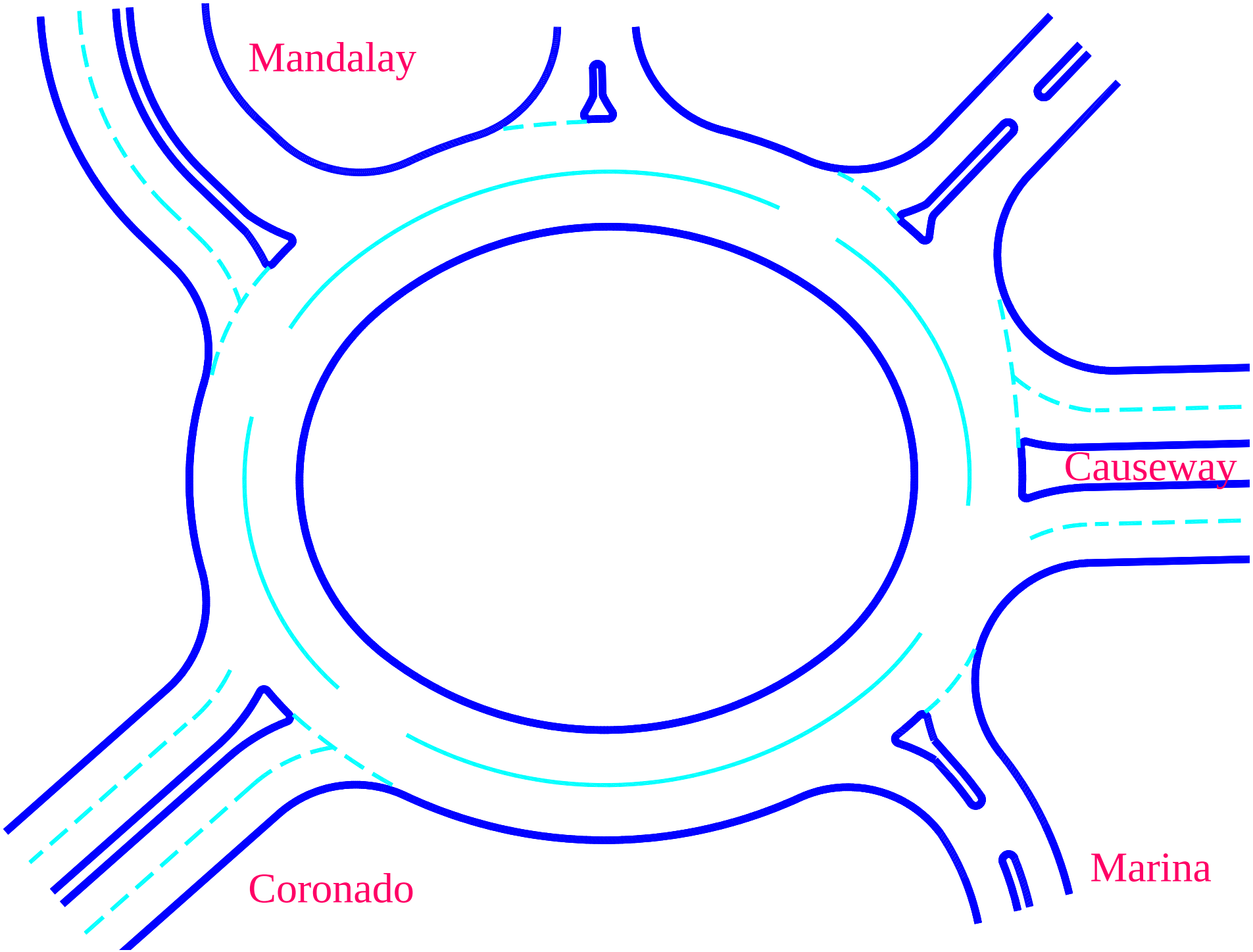
Clearwater Roundabout

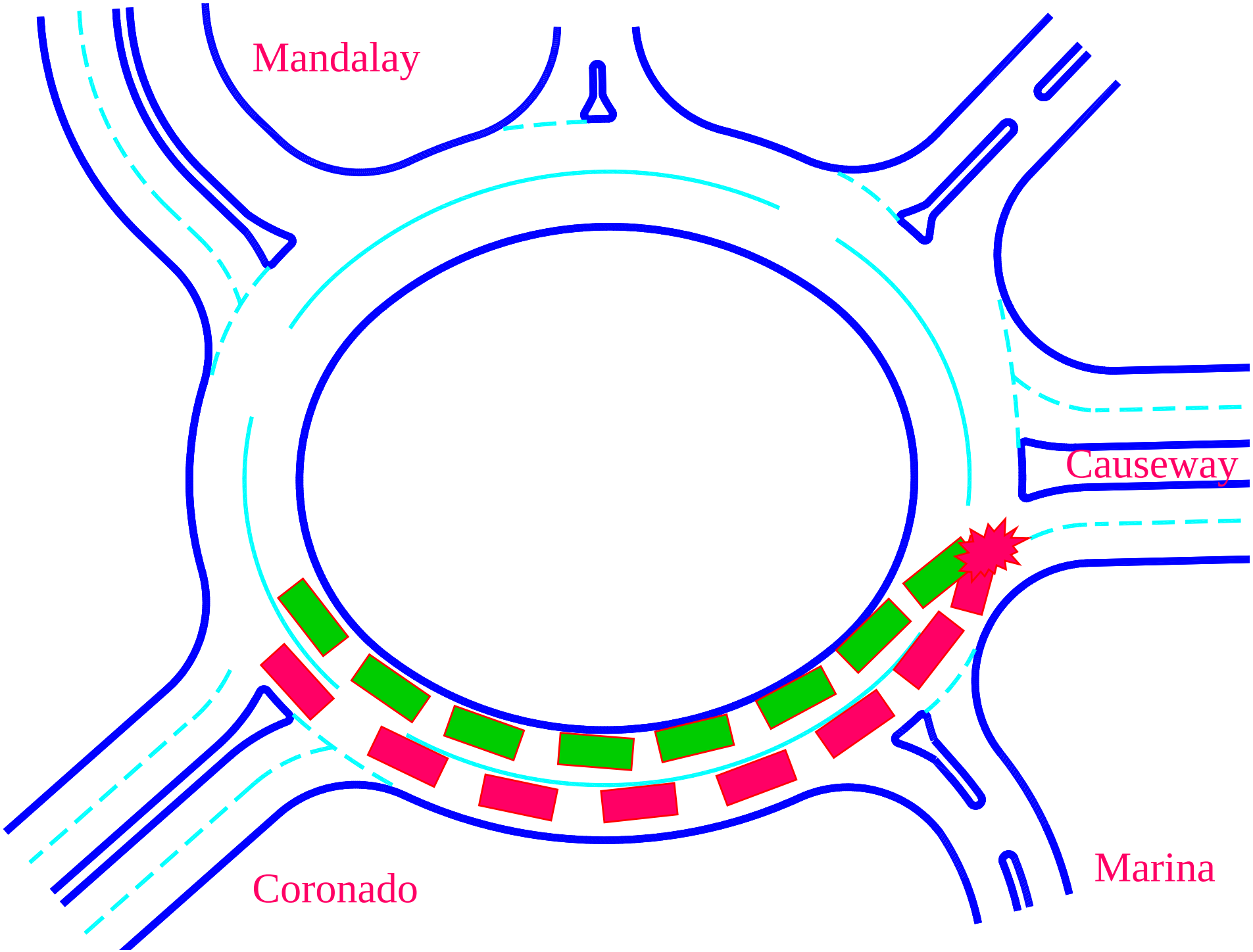
- Exceptional safety example
- Opened midnight on 31st December 1999
- Two lane roundabout
- An Australian/German style design using SLR techniques
  - Very small entry and exit radii
  - Very large entry and exit angles
- 300 crashes in first 6 months
- Over 500 crashes in first 18 months
- Low severity
- Two crash locations

