"AN EVALUATION OF CHARACTERISTICS THAT IMPACT VIOLATION RATES AT RIGHT-IN / RIGHT-OUT DRIVEWAYS"

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Presenter Info

- Steve Thieken, PE, PTOE
- Bachelor of Civil Engineering from University of Dayton
- MS in Transportation Engineering from The Ohio State University
- Transportation Engineer for Burgess & Niple, Inc., Columbus, Ohio
- 11-years of experience

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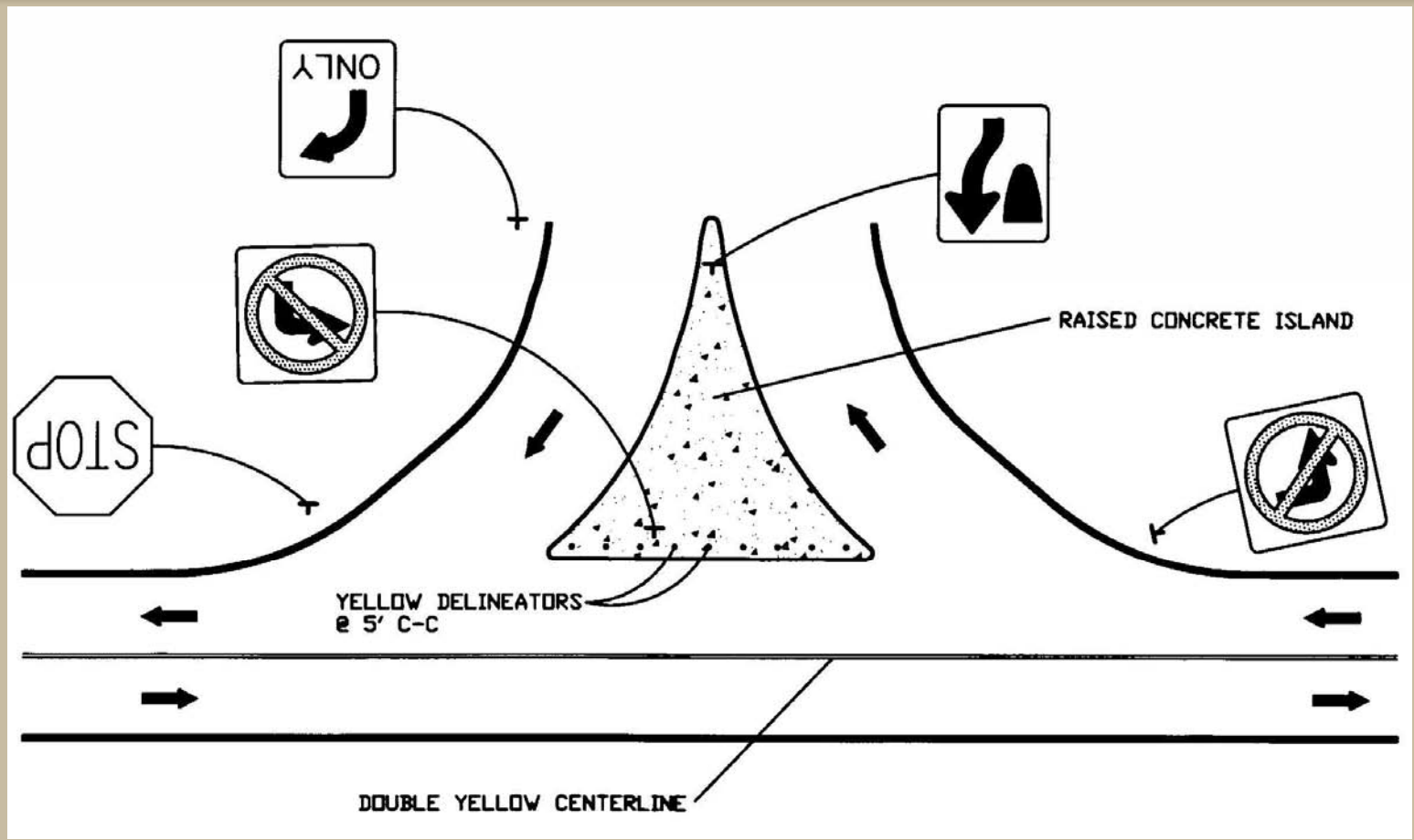
Overview

- Define Right-in/Right-out Driveway and Issues
- Motivation and Objectives
- Surveys and Literature Review
- Data Collected and Violation Rates
- Case Studies and Analysis
- Conclusions

What is a Right-in/Right-out Driveway?



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What is a Right-in/Right-out Driveway?

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Focus of this Research

- No continuous center median on the mainline to physically prohibit movement
- On arterial streets

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Why install one?

To dissuade or prohibit left-turns

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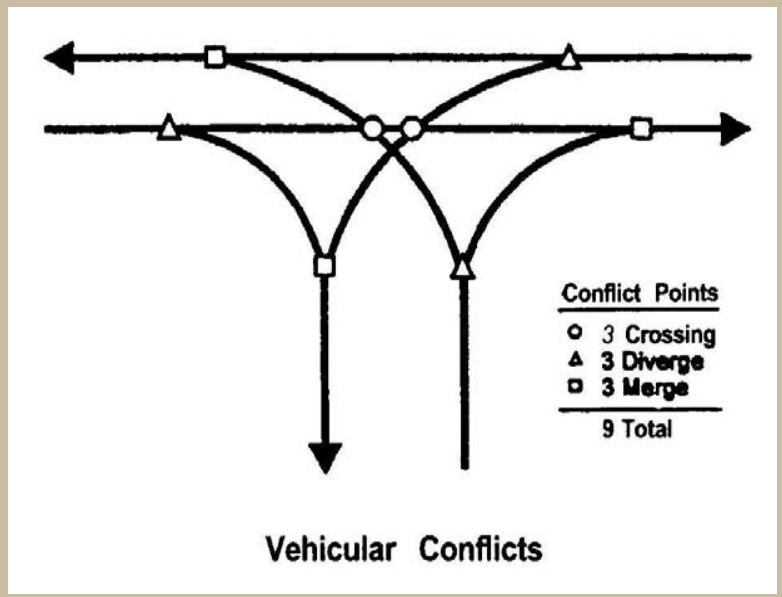
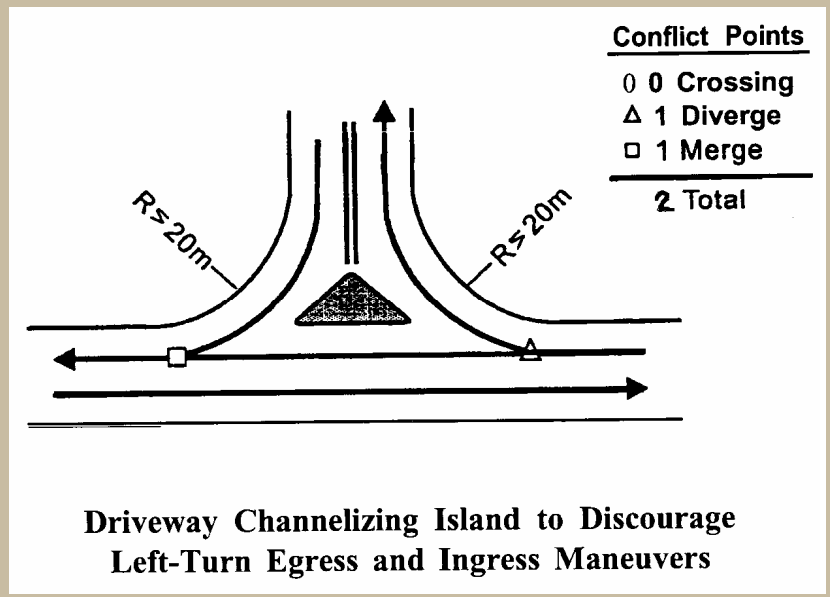
Why dissuade or prohibit left turns?

