

Rightsizing Modern Day Roundabouts

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What is Rightsizing?

- Minimize roundabout size
- Provide sufficient capacity
- Reduce weaving/conflict points
- Reduce impacts (cost, ROW, environmental)

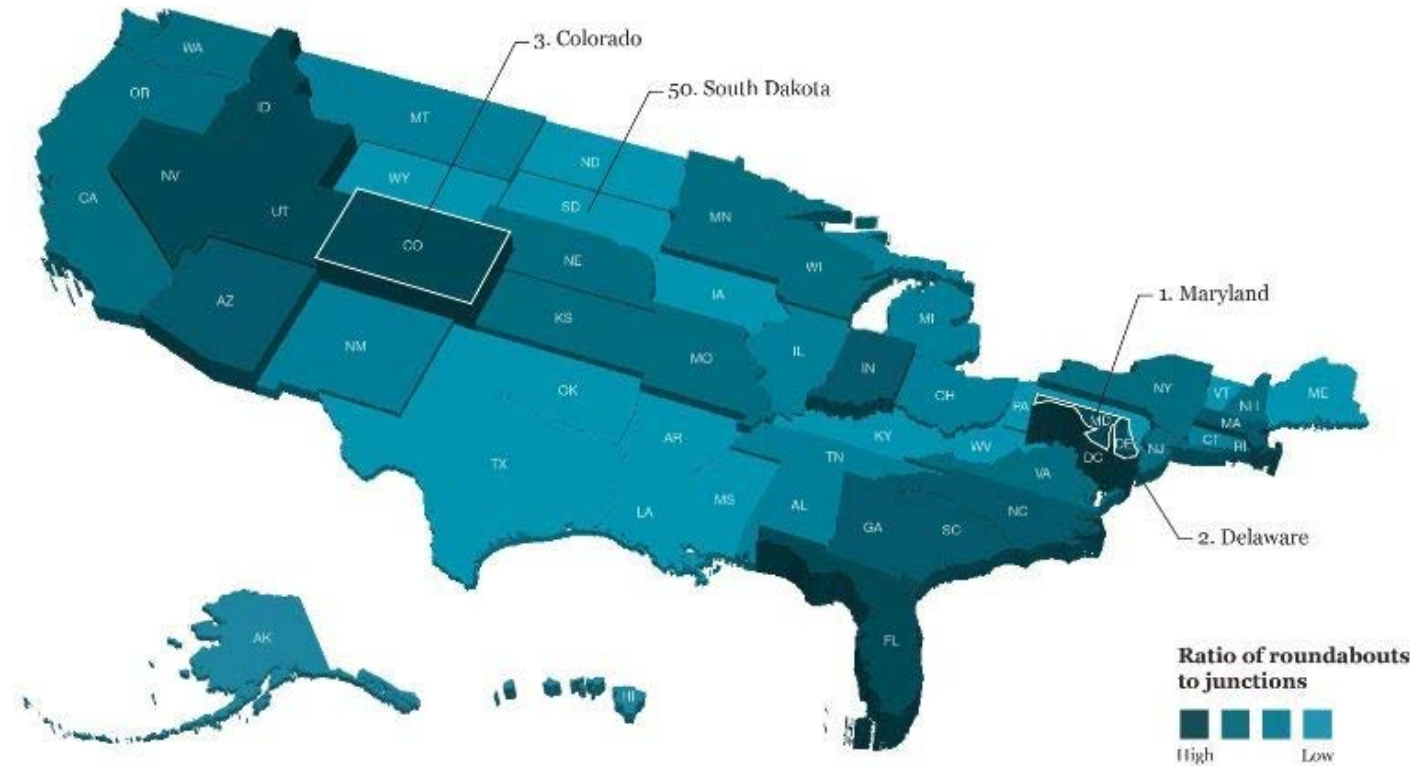
Agenda

- State of Roundabouts Nationally
- Roundabout Rightsizing Process
- Case Studies
 - Hermitage Roundabout
 - SR 2004 Freedom Road Roundabout
 - SR 4008 Five Points
 - Big I

Roundabouts Nationally

Where you're most likely to encounter a roundabout

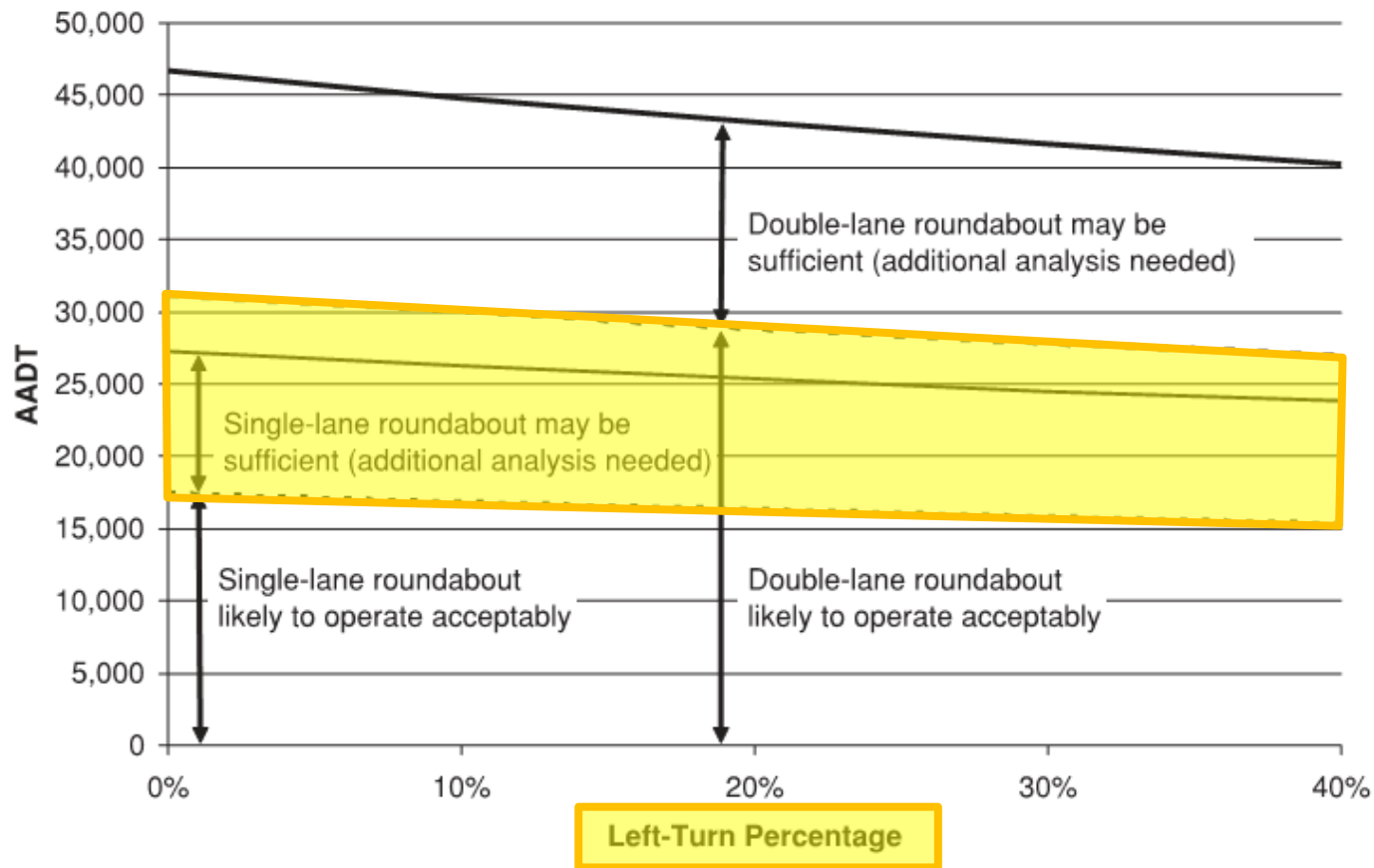
Florida has the most roundabouts, but it's Maryland that has the highest concentration of roundabouts. There drivers are likely to pass through a roundabout once every 363 intersections. By contrast, South Dakota drivers will pass through on average 22,806 intersections before they ever reach a roundabout.



Source: Esri, Graphic: Damien Saunder 2016

1. Planning Level Sizing

Exhibit 3-12
Planning-Level Daily
Intersection Volumes



Source: NCHRP Report 672: Roundabouts an Informational Guide, Second Edition, 2010.