Before and After



Clearwater Roundabout


Mandalay
Causeway
Coronado
Marina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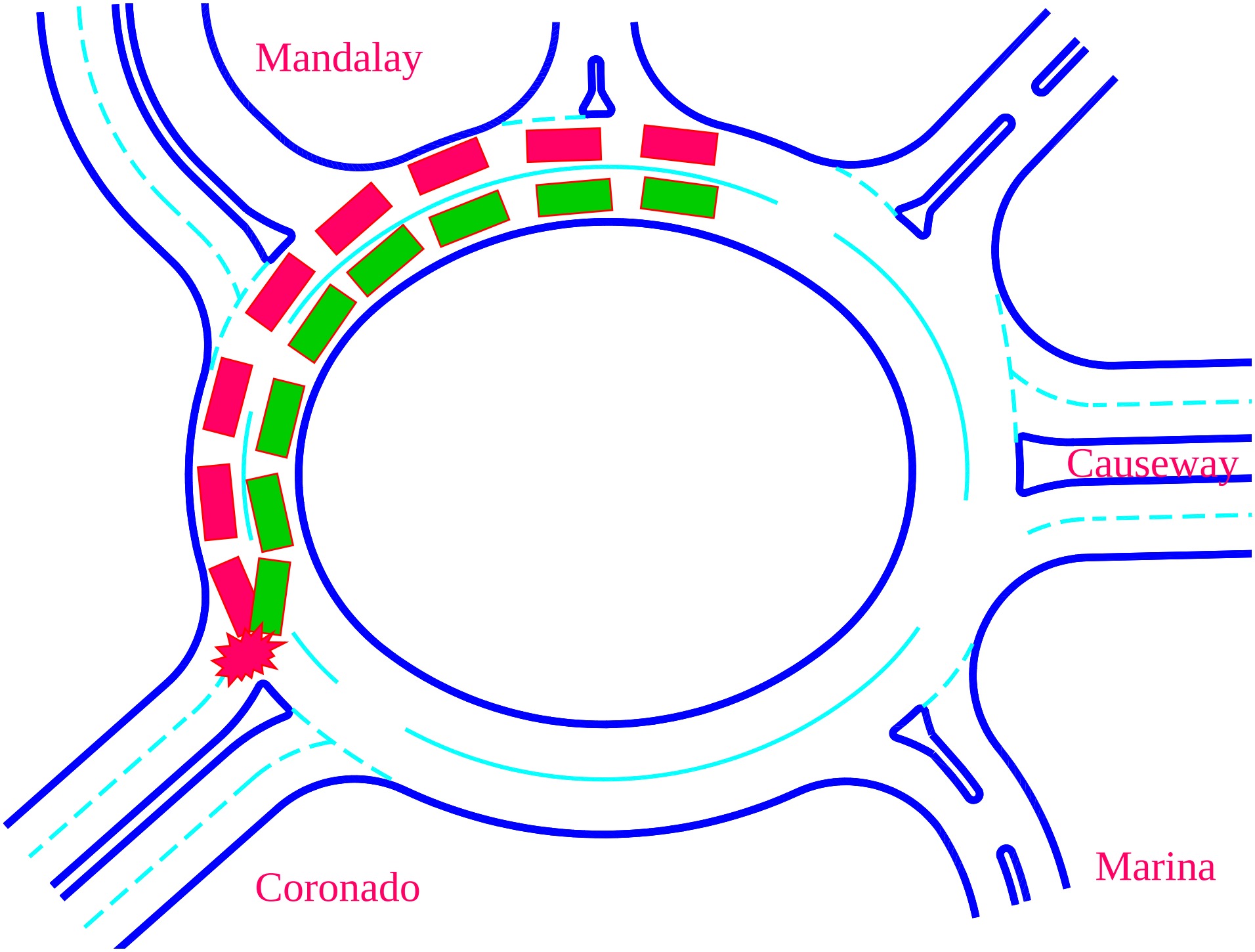