To reduce vehicular conflicts



Full Access Drive



RIRO

Source: National Highway Institute

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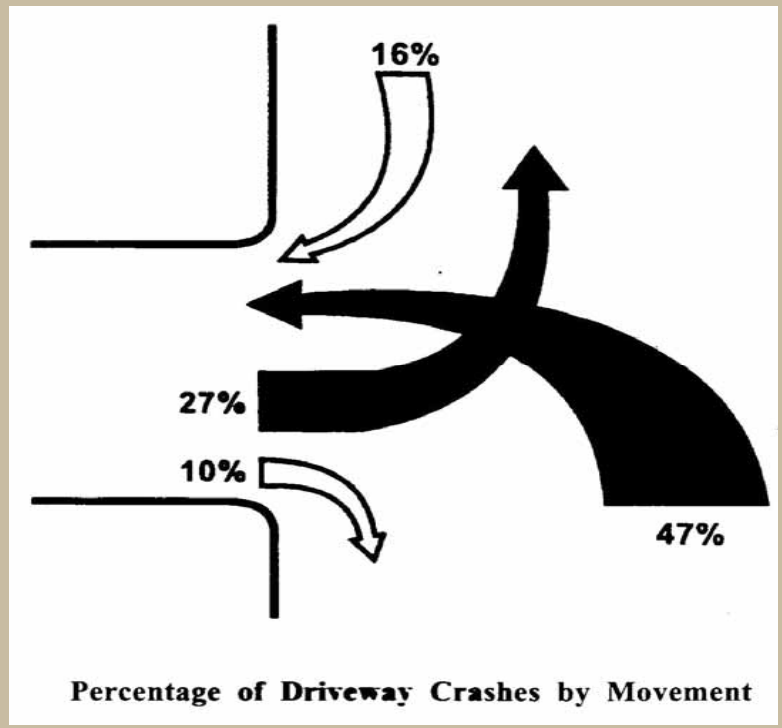
Why reduce vehicular conflicts?

Reduces accident potential (and delay)



Source: National Highway Institute

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So what's the problem?

Compliance!

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Motivation

- Popular design concept
- Very little formal research on topic
- Master's Thesis

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Co-Author

Dr. Frank Croft, PE, The Ohio State University

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Surveys

State Departments of Transportation

- Twenty responses received
- Most use on case-by-case basis
- Five states had design guidelines
- Three state DOT representatives expressed skepticism about effectiveness without a center median.

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Surveys (continued)

Institute of Transportation Engineers

- Nearly all respondents were skeptical about their effectiveness in preventing left turns
- Other thoughts
  - "If the mainline traffic volume is high enough then most drivers will not even bother to try the left turn"
  - Could possibly increase safety concerns

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Literature Review

- Aksan and Layton Oregon State University/Oregon Department of Transportation Study
- NHI Course No. 15255 Access Management, Location and Design
- FHWA-RD-76-86 Technical Guidelines for the Control of Direct Access to Arterial Highways

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Aksan / Layton Conclusions

- The rate of violation depends primarily on the "setting" of the island.

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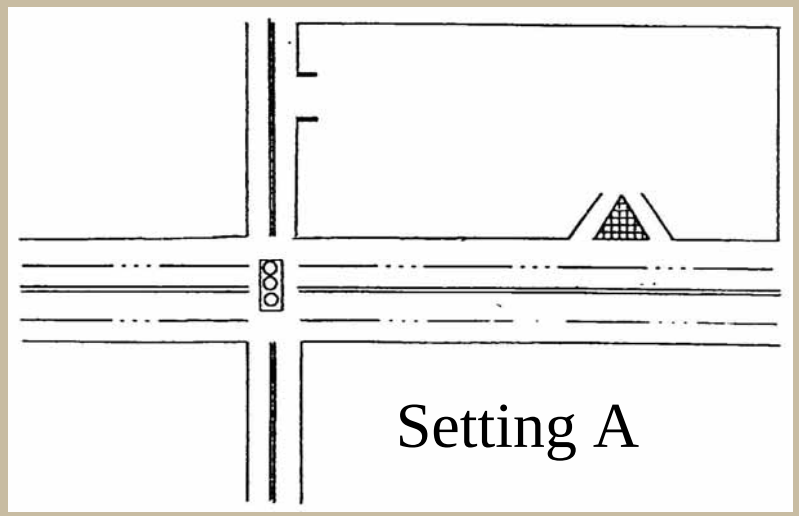
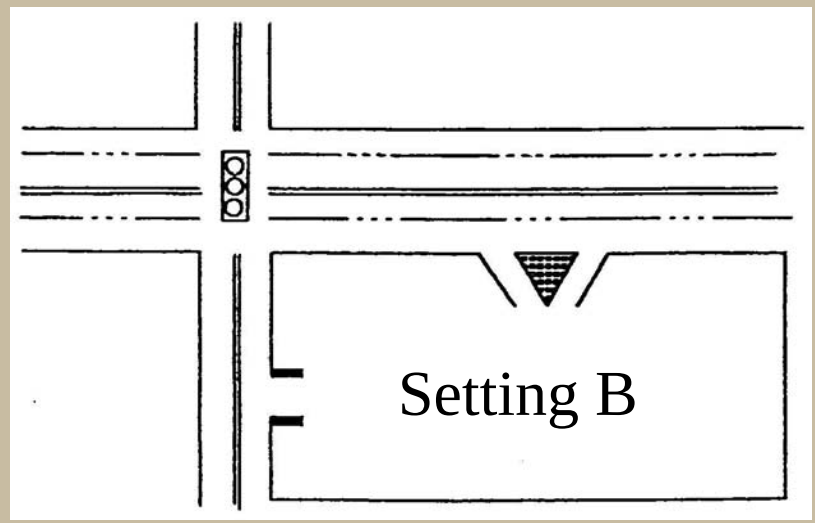
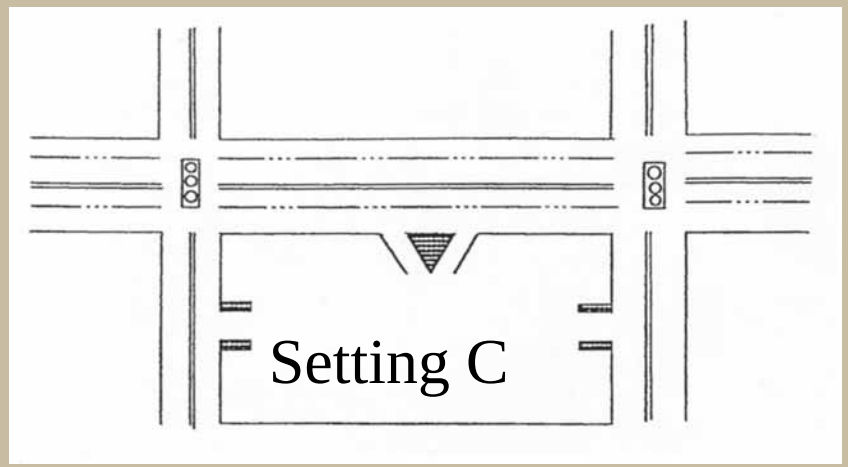
Setting