2. Flow Diagram

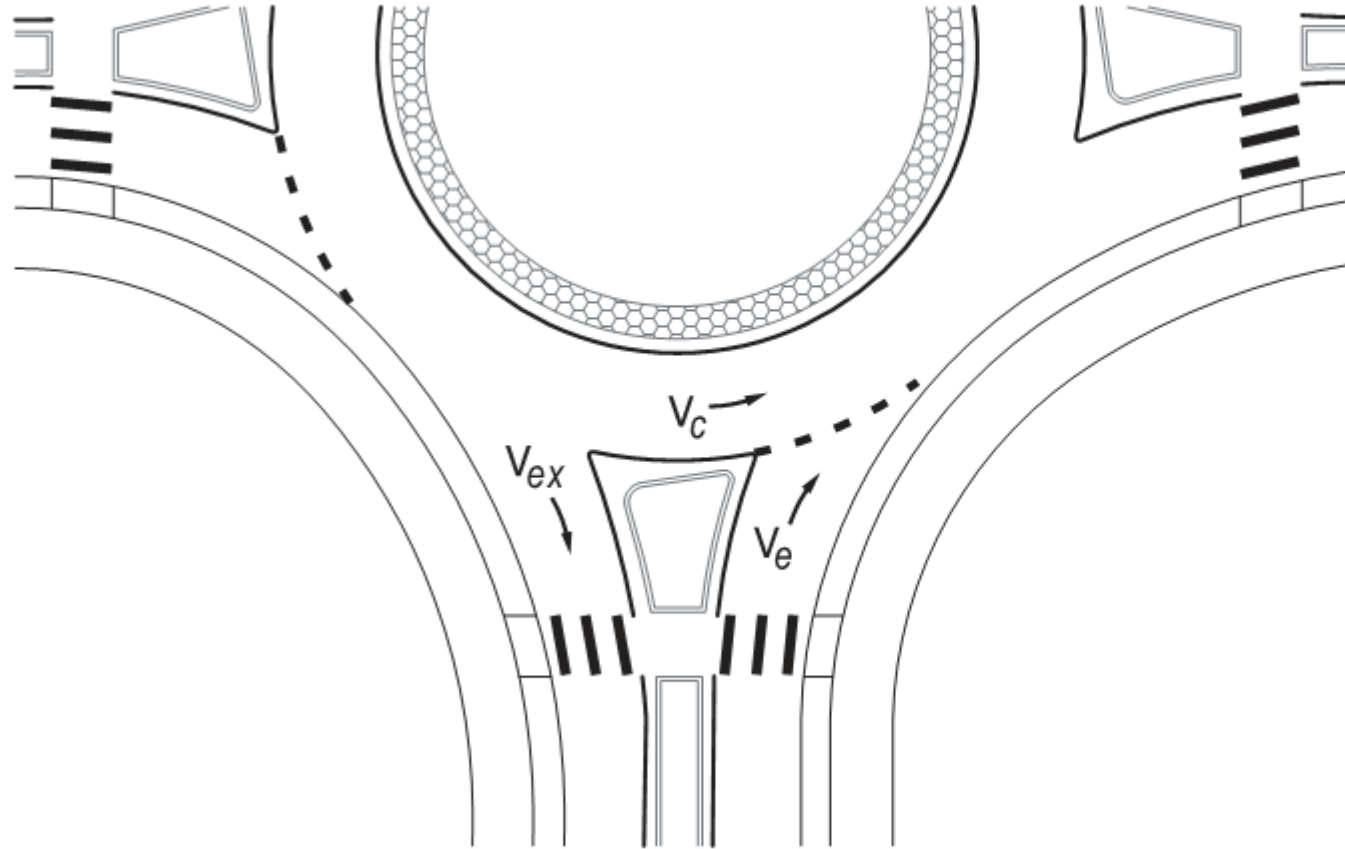


Exhibit 3-13
Traffic Flows at a Roundabout
Entry

Rule of Thumb: If the sum of the entering and circulating volumes for each approach is less than 1,000 veh/h, then a single-lane roundabout is likely to operate acceptably.

Source: NCHRP Report 672: Roundabouts an Informational Guide, Second Edition, 2010.

2. Flow Diagram

Volume Range (sum of entering and conflicting volumes)	Number of Lanes Required
0 to 1,000 veh/h	<ul style="list-style-type: none">▪ Single-lane entry likely to be sufficient
1,000 to 1,300 veh/h	<ul style="list-style-type: none">▪ Two-lane entry may be needed▪ Single-lane may be sufficient based upon more detailed analysis.
1,300 to 1,800 veh/h	<ul style="list-style-type: none">▪ Two-lane entry likely to be sufficient
Above 1,800 veh/h	<ul style="list-style-type: none">▪ More than two entering lanes may be required▪ A more detailed capacity evaluation should be conducted to verify lane numbers and arrangements.

Source: New York State Department of Transportation

Exhibit 3-14

Volume Thresholds for
Determining the Number of
Entry Lanes Required

3. Roundabout Analysis

- NCHRP 572 – Roundabouts in the United States