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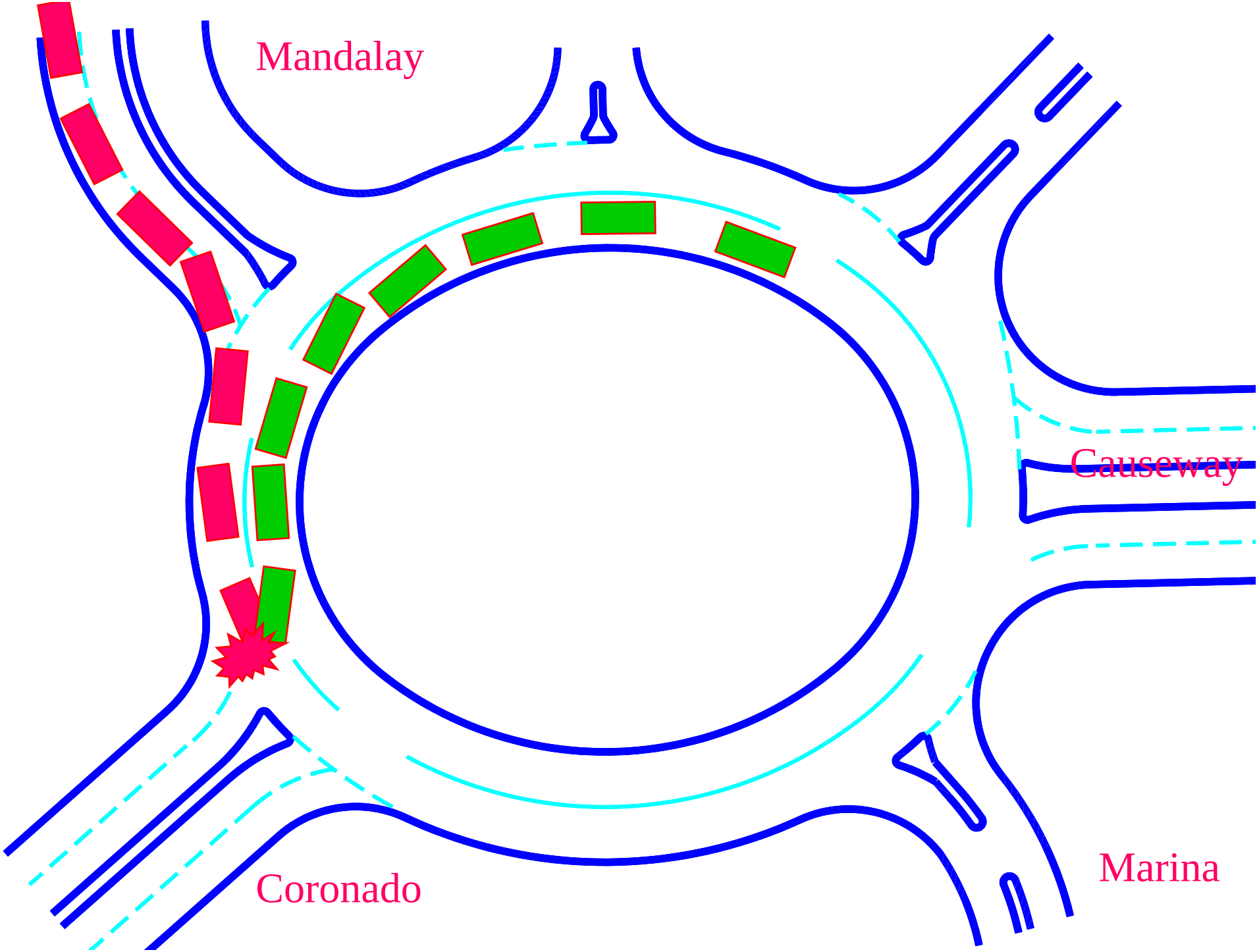
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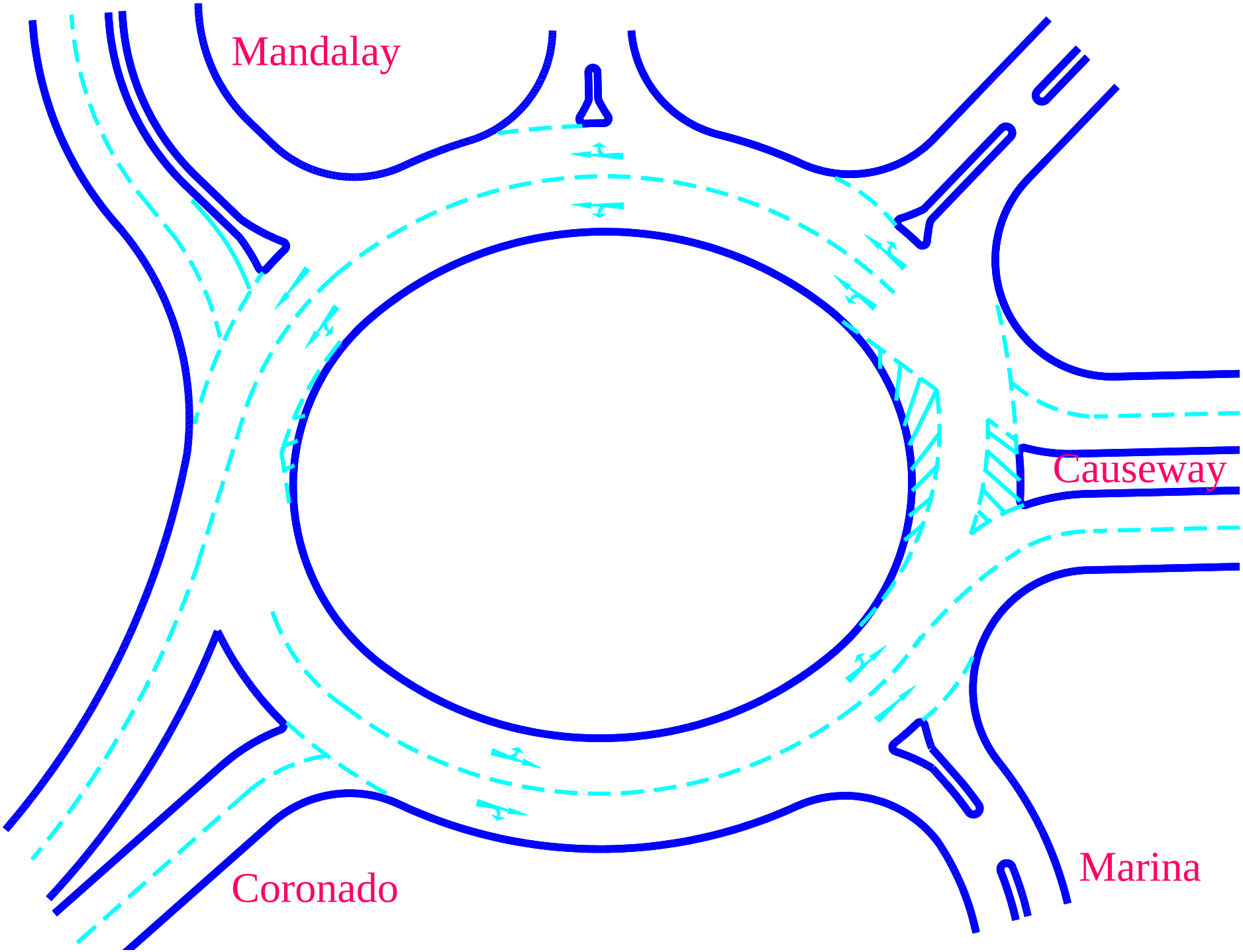