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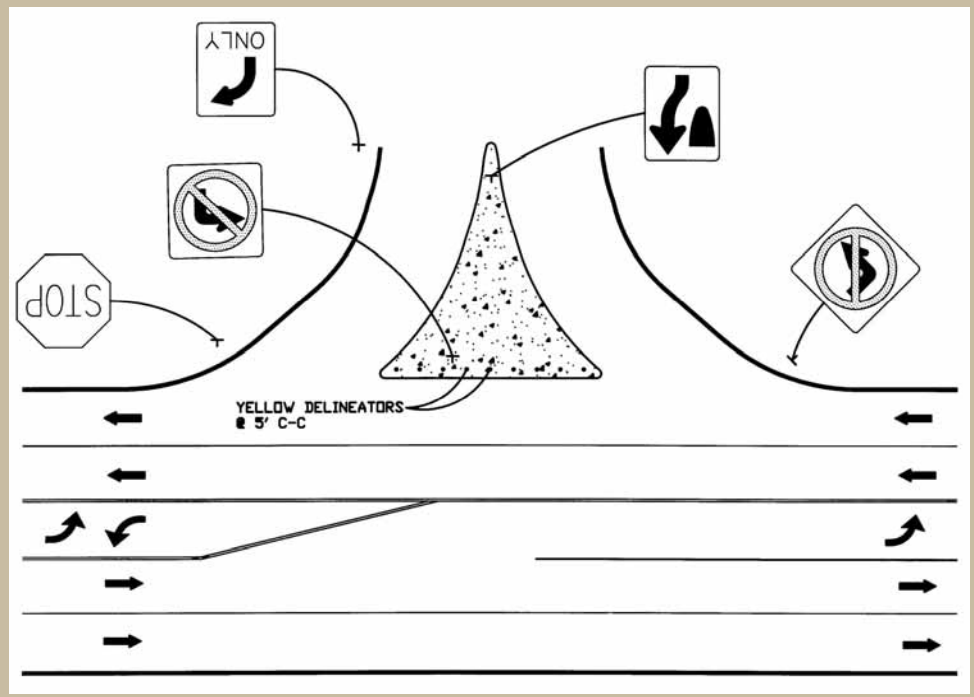
Aksan / Layton Conclusions (continued)

- A continuous raised median is the only solution for preventing left turns to and from a right-in right-out island.
- Larger island sizes have been found helpful but are not sufficient to prevent violations.

Aksan / Layton Conclusions (continued)

- Where there is a two-way left turn lane or left turn lane for an adjacent intersection between through traffic lanes, the violation rate is higher.



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Aksan / Layton Conclusions (continued)

- No correlation between the accident rate and the violation rate could be found.

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National Highway Institute

- Channelized RIRO driveways discourage left turn maneuvers, reducing the conflict points at the driveway from nine to two
- Left turns are involved in a high proportion of crashes
- Use AASHTO guidelines for island design
- Use turn prohibition regulatory signs per the MUTCD

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Report No. FHWA RD-76-86

- Discusses benefits – accident reduction
- States: "…violations will be common in absence of a non-traversable median."
- Conclusions and recommendations based on assumptions not on research of RIRO driveway locations.
- Considers the method "cost effective"

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Report No. FHWA RD-76-86

Recommended Design

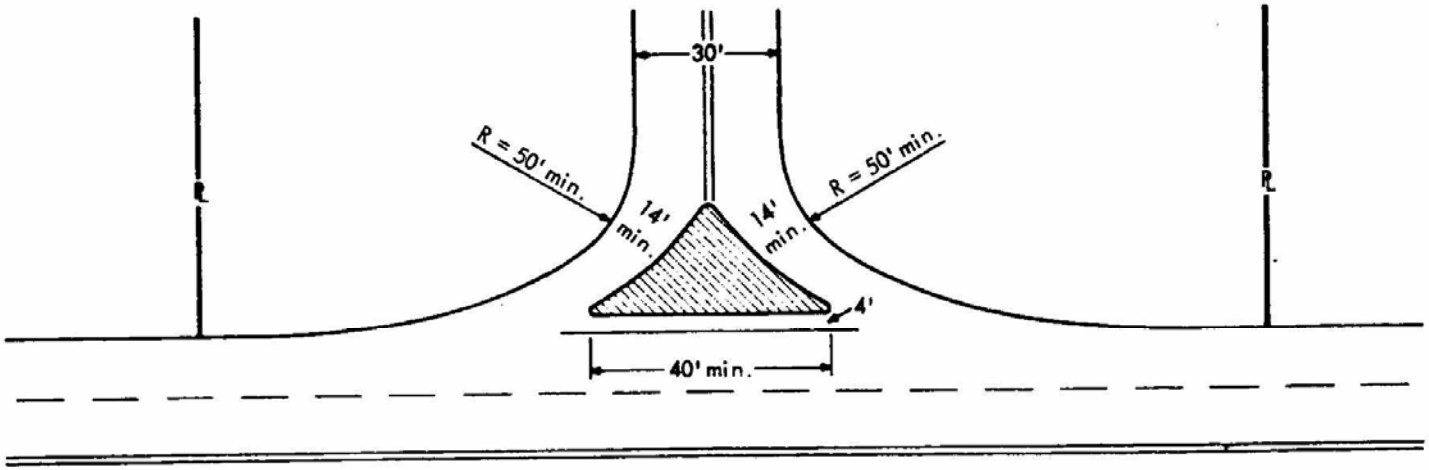

Figure C-3.3 - Driveway Channelizing Island to Prevent Left-Turn Egress and Ingress Maneuvers

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Research Objectives

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Research Objectives

- Develop a better measure of effectiveness than used in previous research
- Evaluate compliance/violation rates at RIRO driveways
- Relate the violation rates to driveway and site characteristics that are generally available to designers at time of site design

Objectives (continued)

- Develop a mathematical model(s) that predicts violation rates base on design characteristics of a RIRO driveway
- Gain insight into the appropriate application of RIRO driveways
- Develop warrants