- HCM 2015/HCS6 (US Model)
- Rodel (UK Model)
- Sidra (Australian Model)
 - Environmental Factors adjust for driver unfamiliarity
 - 1.1 for opening day
 - 1.05 to 1.0 for design year
 - Sensitivity Analysis

4. Measures of Effectiveness

- **Volume-to-Capacity Ratio (V/C ratio)**
 - “. . . International and domestic experience suggests that volume-to-capacity ratios in the range of 0.85 to 0.90 represent an approximate threshold for satisfactory operation.”
 - Single-Lane roundabouts: $V/C \leq 0.90$
 - Multi-Lane roundabouts: $V/C \geq 0.85$ and ≤ 0.90
- **Queueing**
 - Intersection Conflicts
 - Driveway Conflicts
- **Delay**
 - Signalized LOS
 - Rolling Queue

Source: NCHRP Report 672: Roundabouts an Informational Guide, Second Edition, 2010.

Let's Look at some Case Studies



Case Study 1 – Hermitage Roundabout



Case Study 1 – Received Design



Case Study 1 – Verifying Peak Hour Turn Volumes

- Volumes from 2012 SR 62 Corridor Study
- 0.5% Linear Growth Rate Applied per Study
- PennDOT Growth Factors have fallen to 0.00% for County
- District proceeded with 2011 growth factor of 0.28%

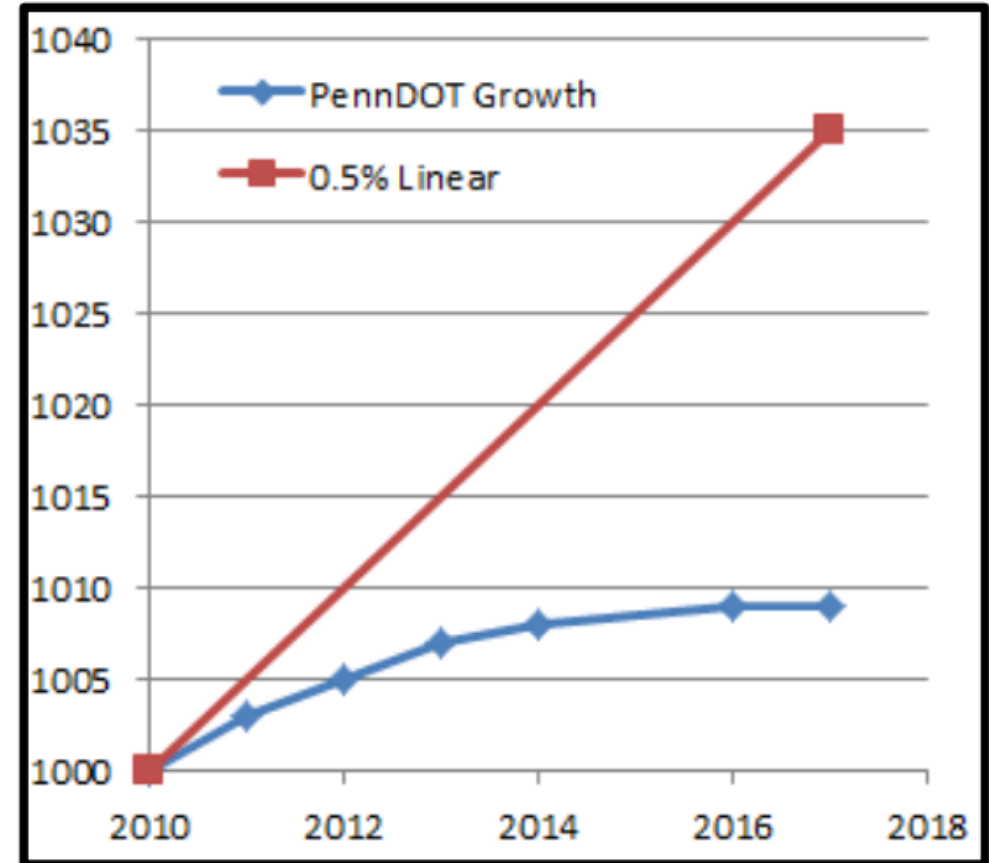
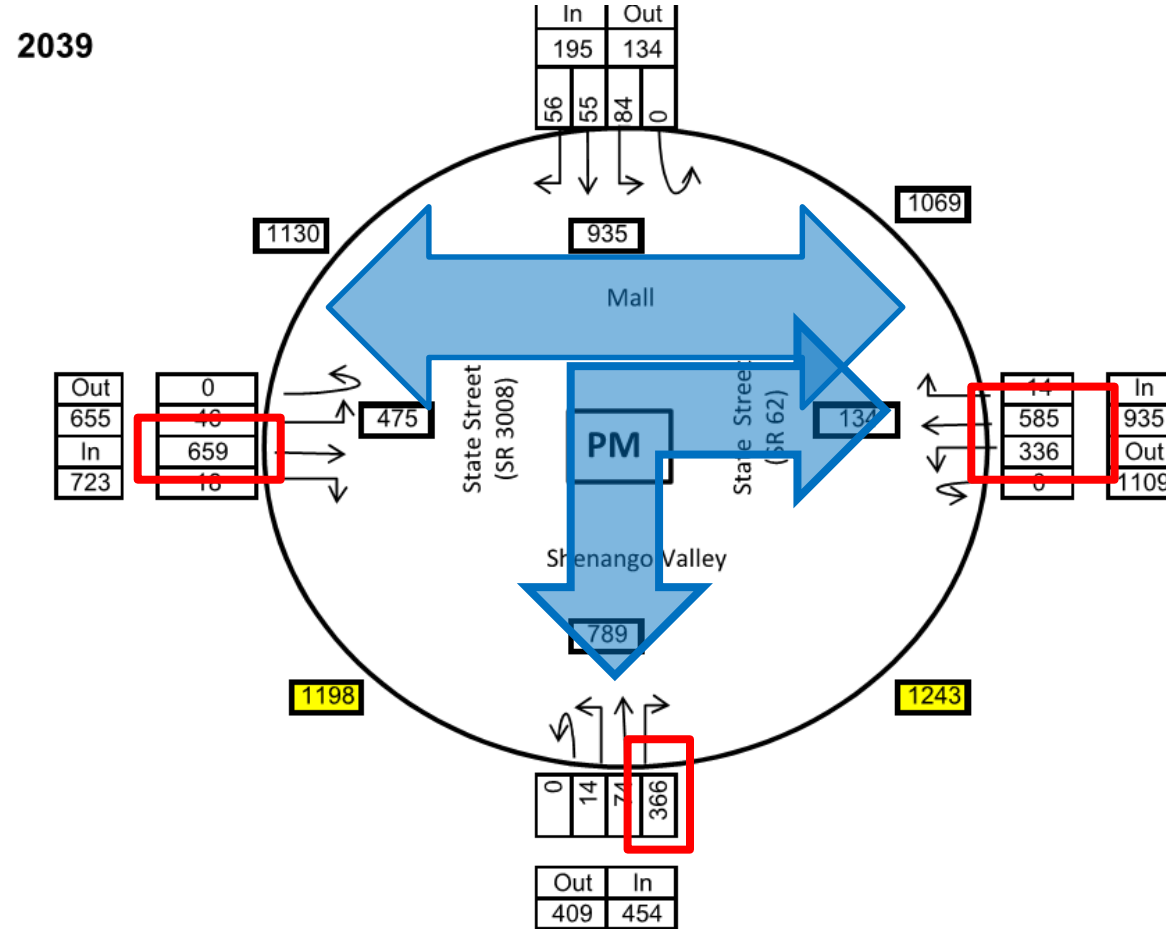
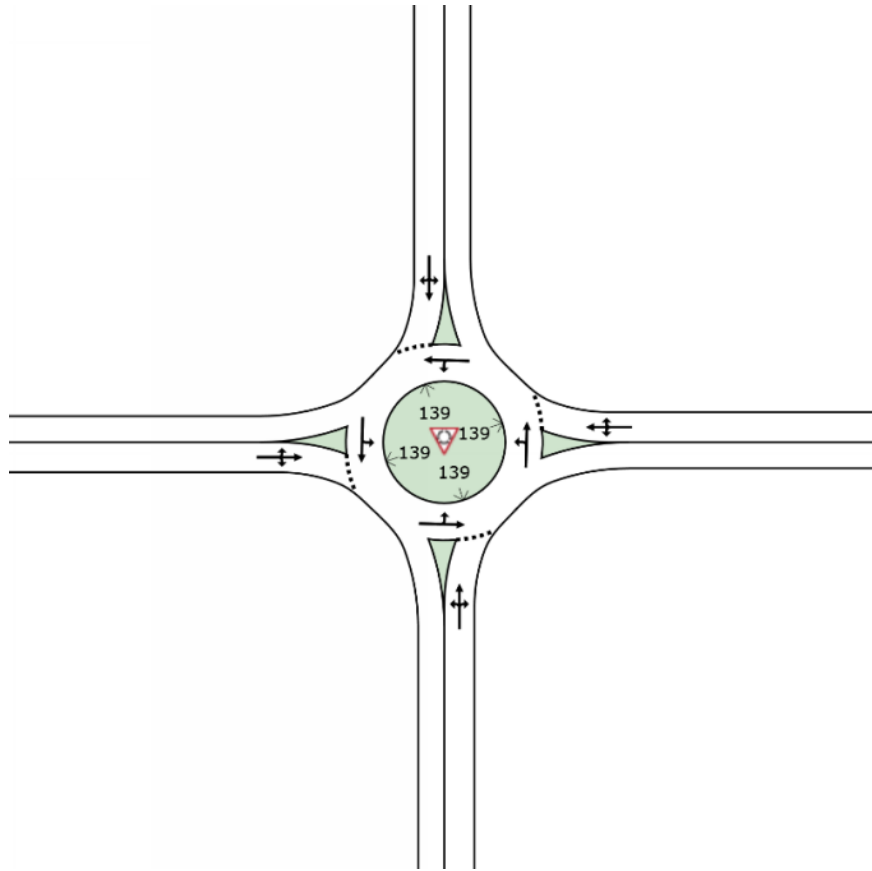