Mandalay
Causeway
Coronado
Marina

Clearwater Roundabout

- Spiral striping
- Flattened exit radius – moved curb
- Larger entry angle creates safe entry conflict
- Fountain ripped out
- Moved crosswalks
- Crashes dramatically dropped – only 3 minor crashes in 15 months following changes

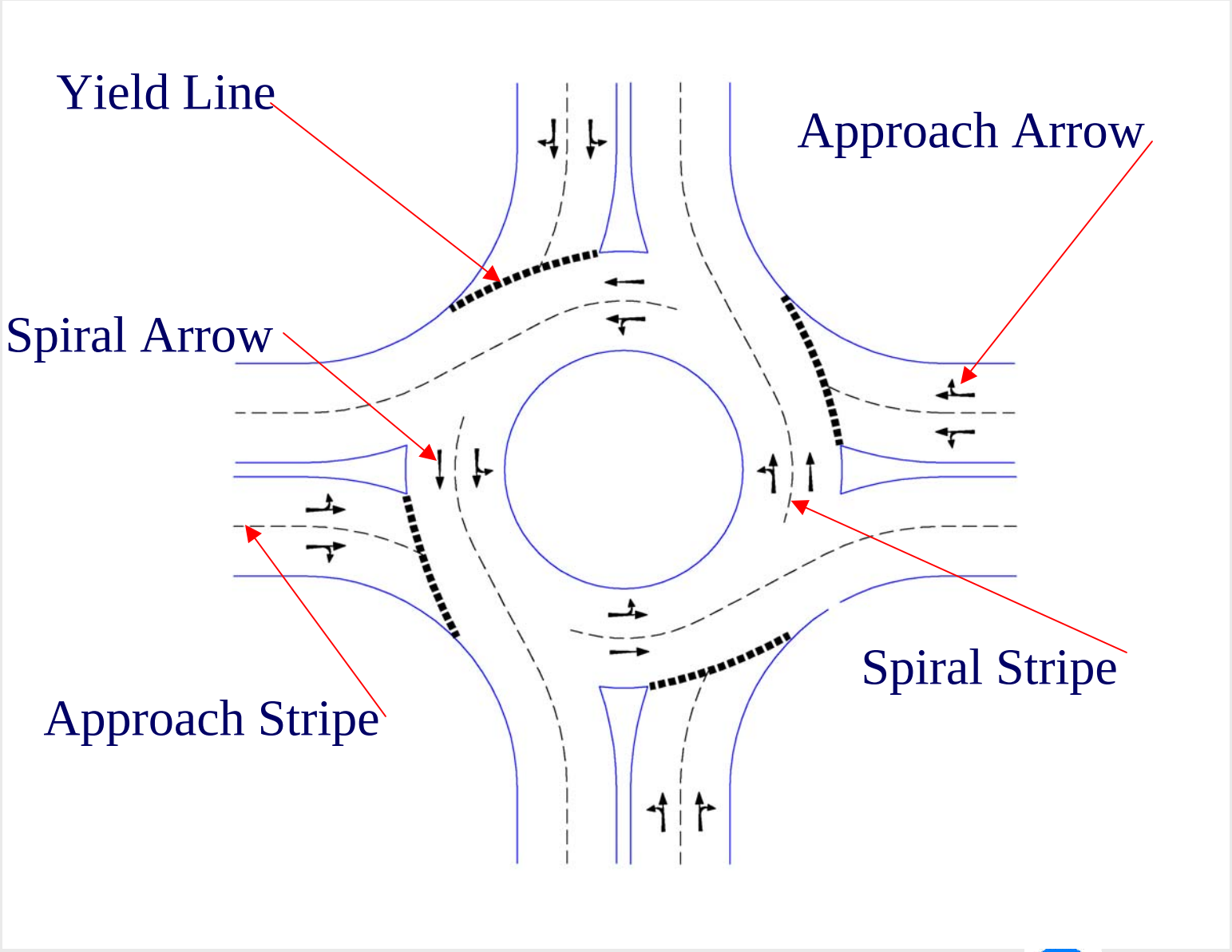
Clearwater Roundabout

- The cost:
  - City Manager lost job
  - $1-2 M property damage
  - Bad publicity about roundabouts – WSJ article
  - $400,000 in reconstruction costs
  - Other roundabouts not constructed as a result = more injuries and deaths elsewhere
- The lessons:
  - Plan for suppressed traffic demand
  - Proper design techniques crucial
  - Appropriate pavement markings are powerful
  - Multi-lane roundabouts require experienced designers

Pavement Markings

- Pavement markings work together with roundabout signing and design
- Provide guidance to motorists
  - Approaching
  - Circulating
  - Exiting
- Goal is to enhance roundabout safety and operations and address problems
- Wide variety of applications

Definitions



Benefits of Markings

- Why markings at MLRs?
  - Improve safety and traffic operations
  - Guide motorists from approaches to exits without changing lanes/weaving – solves 95% of problems
  - Makes driving roundabouts easy for motorists
  - Educates drivers about lane use
  - Self regulating
  - Lane discipline reduces speeds
  - Crucial for some intersections – will not work without it

Concerns with Markings

- Why not markings at MLRs?
  - Not appropriate in all situations – conflicting AM and PM turning patterns can preclude
  - Some intersections work fine without
  - Lots of misinformation out there
  - Many ways to get it wrong
- Like fire – powerful and beneficial, but dangerous if used improperly

Trucks at Roundabouts

- Roundabouts can be designed to accommodate all types of trucks, including emergency vehicles
- Can require truck apron in central island
- Test using software such as Autoturn
- Video clips from actual roundabouts
- Also assure emergency vehicles can negotiate (especially large fire trucks)

Okemos Roundabout

Maryland Roundabout

Maryland Roundabout

Pedestrian Safety

- Roundabouts shown to be safer than other types of intersections (signals, stop control)
- Function of vehicle speeds on approach and departure (low speed for roundabouts)
- Design is crucial element in safety (entry and exit radii)
- Only cross one direction of traffic at a time
- Motorists deal with pedestrian crossing separate from entering roundabout