Case Studies

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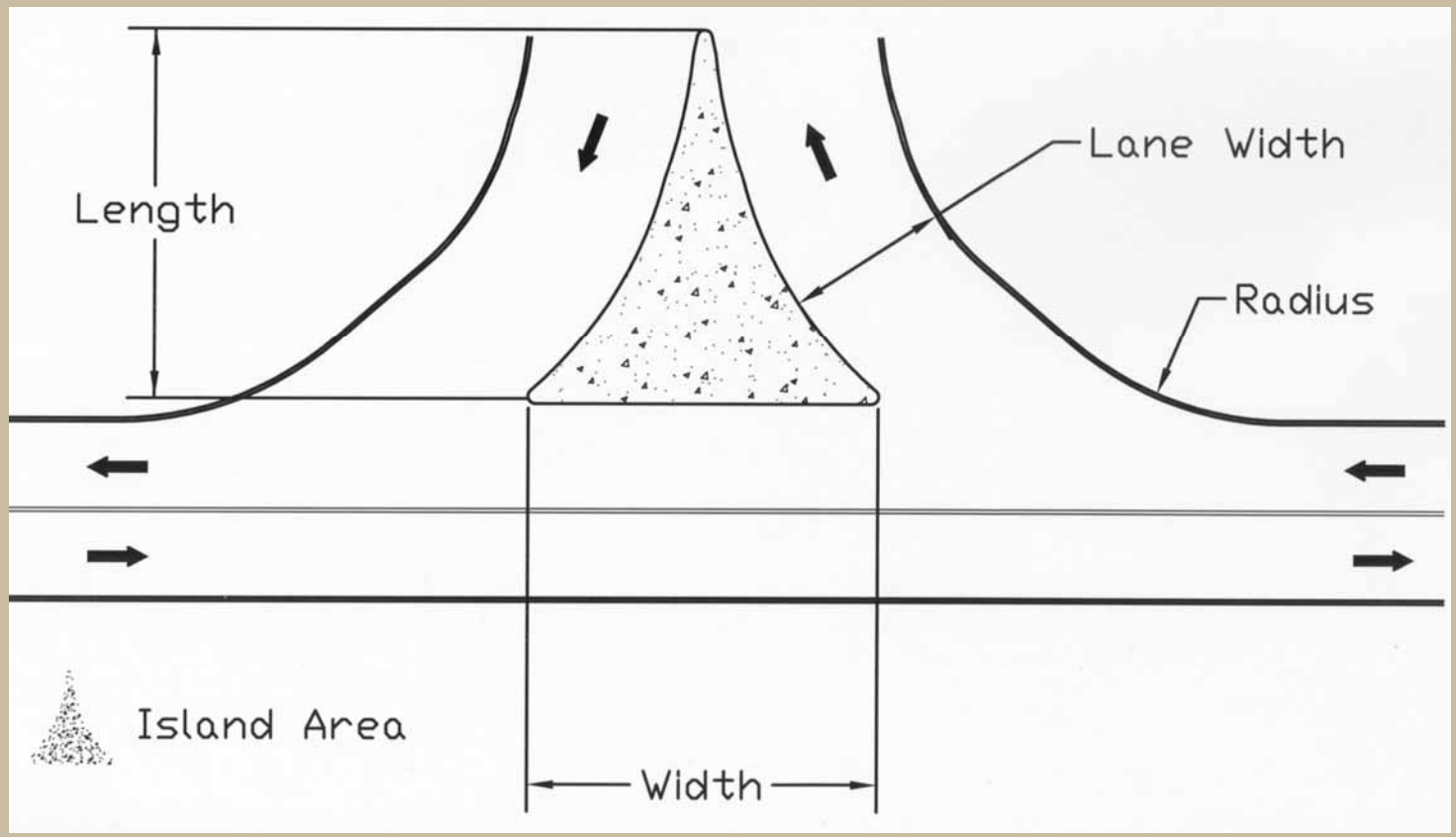
Case Studies

- Collected Field Data at 7 RIRO Sites

Site Data Collected



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Site Data Collected (continued)

- Existence of adequate “no left-in, left-out” regulatory signage
- Availability of storage on mainline
- Setting

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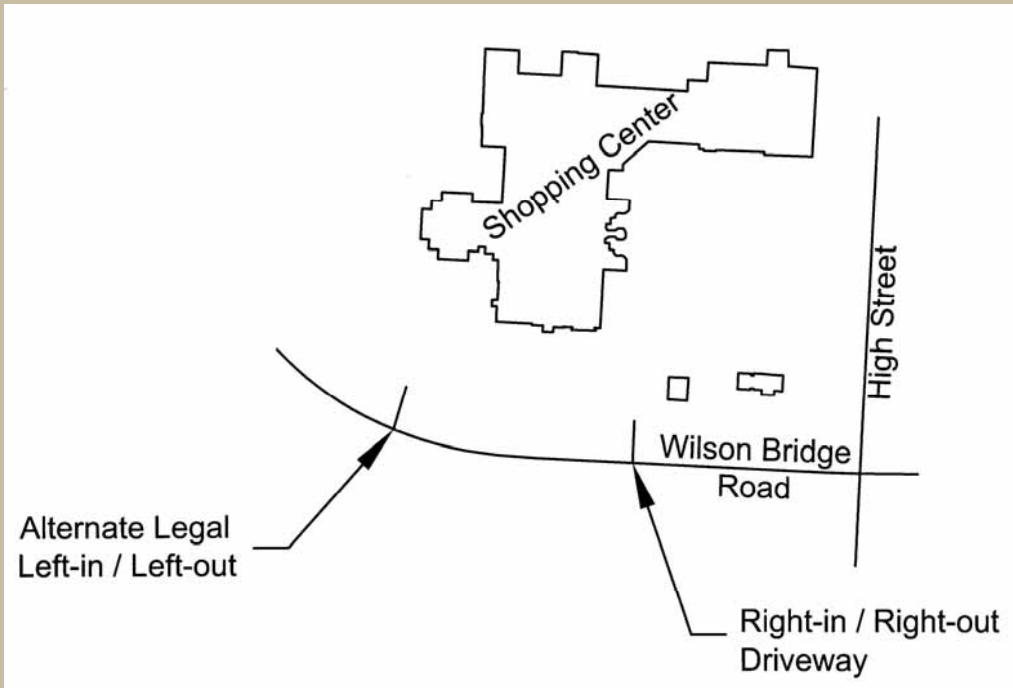
Site Data Collected (continued)

- Distance to closest legal alternate left-in/left-out access
- Visibility of alternate access



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Site Data Collected (continued)

- Average Daily Traffic (ADT) on arterial
- Number of lanes on the arterial
- ADT divided by the number of through lanes on mainline roadway in vehicles per day

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Traffic Field Data Collected

PM Peak Hour (2 hours)

- Number of violations at RIRO driveway
- Total volume at RIRO driveway
- Total alternate legal LI and LO volume