Figure 1 Volume Growth Comparison

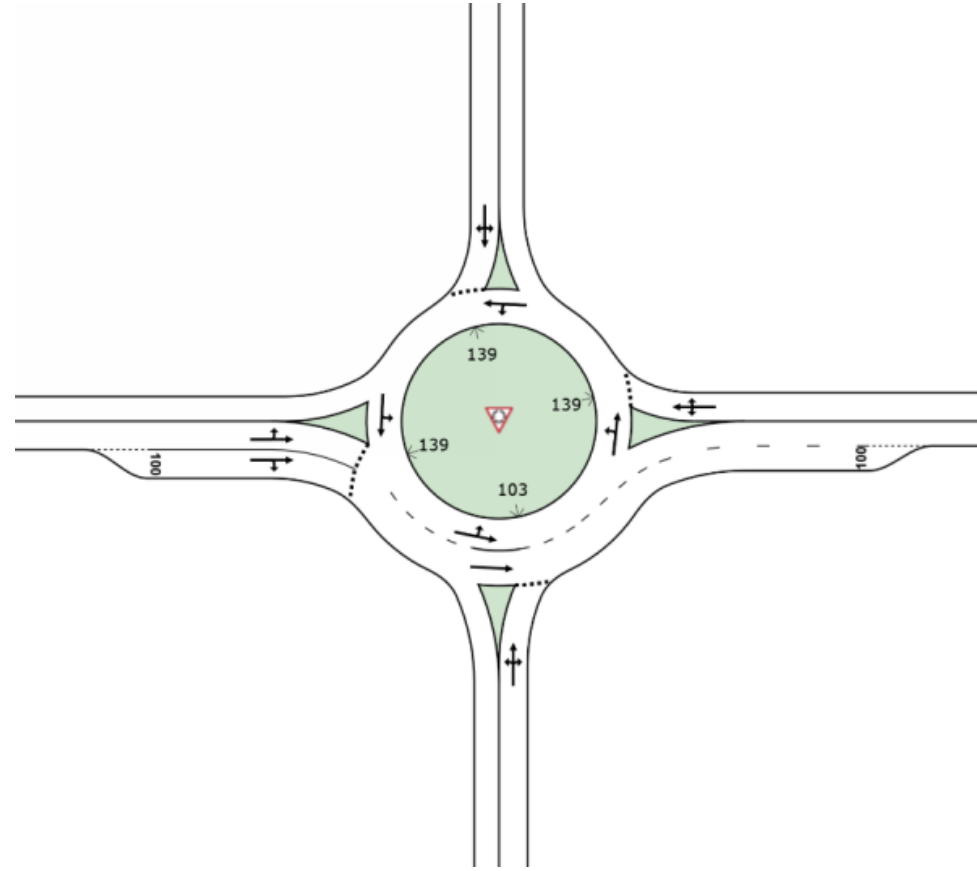
Case Study 1 – Flow Diagram



Case Study 1 - Alternatives



175' ICD Single Lane Roundabout



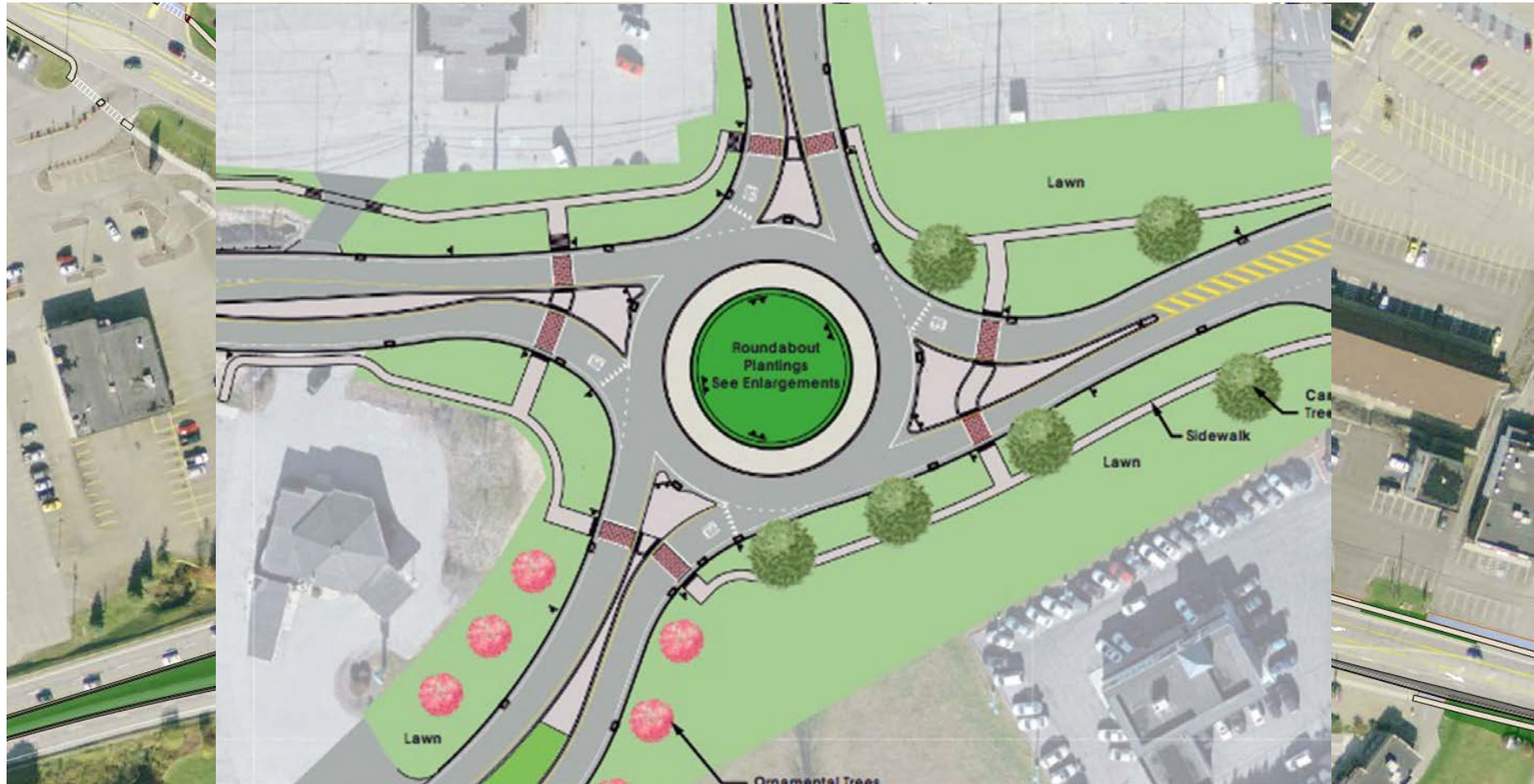
175' ICD Dual EB Through Roundabout

Case Study 1 – Capacity Analysis

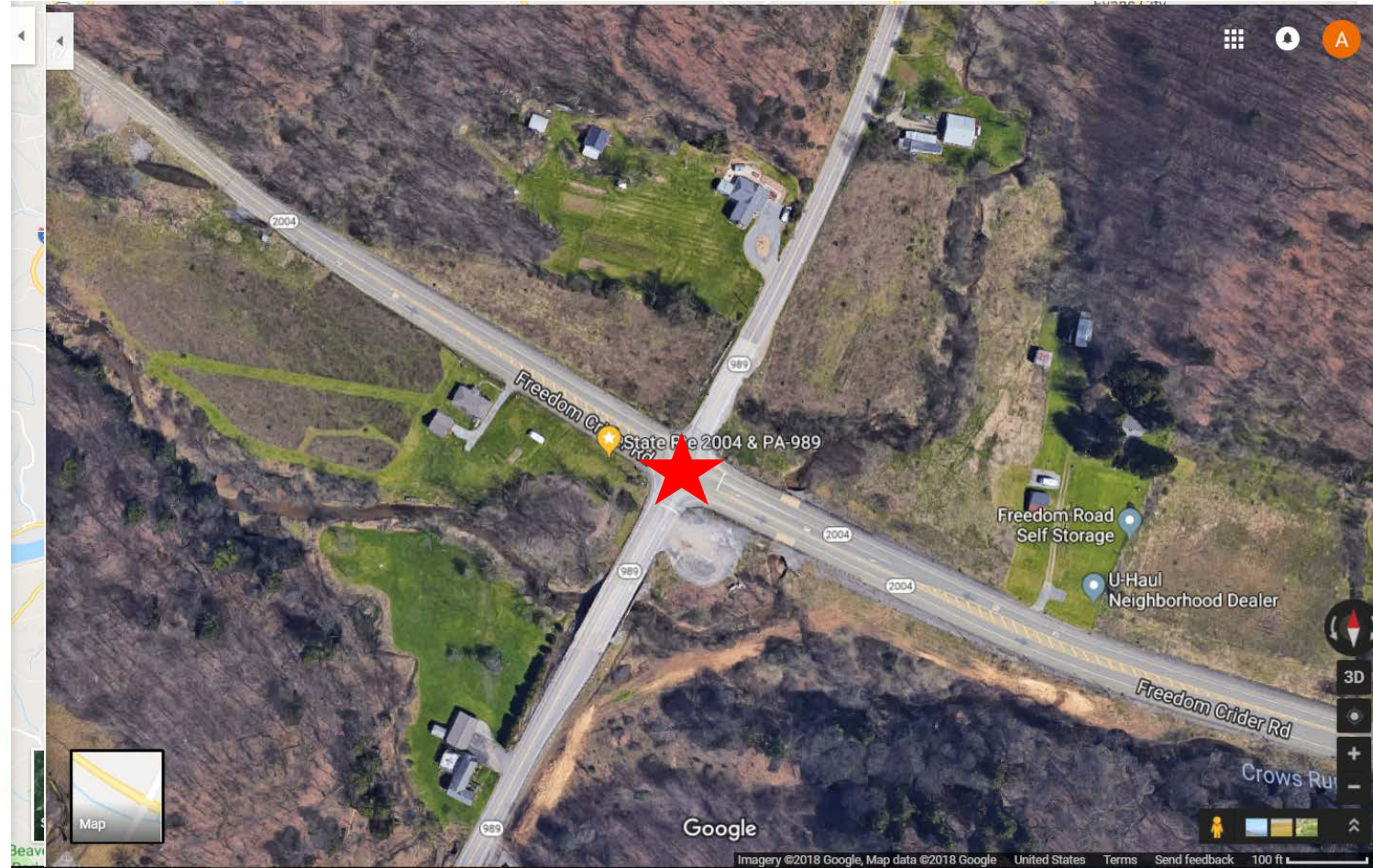
- Environmental Factor of 1.1
- Sensitivity Analysis assumed 0.5% linear growth rate

Alternative	Design Year (2039)			Sensitivity Year	
	V/C	Delay	Queue (ft)	V/C=0.85	V/C=1.0
Single Lane RAB	0.875	25.9	361	2037	2053
Dual EB Through RAB	0.829	4.4	319	2045	2071