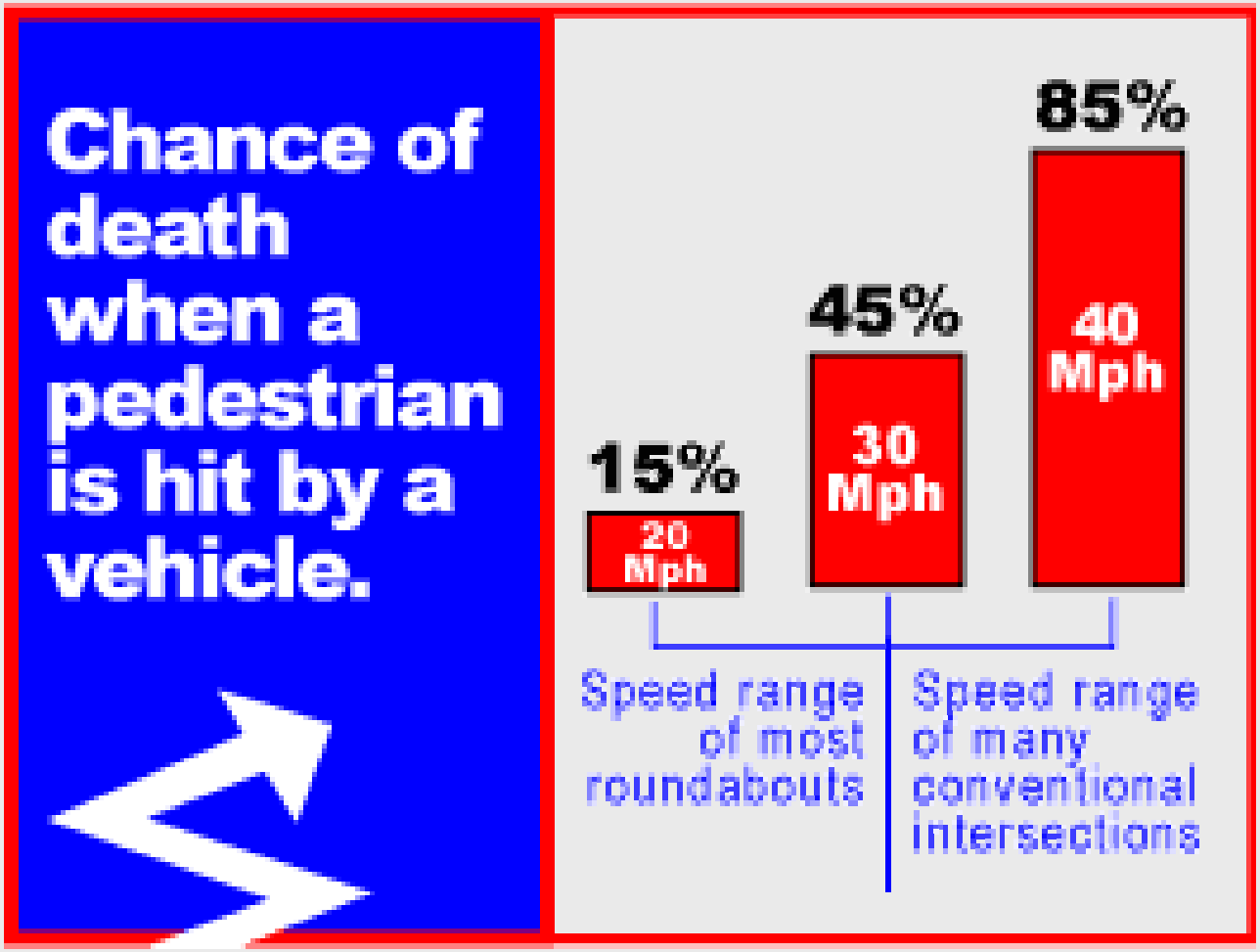
Statistics – Pedestrians & Bicycles

- US - minimal information – anecdotal
- Tumber, 1997 (Australia)
  - Most ped crashes on approaches and in circulating road (less at exits)
  - Severity of ped crashes lower than other intersection types
- Peel, 2002 (U.K.)
  - Crash rates for bicyclists significantly higher than traffic signals when they circulate inside roundabout
- Brude, 1997 (Sweden)
  - Single lane roundabouts safer than multi-laners for both peds and bicyclists
- Lalani, 1975 (U.K.)
  - Ped crash frequency dropped 46% after conversion to roundabouts
  - Fatal and serious ped crash frequency dropped 70%

Crosswalks

- Located one to three vehicle lengths BEHIND the yield line
- Pedestrians cross BEHIND the vehicle waiting to enter.
- Refuge on splitter island and need only look one way when crossing

Exit Speeds and Pedestrian Safety



Pedestrians – MSU

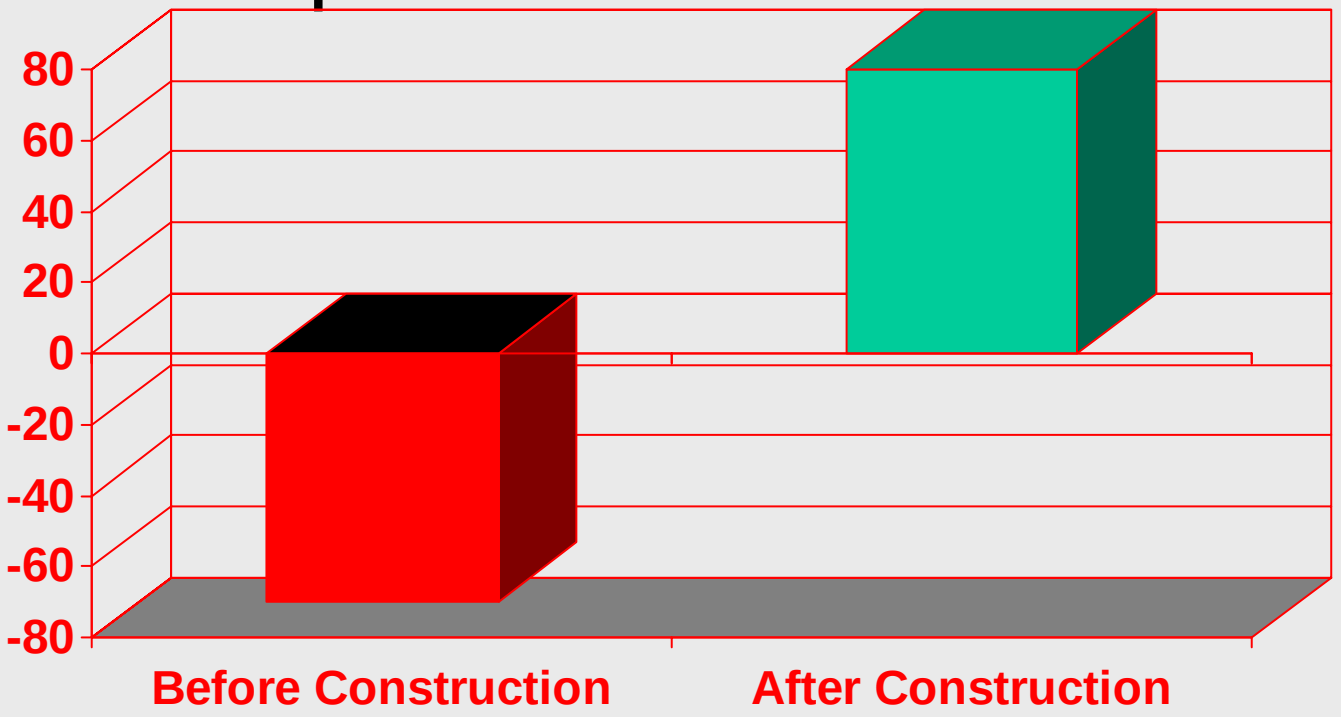
Blind Pedestrians

- Blind US pedestrians not used to roundabouts – have raised concerns
  - Quieter, so traffic is harder to hear
  - Harder to differentiate exiting and circulating cars
  - They may learn to do this?
- UK - no notable problems
- Options include
  - Signalized crosswalks with auditory cues
  - Tactile paving
  - Split crosswalk with barriers (shorter walk time, timings more flexible)
- Questions
  - Will green crosswalk light confuse drivers in US?
  - What is the impact on entry capacity?
  - What about exit capacity?