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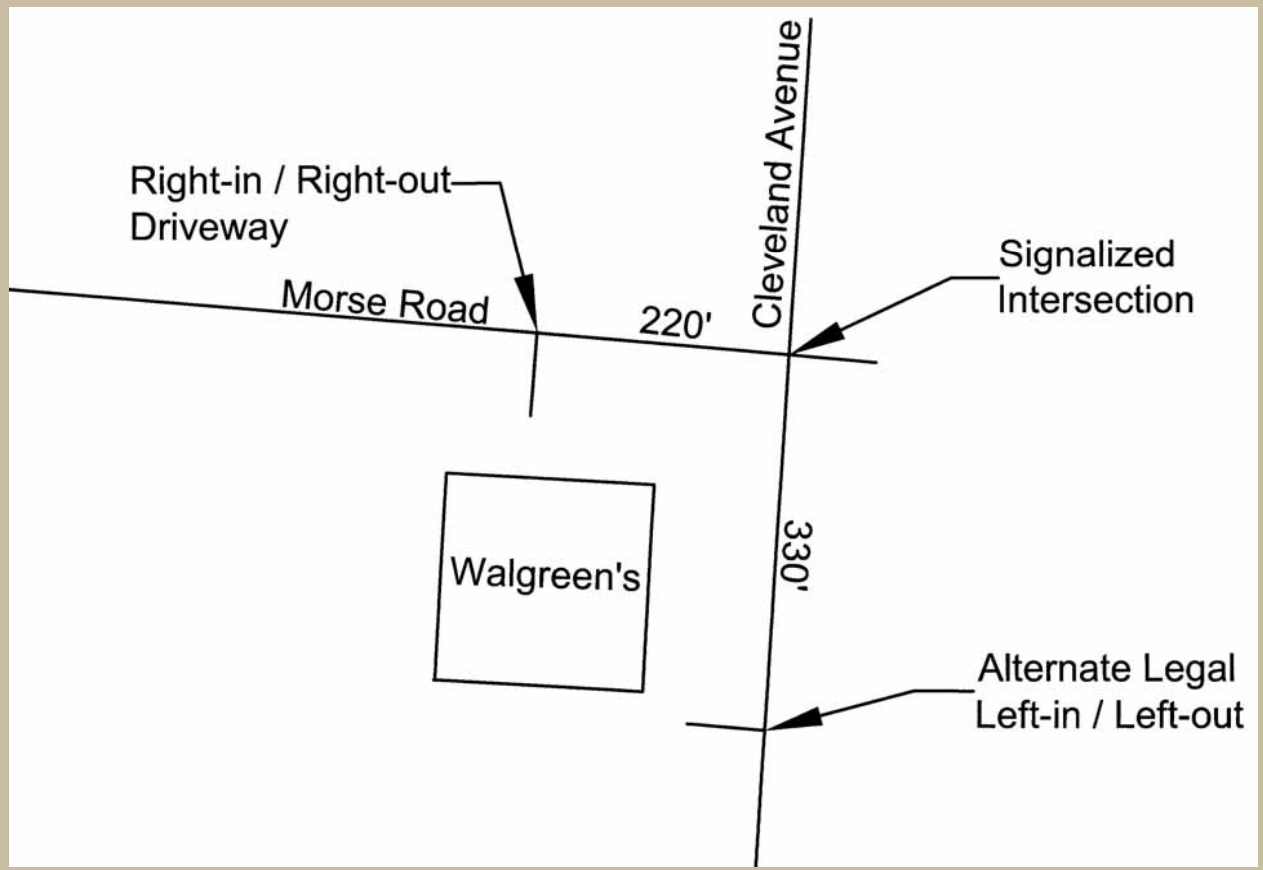
Legal Alternate Left



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Violation Rates

Total Rate

Total Rate = (LI Violations + LO Violations) / (RI Volume + RO Volume) x 1000

LIRI Rate & LORO Rate (Aksan/Layton)

LI/RI Rate = LI Violations / RI Volume x 1000

LO/RO Rate = LO Violations / RO Volume x 1000

LI Alternate Rate & LO Alternate Rate

LI Alternate Rate = LI Violations / LI Legal Alternate Volume x 1000

LO Alternate Rate = LO Violations / LO Legal Alternate Volume x 1000

Better Measure!

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Sites

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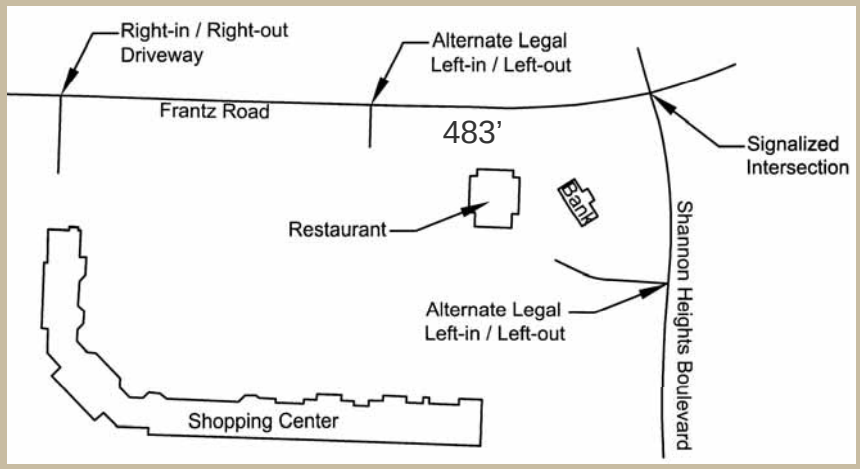
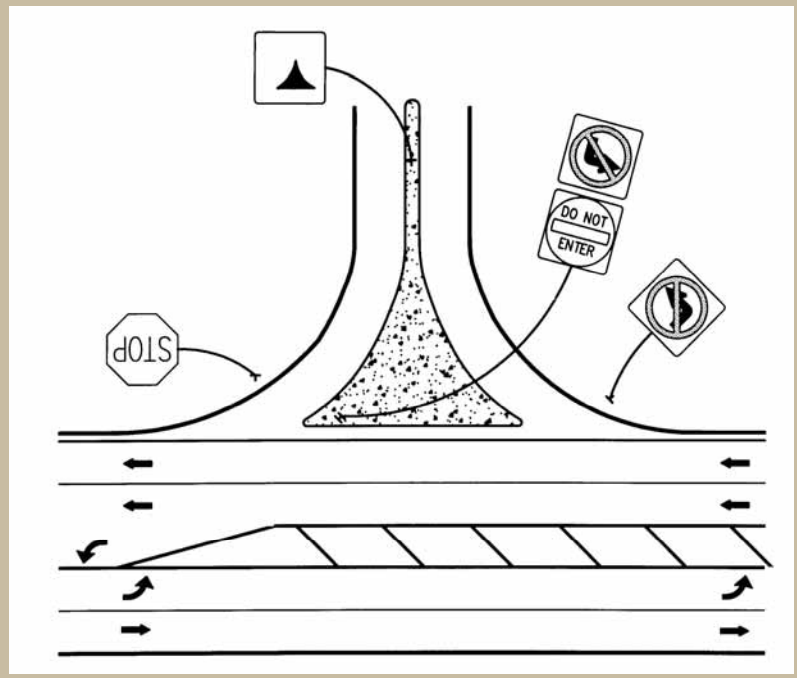
Frantz Road @ Shopping Center