Case Study 1 – Final Arrangement



Case Study 2 – SR 2004 Freedom Road Roundabout

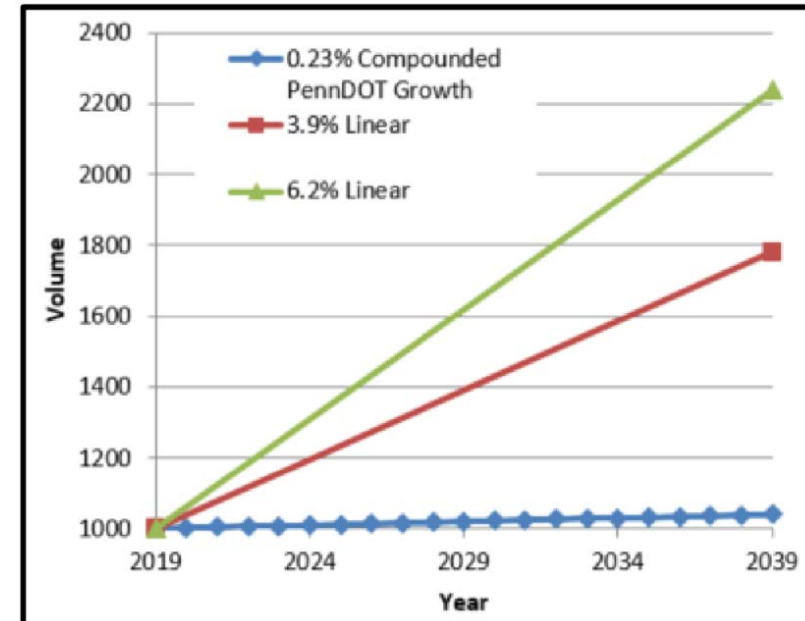


Case Study 2 – Received Design

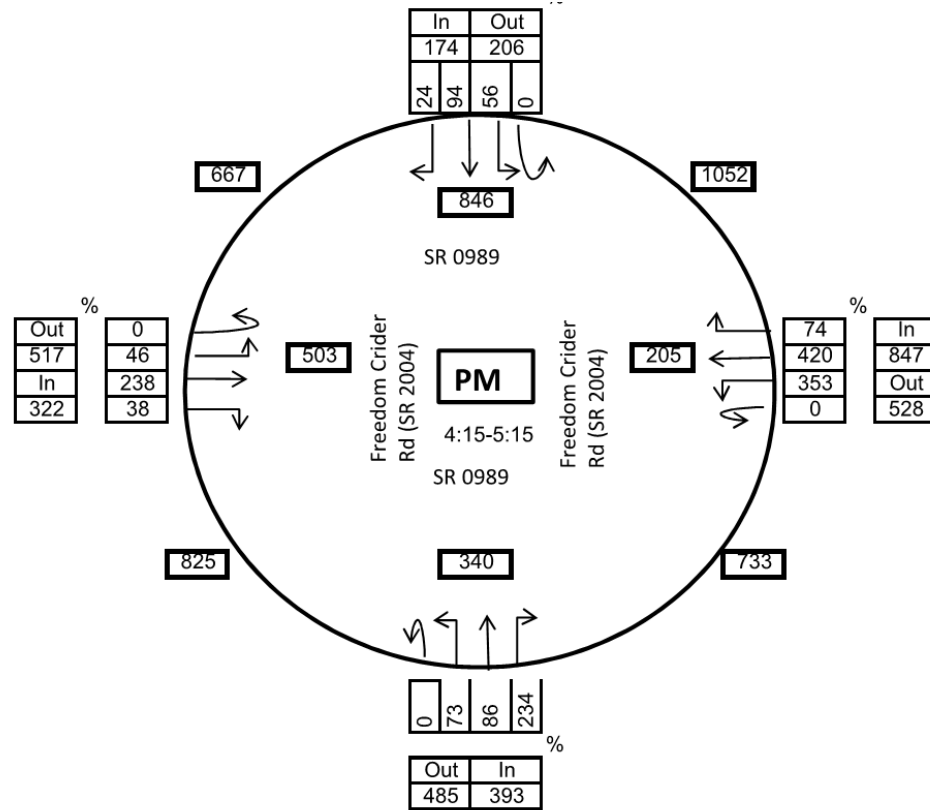


Case Study 2 – Peak Hour Turn Volumes

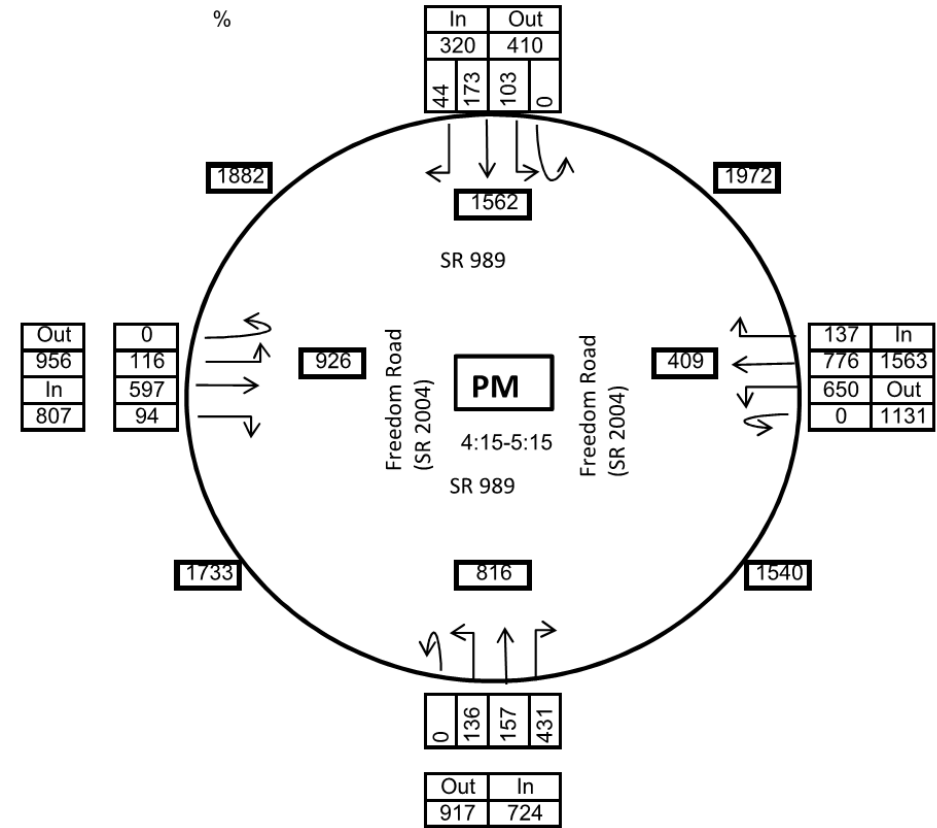
- Growth rate of 6.2% Linear provided by MPO (124% over 20 years)
- Highest PennDOT County Growth Factor over past five years of 0.23% (4.7% over 20 years)



Case Study 2 – Flow Diagram



Using 0.23% Compound Growth



Using 6.2% Linear Growth

Case Study 2 – Capacity Analysis

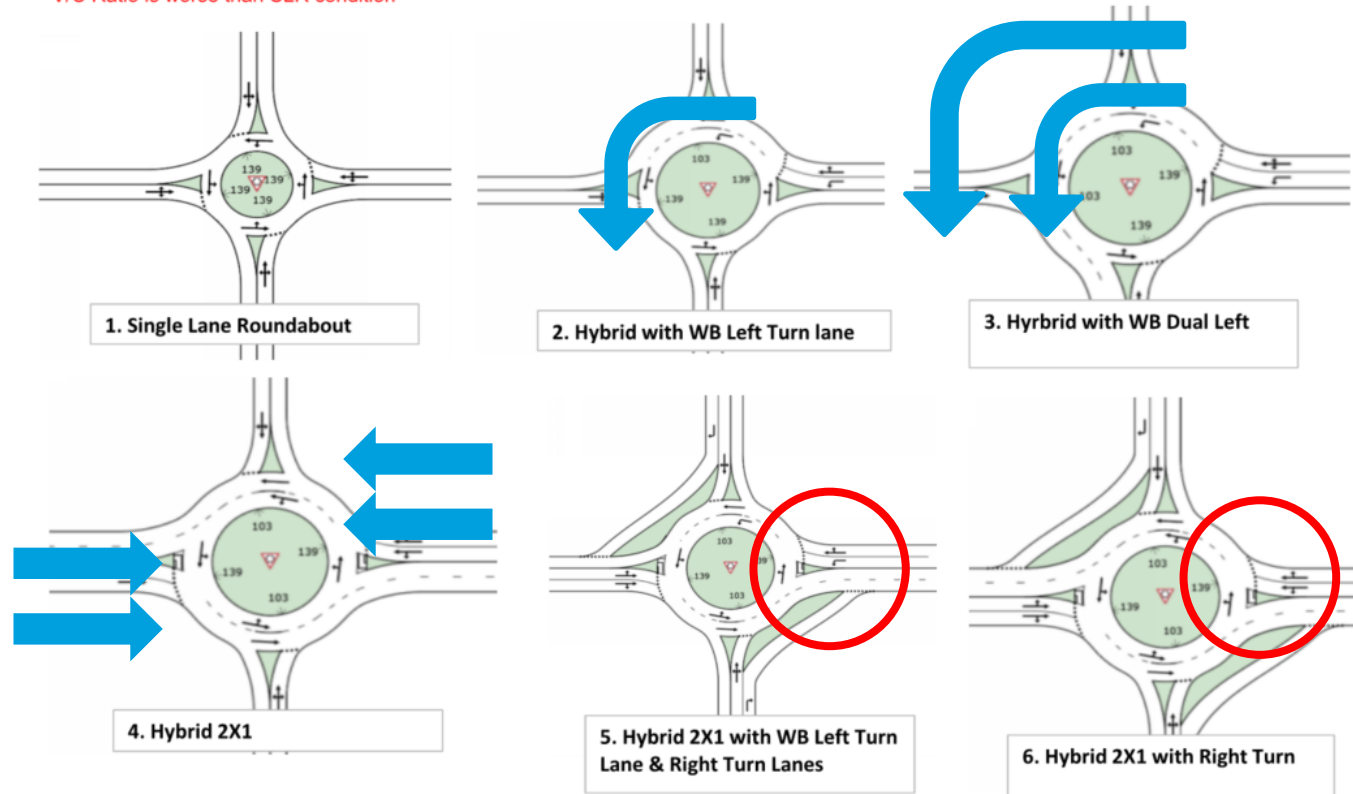
- Sidra Standard (EF = 1.05)
- Using PennDOT Growth Rate (0.23% Compound)
 - 150' ICD Single-Lane Roundabout
 - 2019 Opening Day (V/C = 0.834)
 - 2039 Design Year (V/C = 0.884)
 - Sensitivity Analysis (64 years → 2083)

Case Study 2 – Capacity Analysis

- Sidra St
- Using M
 - 17%
 - 20%

2039 PM V/C Ratios - 175' RAB - EF 1.05						
	1. SLR	2. HYB - WBL	3. HYB - Dual WBL	4. HYB - 2X1	5. HYB 2X1 - WBL w/ RT	6. HYB 2X1 w/ RT
South	1.319	0.977	0.926	1.409	0.522	0.522
East	1.754	0.885	0.851	0.776	0.874	0.840
North	0.866	1.123	1.121	0.993	0.714	0.670
West	1.276	1.964	2.220	0.879	0.896	0.898