Blind Pedestrians

- Cost of signalized crosswalk ~ $100,000
- May lead to signals constructed where roundabouts would have been otherwise
- Net injuries are more than with a Roundabout
  - Blind benefit, but
  - Non-blind motorists have an increase in injuries
- Need for balance
  - When peds are too few for signalized crosswalk
  - Blind volumes are extremely low or nonexistent
- Access Board draft guidelines - controversy
- Issue still unresolved - needs further debate

Public Opinion – Before and After



Reasons for Opinions

1. Unfamiliar technology
2. Bad experience with circles
3. Don't believe in benefits
4. Always used signals and know how to use them

1. Familiar after use
2. Positive experiences with roundabouts
3. Witness the benefits
4. Learn to avoid signals after using roundabouts

DLZ

Public Education

- Very important
- During studies, prior to construction
- Many misperceptions (traffic circles, etc.)
- Variety of tools – tailor to situation at hand
  - Photos
  - Videos
  - Simulations
  - Media outlets
  - Meetings
  - Graphics
  - Radio stations
  - Expertise

Photos - Aesthetics

Graphics

Expertise

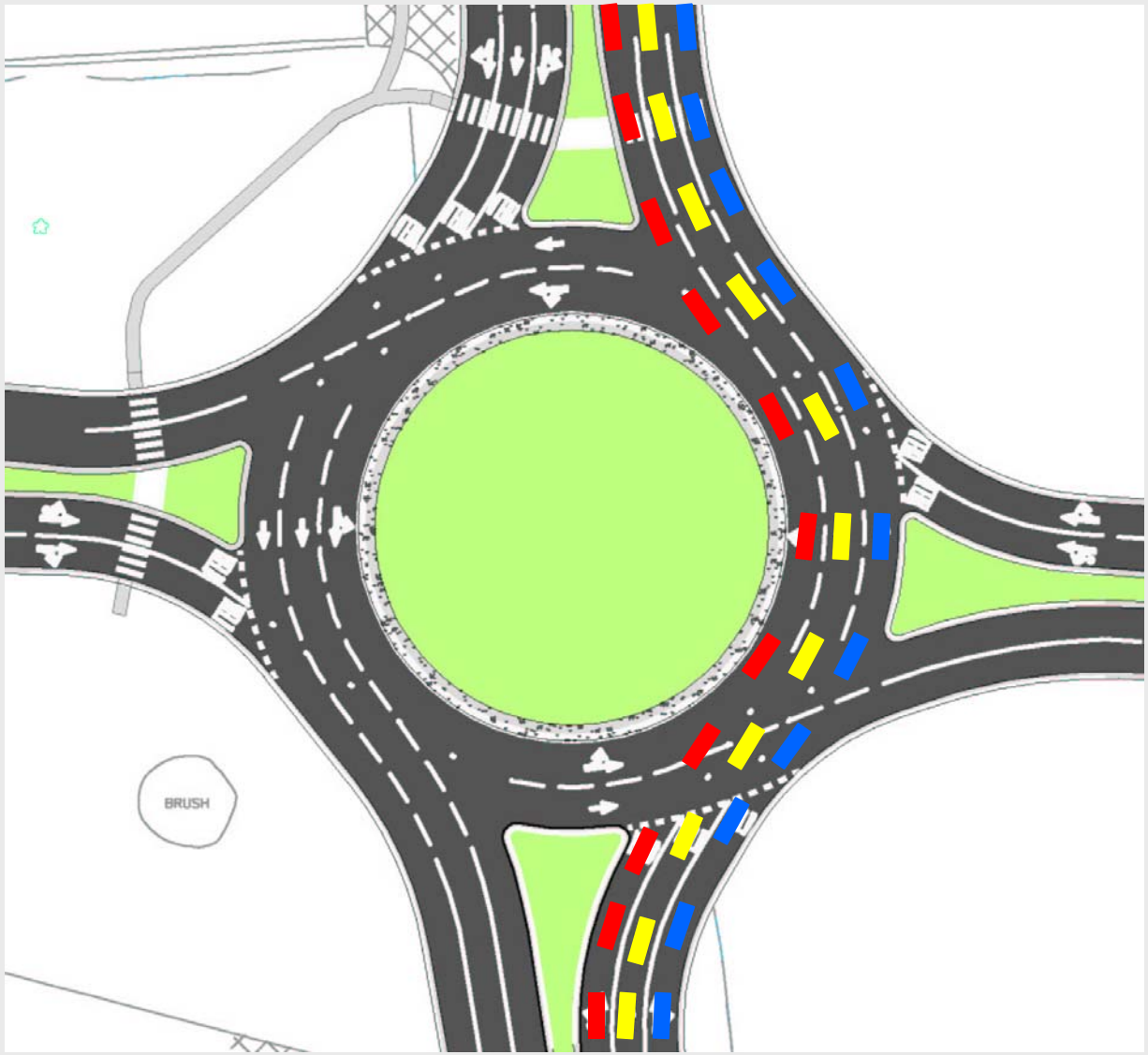
- Complex problems, especially MLRs
- Many ways to get it wrong
- Consequences can be serious:
  - Clearwater, FL
  - Oregon roundabout (article in Appendix)
- Have adequate expertise on your project team, even if just in review capacity

Videos

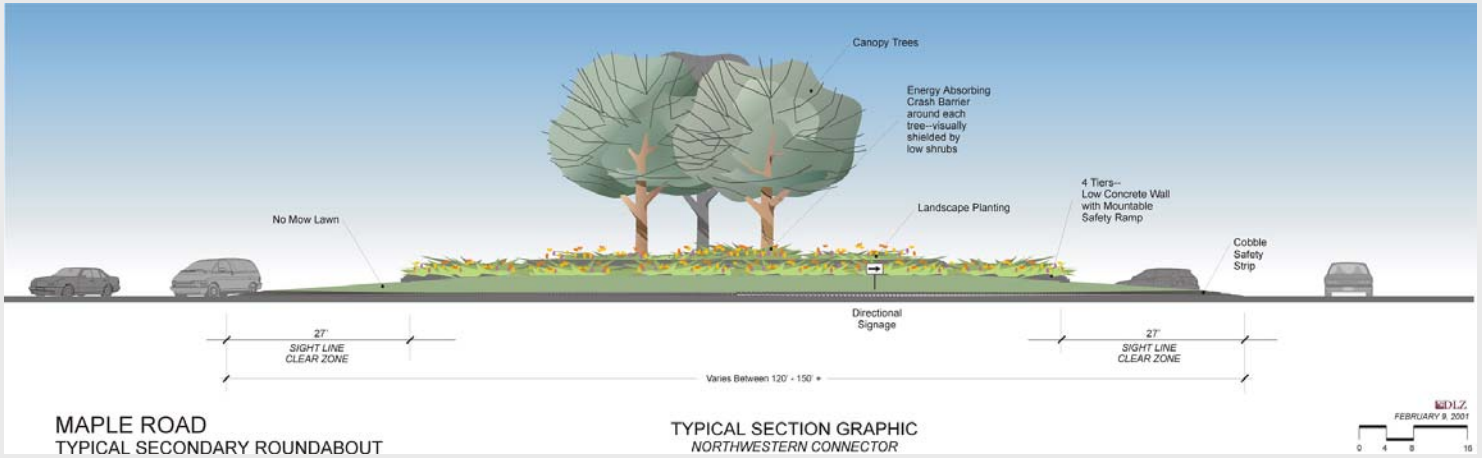
- Many videos exist that show the “real” story
  - Avon Valley : series of roundabouts
  - Santa Barbara, CA : converted traffic circle on Pacific Coast Highway
  - Lacey, Washington (Link in Appendix)
  - Dublin, OH video