- Low total rate
- Average LO rate
- Long Island Length

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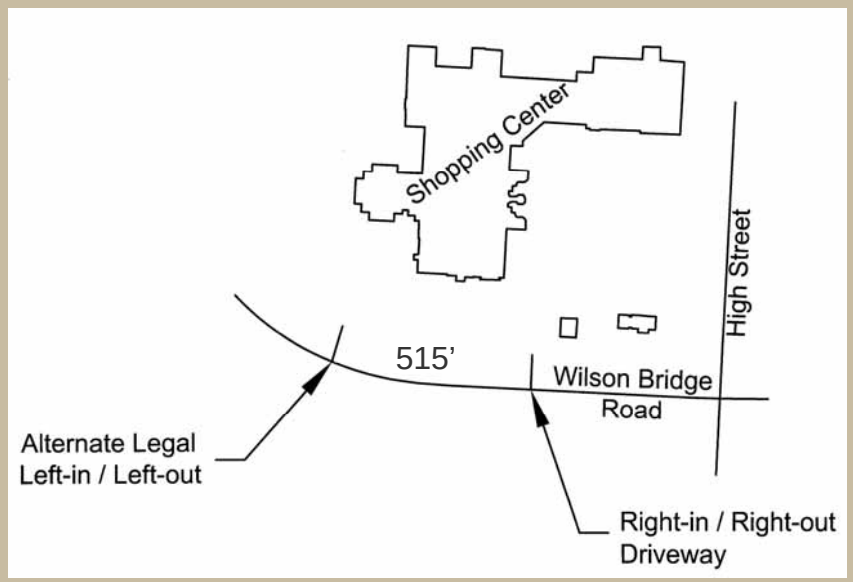
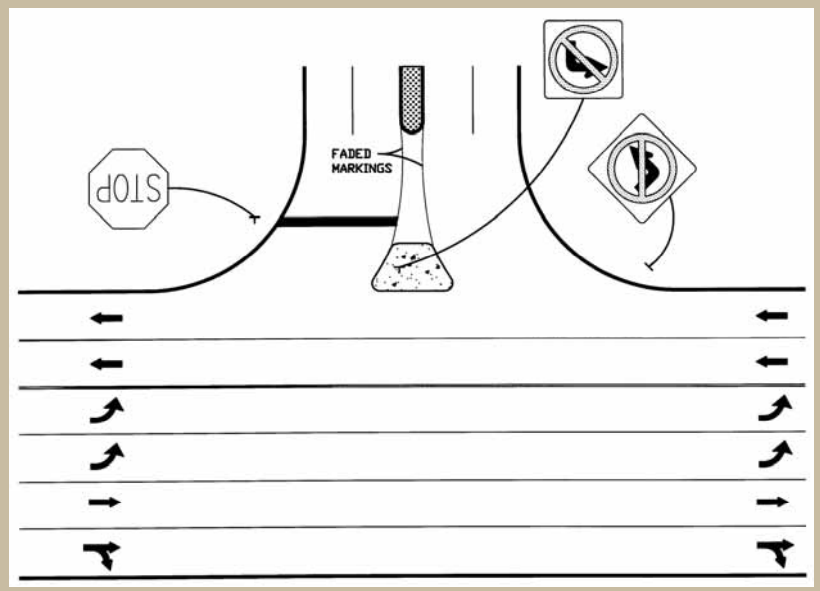
Wilson Bridge Road @ Worthington Mall





- High violation rates
- Small Island
- 2-lanes in/out

- Site and Parking Layout
- Poor visibility of alternate LILO

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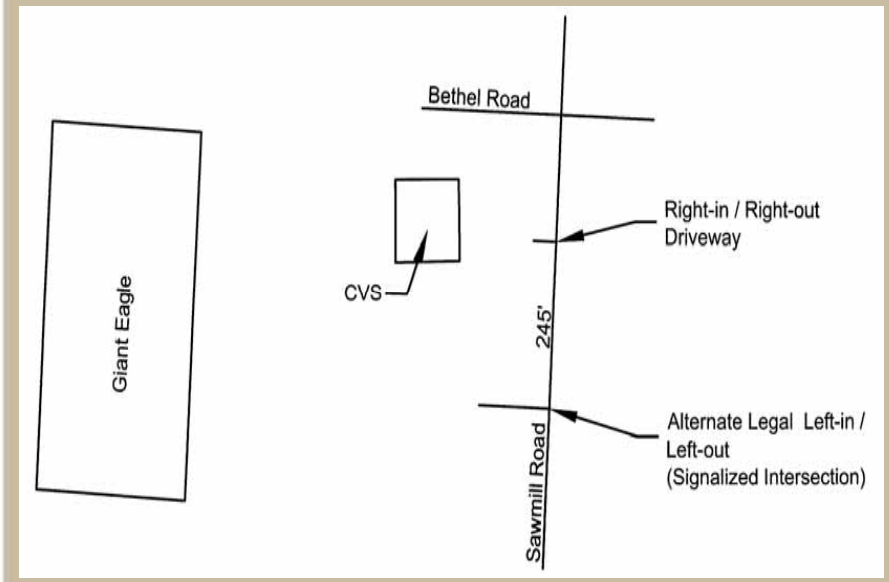
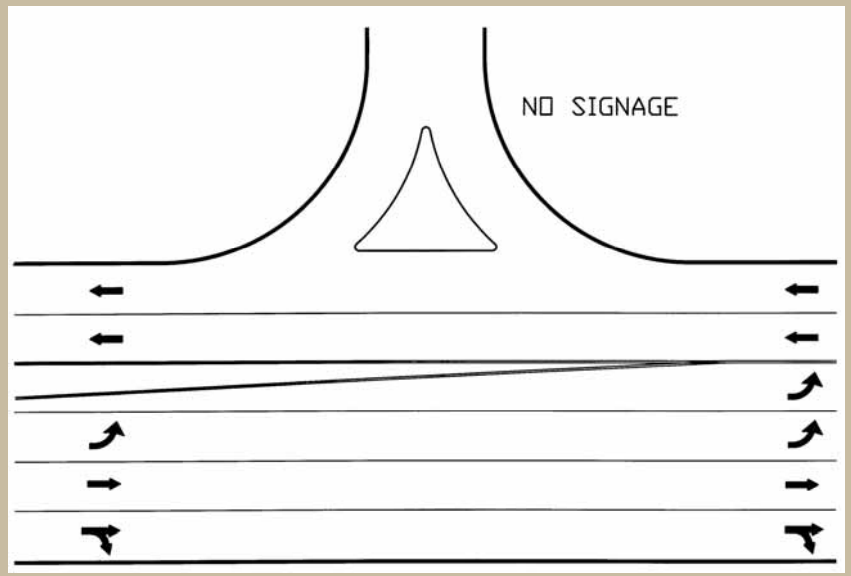
Sawmill Road just South of Bethel Road CVS