*V/C Ratio is worse than SLR condition



Phased Improvements

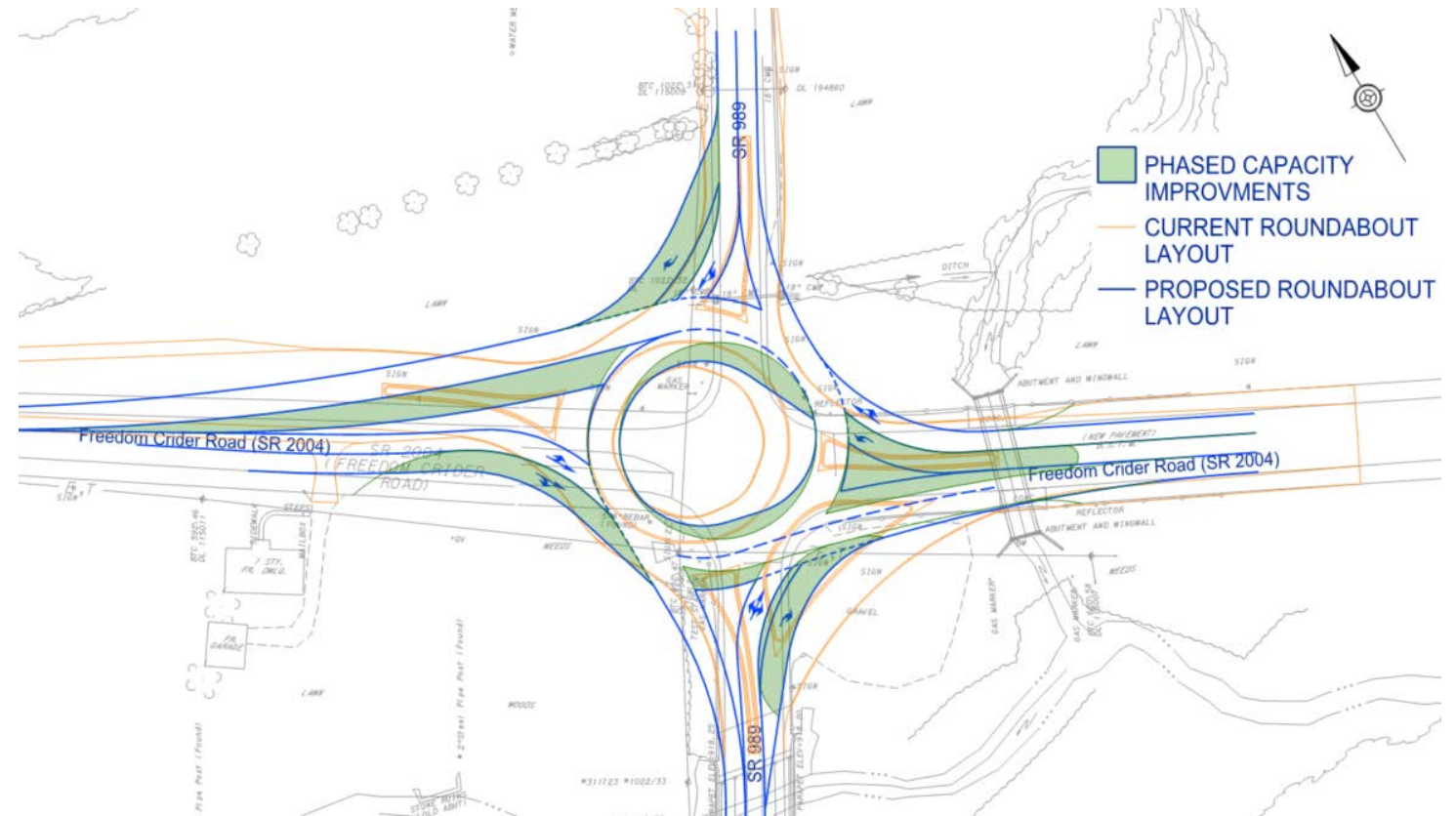
- NCHRP 672



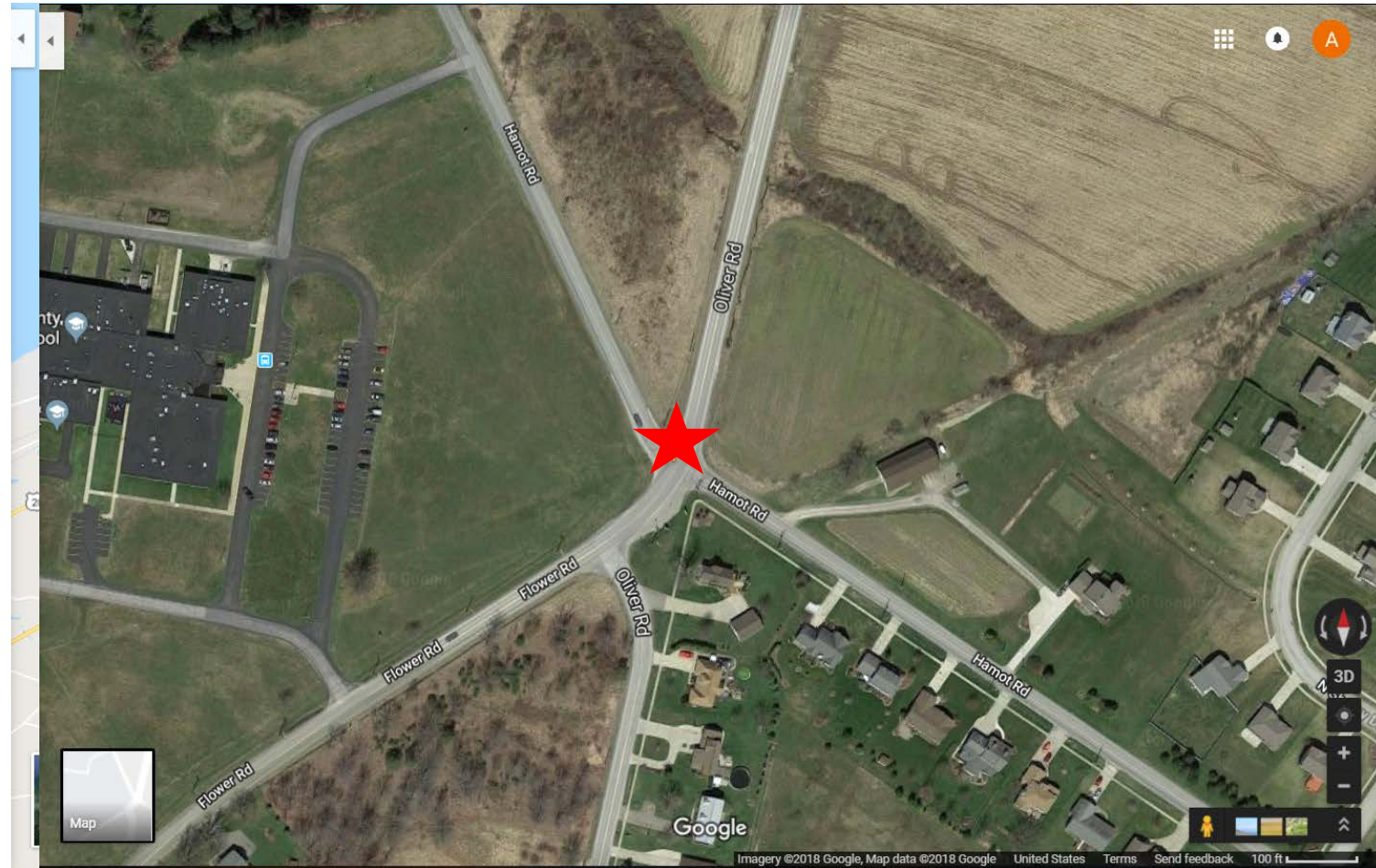
Source: NCHRP Report 672: Roundabouts an Informational Guide, Second Edition, 2010.

Case Study 2 – Phased Implementation

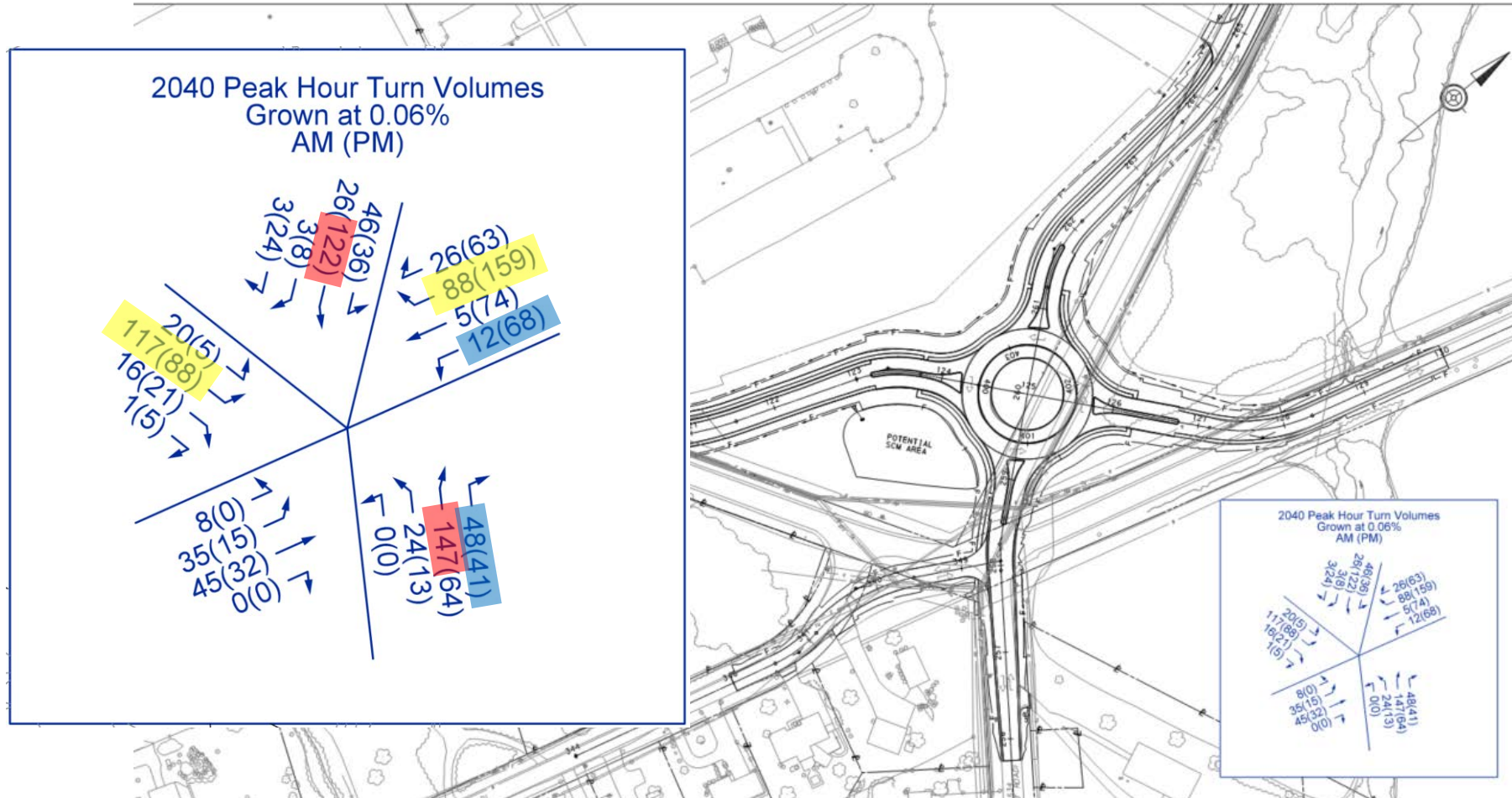
- Single Lane Roundabout (2019)
- Open WB Left Turn Lane (2023)
- Open additional EB Thru Lane (2033)
- Open NB Right Turn Lane (2036)
- Open SB Right Turn Lane (2041)