Simulations

Other Graphics

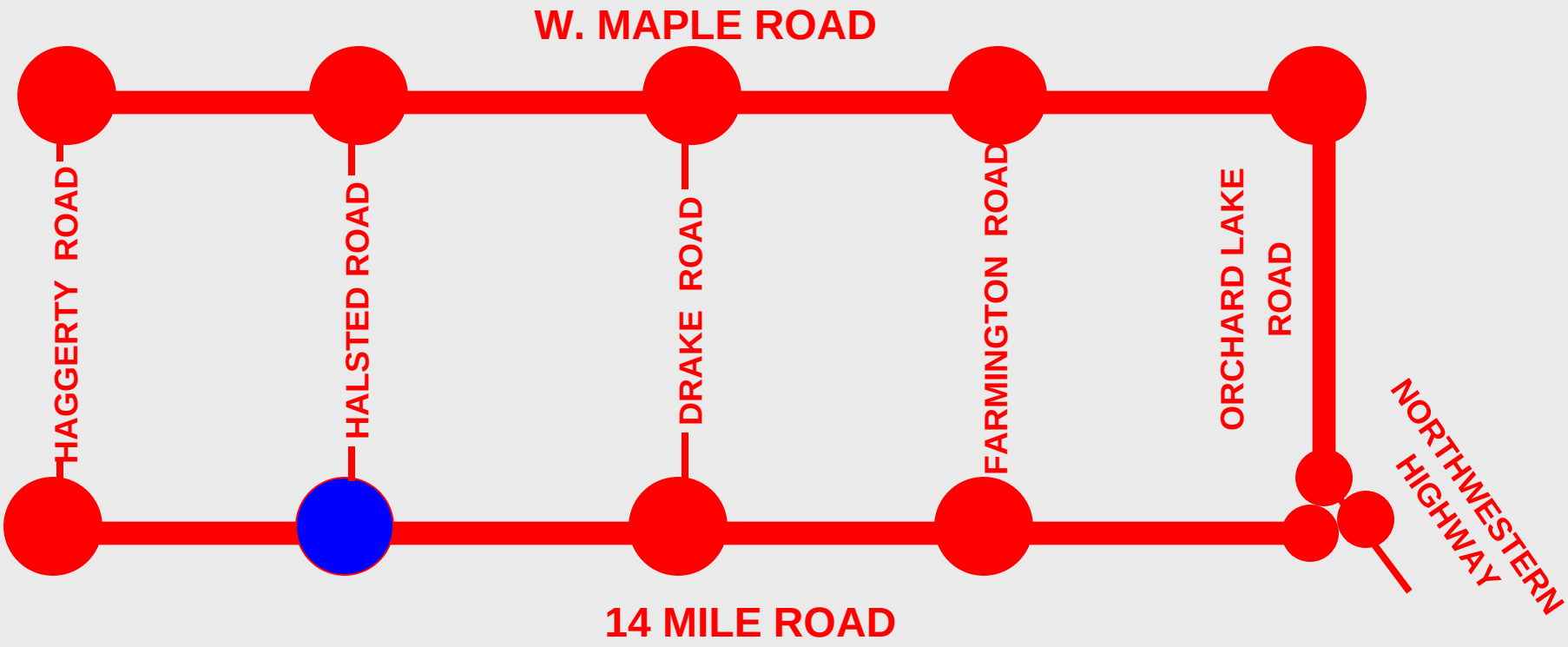


Aesthetics



DLZ

2020 No Build Traffic Delays
Afternoon Rush Hour



LOS		INTERSECTION DELAY
A-C		<35 SECONDS
D		35 - 55 SECONDS
E-F		>55 SECONDS

DLZ

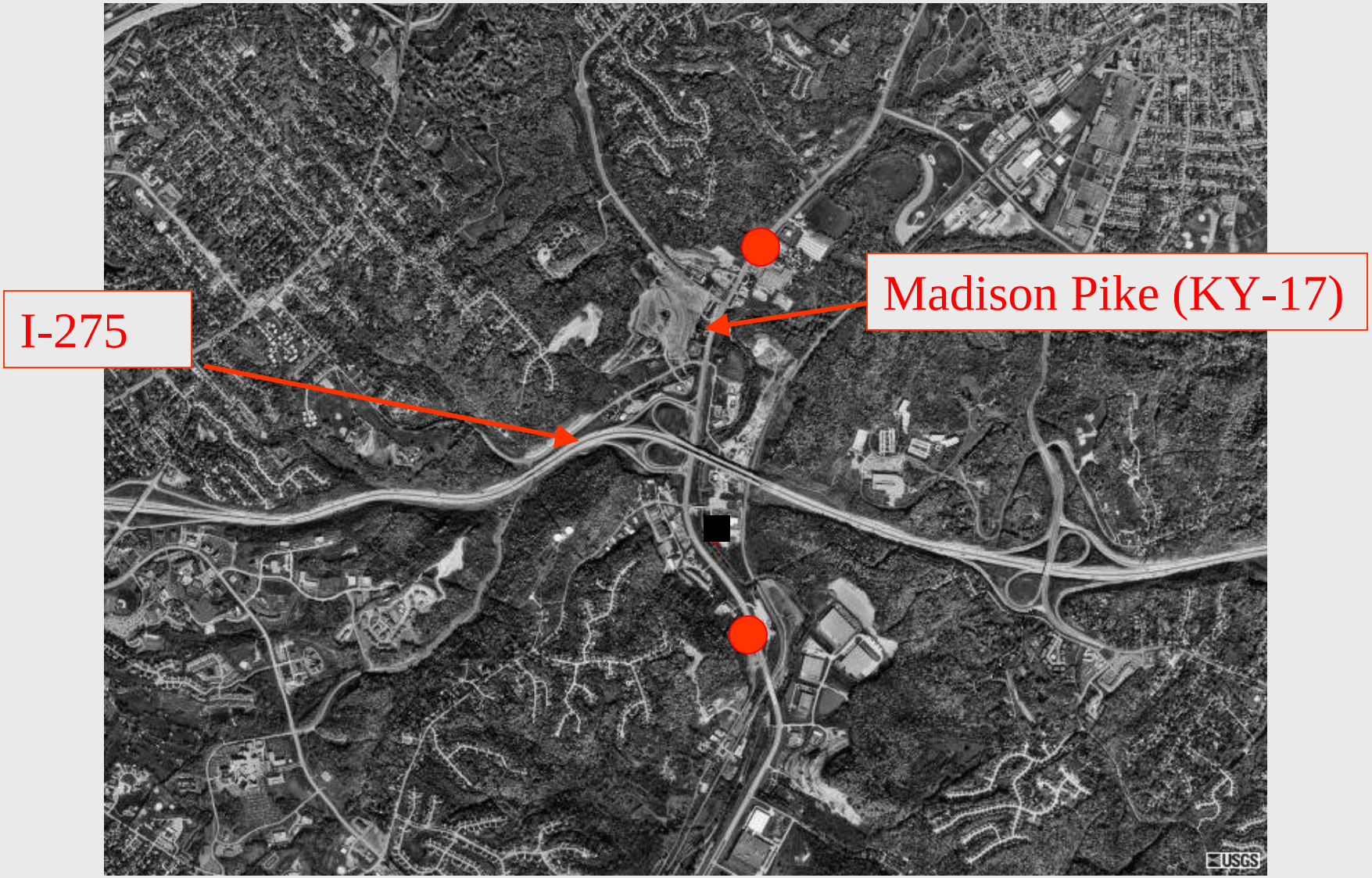
Initial Assessment of Madison Pike Roundabouts