- Unexpectedly high LI rates
- Low LO Alternate Rate

- Small Island
- No signage
- Site layout

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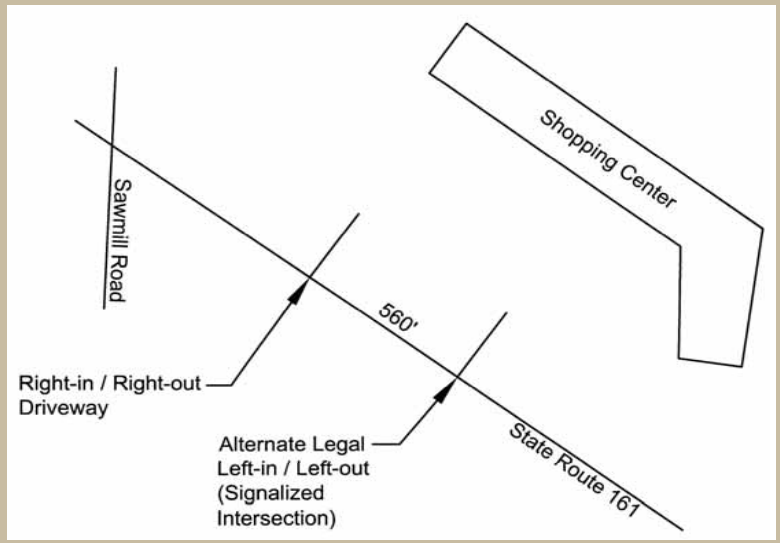
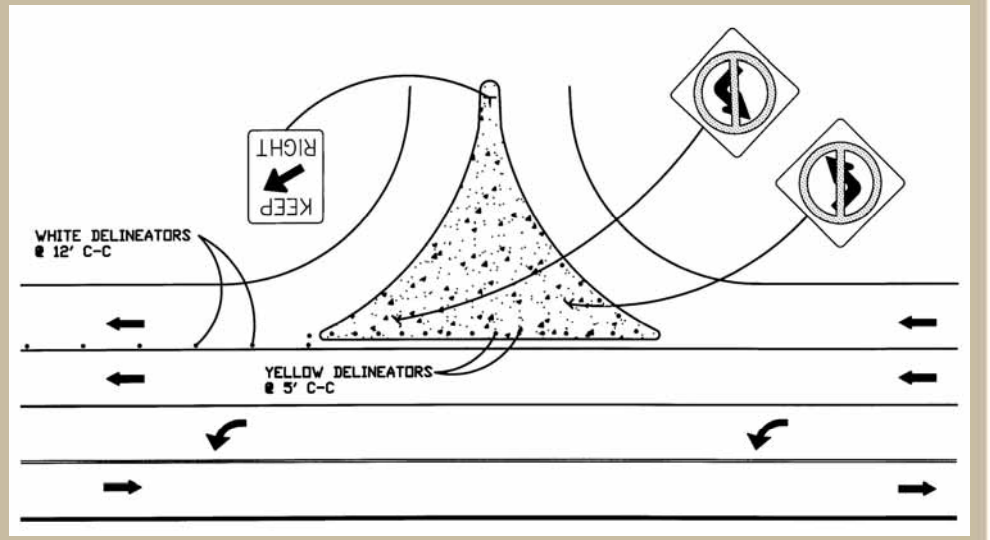
SR 161 @ Shopping Center





- No Violations
- Large Island

- High ADT per lane on SR 161
- RI deceleration, RO acceleration lanes

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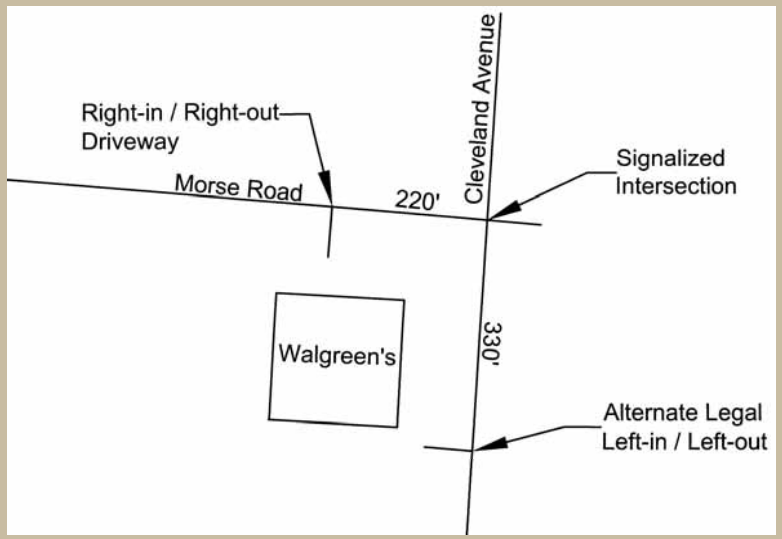
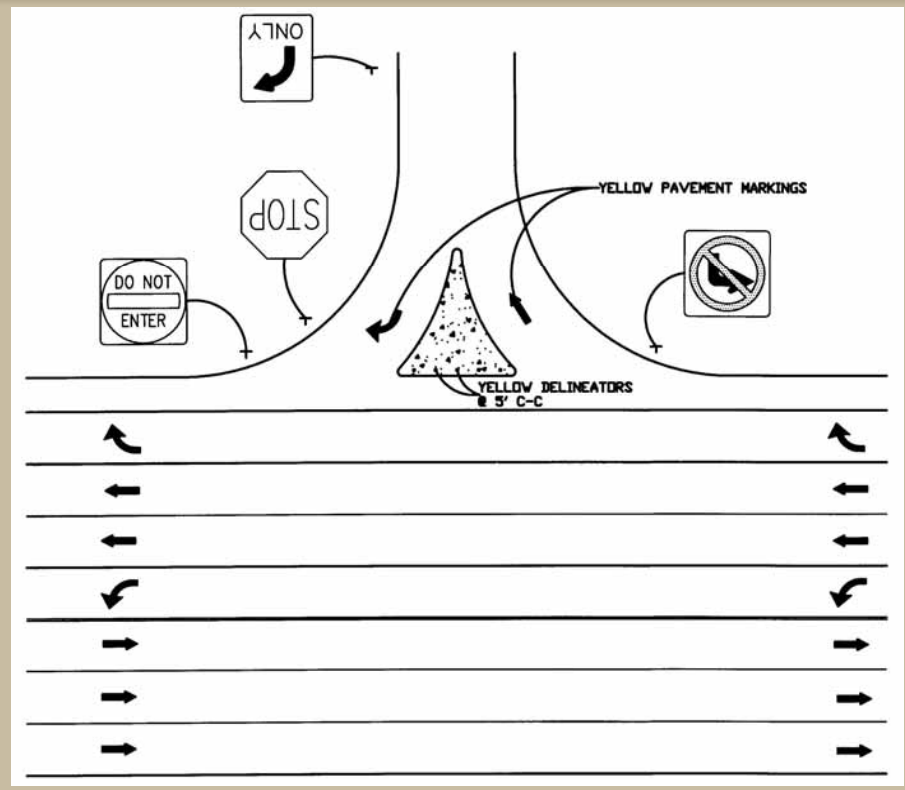
Morse Road @ Walgreen's





- No violations
- High ADT per lane
- Large # of lanes
- Backup of adjacent intersection traffic