Case Study 3 – SR 4008 Five Points



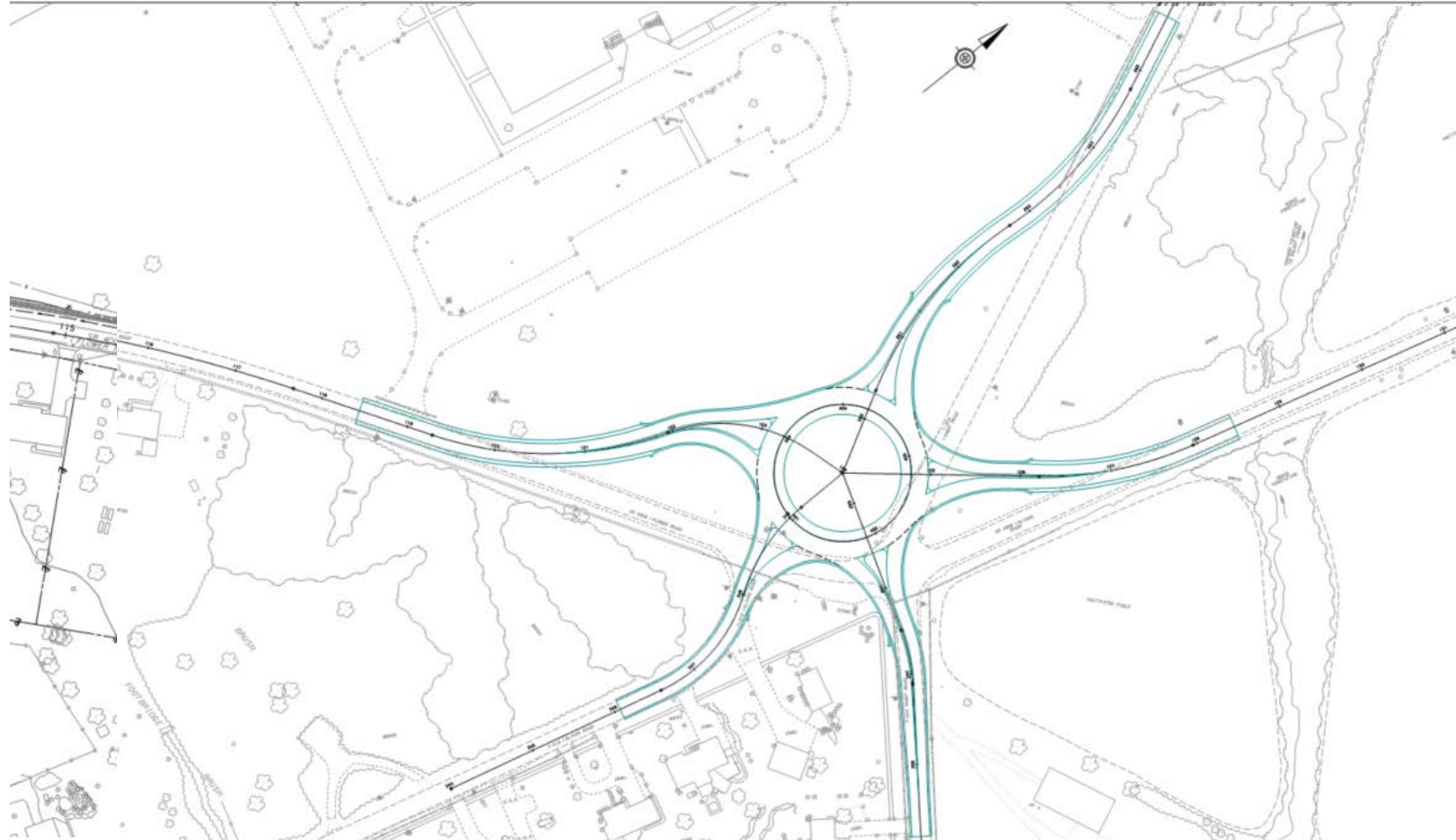
Case Study 3 – Received Design



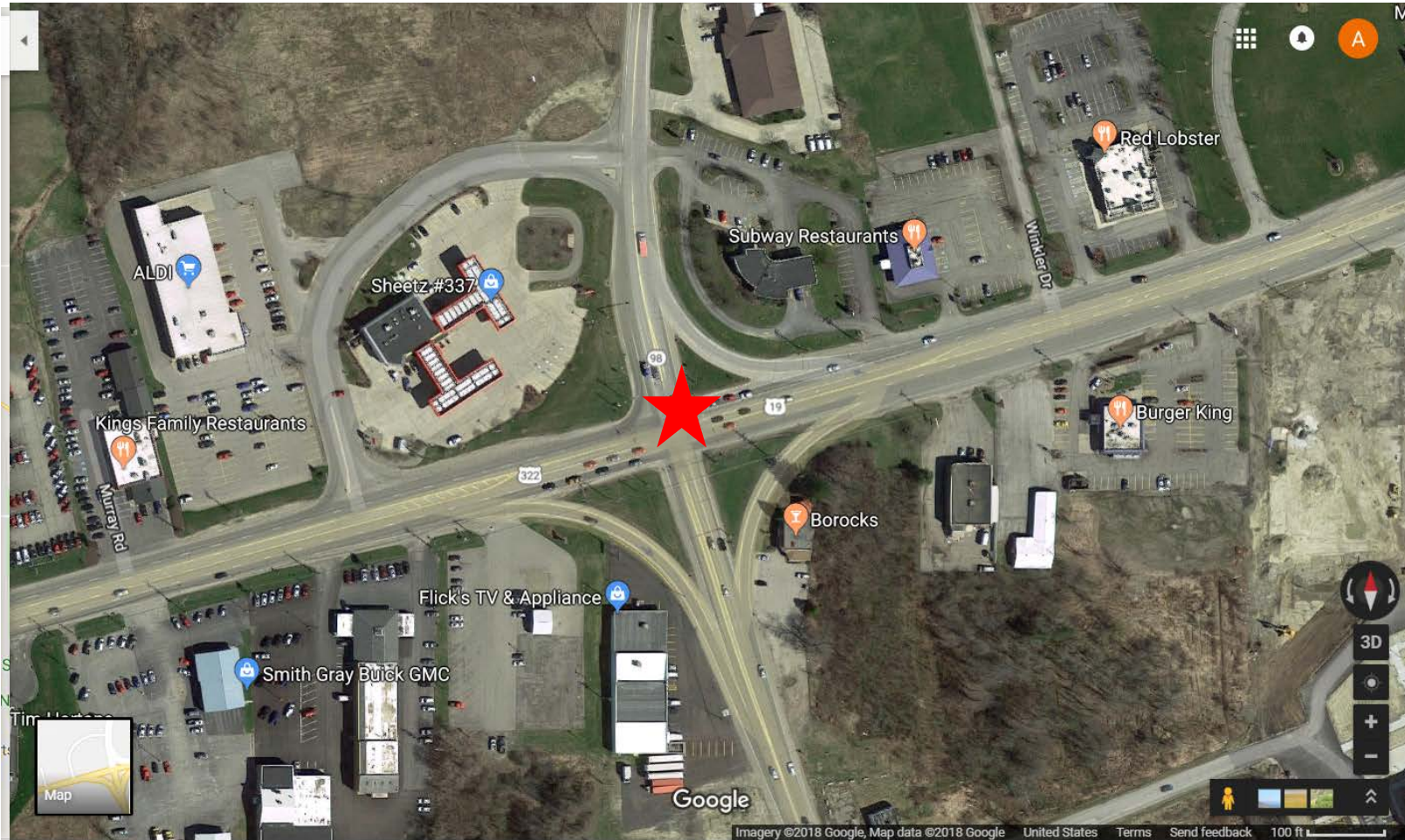
Case Study 3 – Capacity Analysis

- Using HCS6 methodology in Design Year 2040
- 4 Leg Roundabout – 150' ICD
 - $V/C = 0.364$, 7.5 seconds delay, 44.7 ft Queue (approx. 2 vehicles)
- 5 Leg Roundabout – 190' ICD
 - $V/C = 0.327$, 6.0 seconds delay, 47.1 ft Queue (approx. 2 vehicles)
 - Combining intersections reduced the volume on the major leg