Preliminary Thoughts and Ideas

Background

- Madison Pike (KY 17)
- Primary non-interstate north-south route in Kenton County
- Substantial residential and commercial growth projected for corridor
- Comprehensive study within City of Fort Wright
- *Madison Pike Corridor Land Use and Economic Development Plan*
- 2.4-mile segment along KY-17 includes I-275 interchange
- Transportation elements included in plan
- Two roundabouts under consideration – northern and Southern locations

General Locations



Northern Roundabout

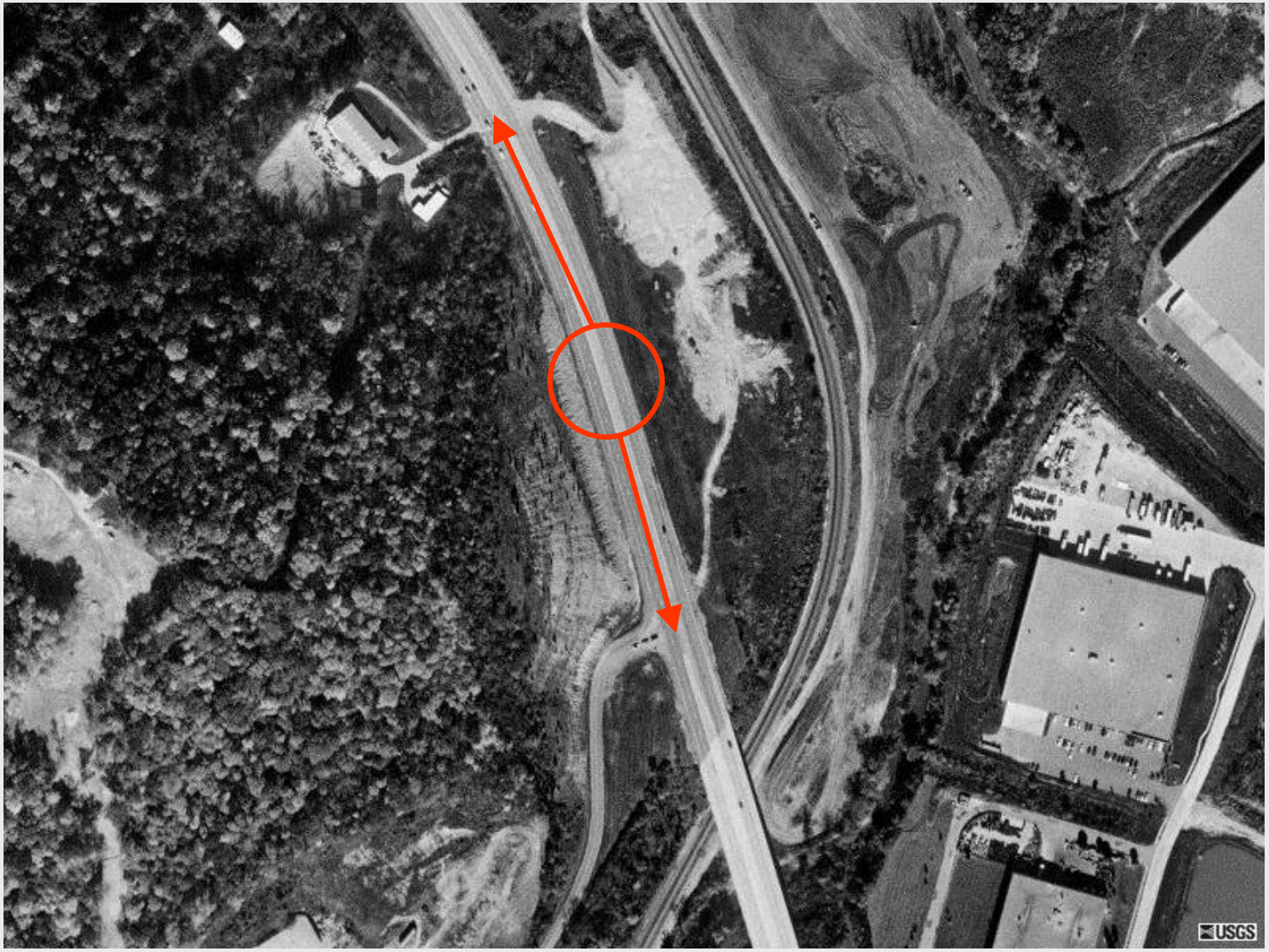
Northern Roundabout

- 5-lane existing cross section on Madison Pike
- Entrance to TANK is east leg
- West leg would be new access road
- New Wal-Mart near here
- Traffic volumes currently about 24,000/day (2 directional)
- Minimum of 2-lane roundabout (diameter = 150-180 feet)
- May need 3-lane roundabout (diameter = 210-250 feet)
- Need will be based on 20-year traffic projections
- Relatively complex design

Northern Roundabout

Directional photos from roundabout location (North to top)

Southern Roundabout



Southern Roundabout

- 4-lane existing cross section with median & 5-lane
- Location is flexible
- West leg new access road connecting to Old Madison Pike
- Traffic volumes currently about 38,000/day (2 directional)
- Likely need 3-lane roundabout (diameter = 210-250 feet)
- Need will be based on 20-year traffic projections
- Relatively complex design

Southern Roundabout

Directional photos from roundabout location (north to top)

General Conclusions

- Appear to be good locations for roundabouts
- Need detailed feasibility evaluation with concepts
- Opportunities to integrate non-motorized facilities
- Could be attractive gateway into area
- TANK's needs can be met if integrated into concept development
- Can be designed for good traffic operations and safety
- Stakeholder and public education are key
- Important for access management strategy
  - Narrow, non traversable median
  - U-turns
  - Helps preserve overall corridor capacity

General Conclusions

- Potential issues:
  - Grades/vertical profile
  - 20-year traffic projections
  - Interaction with adjacent traffic signals
  - Minimizing ROW impacts
  - Integration into access management plan
  - Very important to get proper expertise – these designs are complex!
  - Public education
  - Accommodation of trucks/TANK busses
  - Coordination with key stakeholders, especially KTC
  - Accommodation of non-motorized facilities