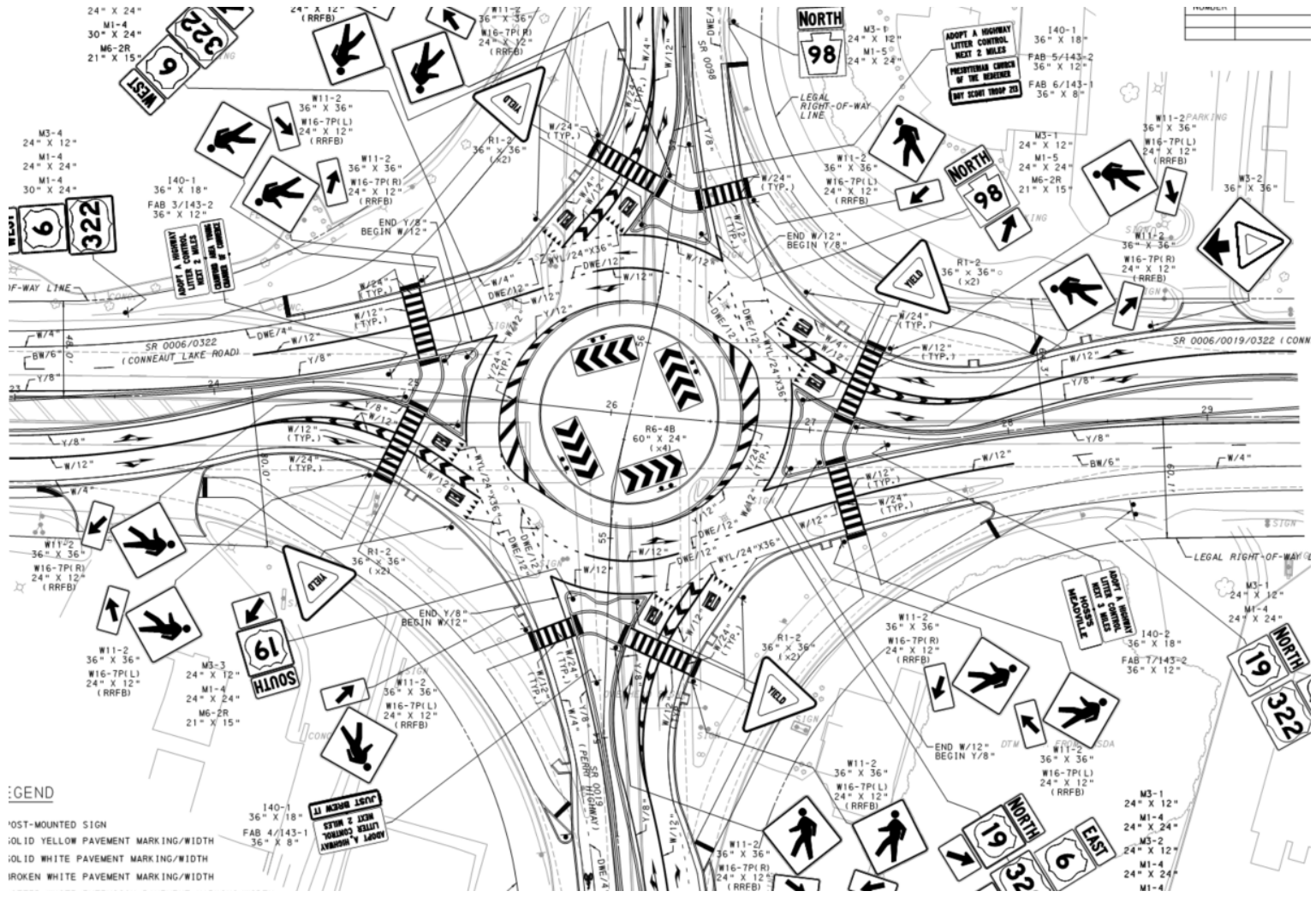
Case Study 3 – Final Arrangement



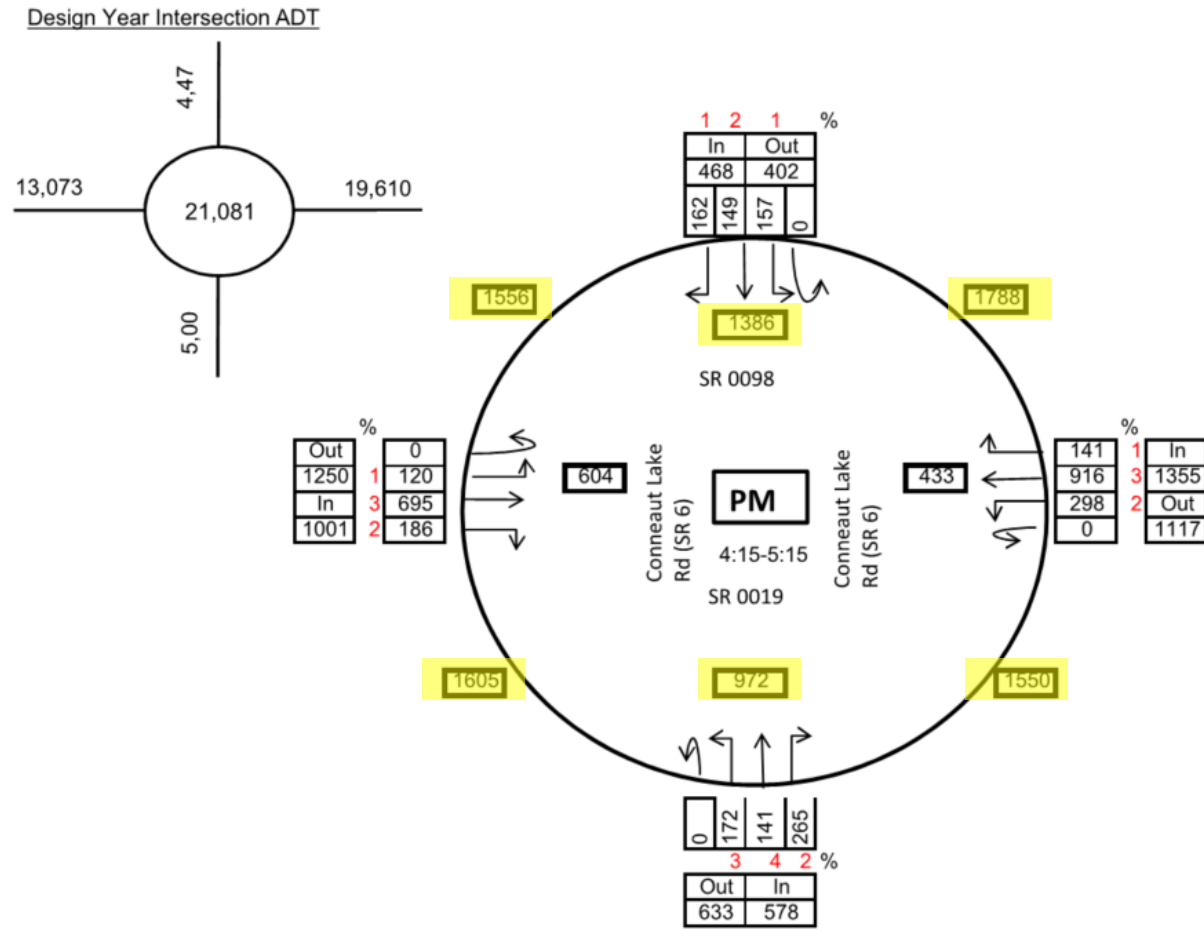
Case Study 4 – Big I Roundabout



Case Study 4 - Received Design



Case Study 4 – Flow Diagram



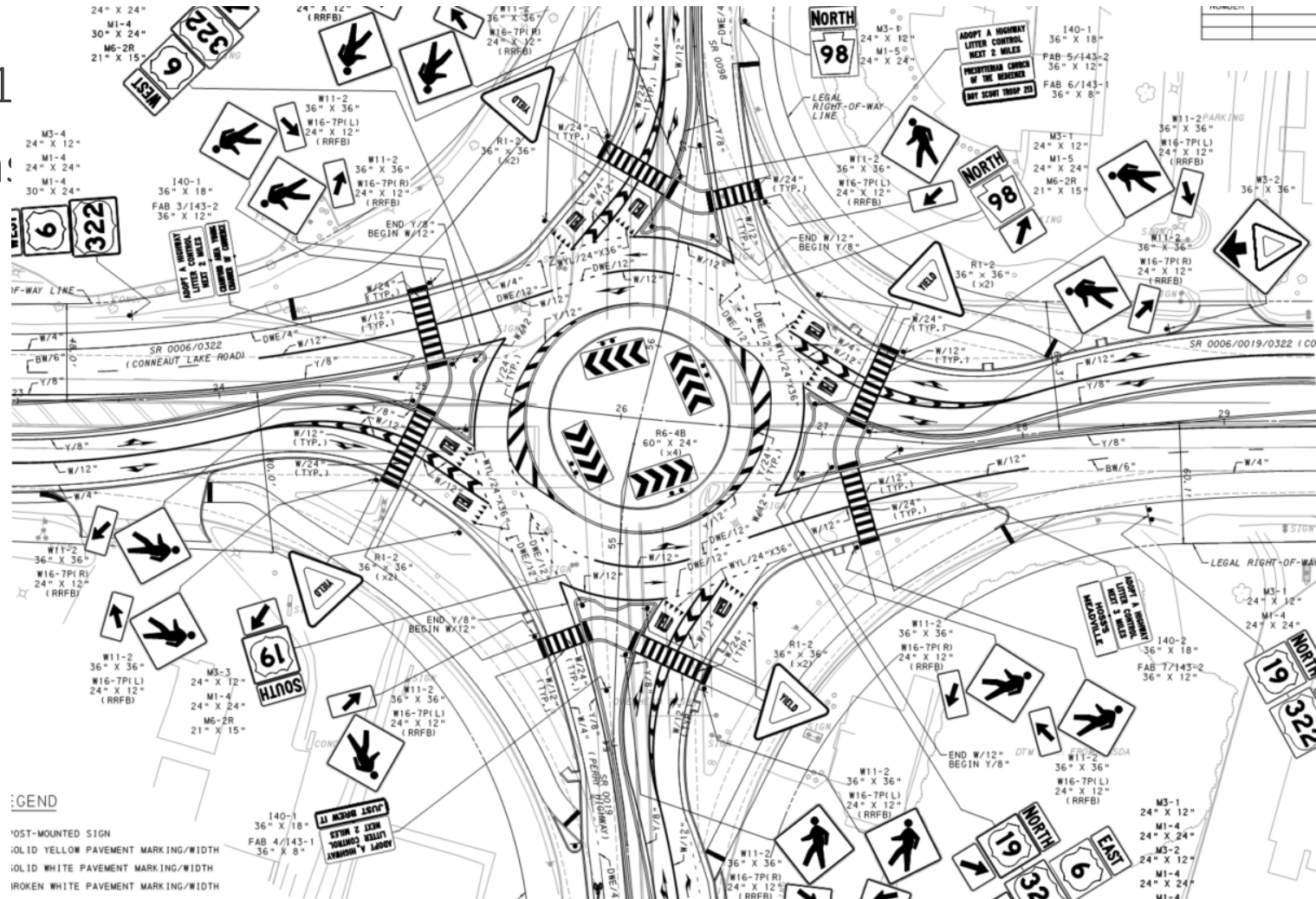
Case Study 4 – Capacity Analysis

- Sidra 8 (EF 1.05)
- ICD 195'

Approach	Single - Lane	Dual WB Lanes	Hybrid 2X1	2X1 w/ NB/SB RT Turn Lanes
South	1.180	1.056	0.933	0.396
East	1.383	0.629	0.647	0.631
North	1.213	0.935	0.956	0.466
West	1.080	1.218	0.540	0.631

Case Study 4 – Final Arrangement

- EF 1
- Phase 1



Conclusion – Lessons Learned

- Growth Factors
- Environmental Factors
- Planning Level Sizing
- Flow Diagrams

Thank You!

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