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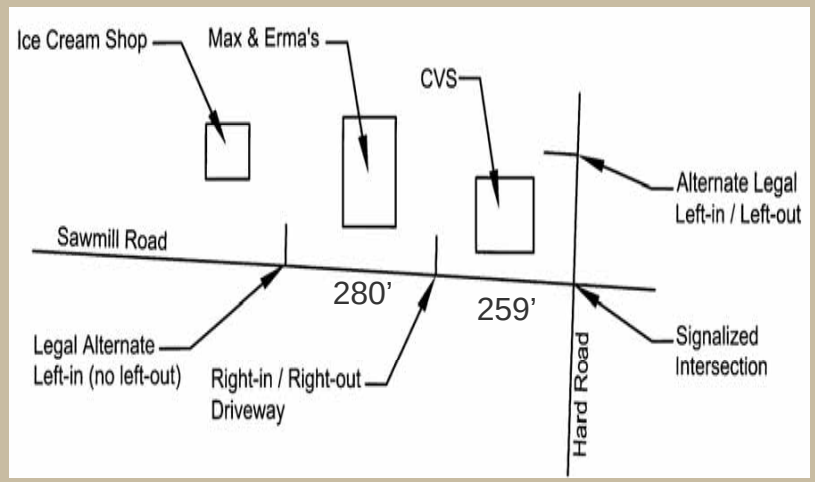
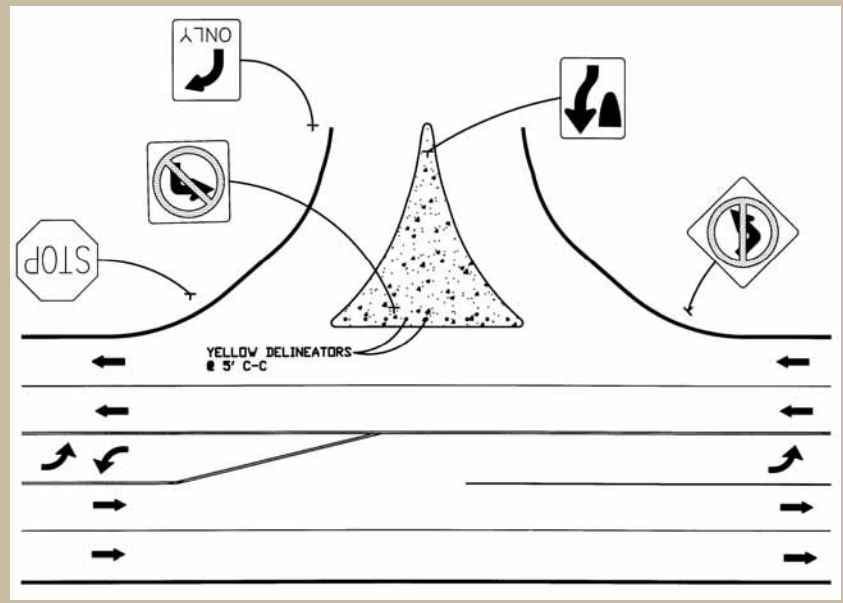
Sawmill @ Max & Erma's/CVS





- High LI rates
- Long Alternate LI

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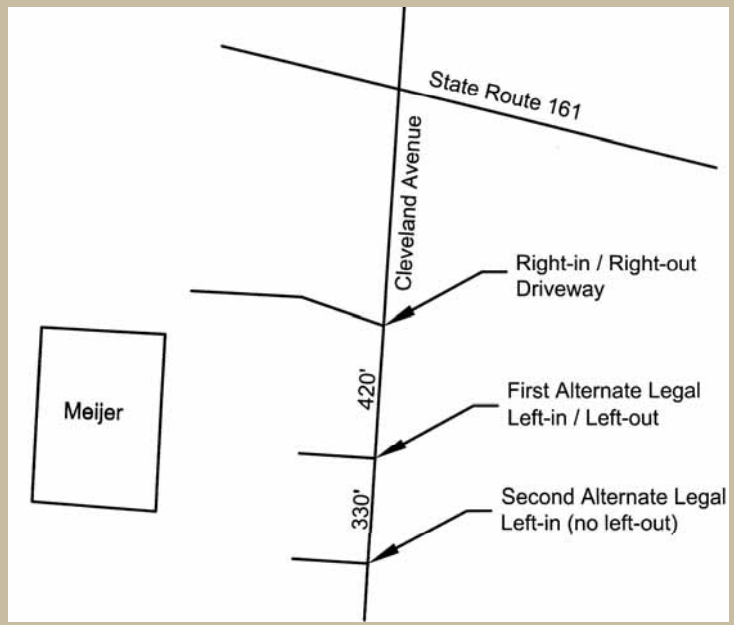
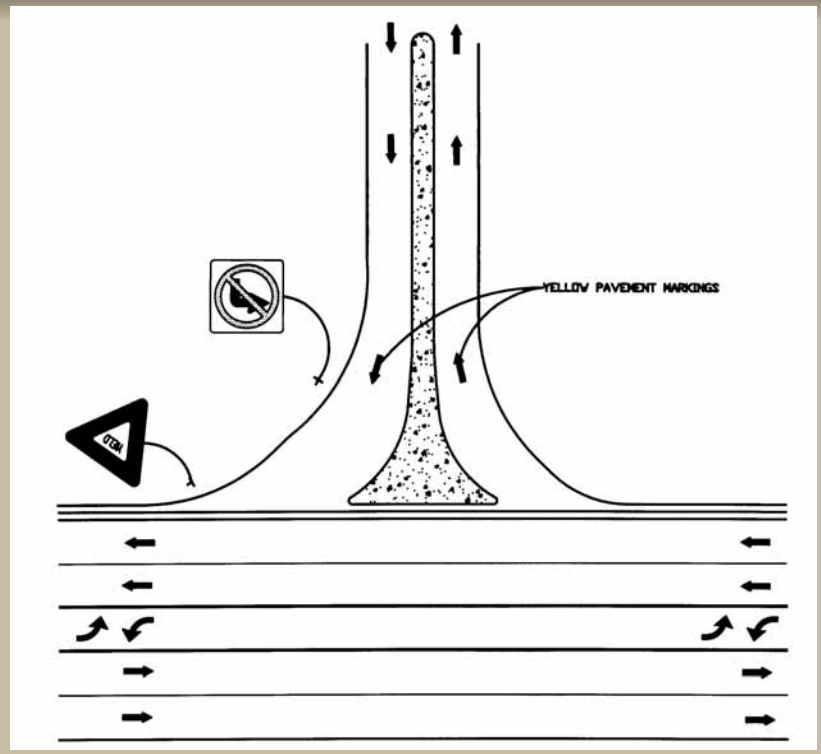
Cleveland Avenue @ Meijer





- No Violations
- Excellent visibility of legal alternate
- High ADT per lane

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Violation Rate Finding

- Most RIRO driveways served numerous RIRO movements with only a few violations
  - 3% of total traffic using RIRO were violators
- Not conclusive that low % due to driveway design

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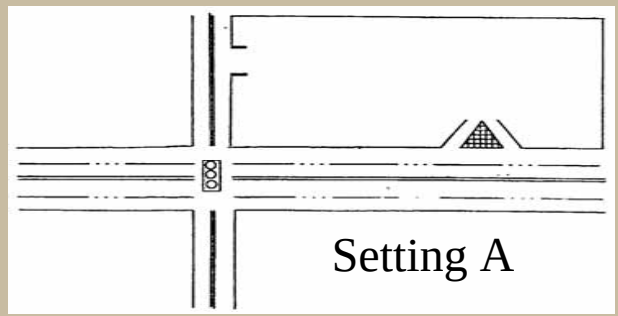
Violation Rate Findings

- Setting A violations confirm Aksan conclusions for Setting A

Violation Rate	Setting A	Setting B*	Setting C*
Total	36.82	0.0	14.08
LI	8.96	0.0	27.03
LO	165.29	0.0	0.0
LI Alternate	17.79	0.0	60.61
LO Alternate	39.53	0.0	0.0

* Only one site.



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Linear Regression Analysis

- To evaluate nature of relationships between violations and RIRO driveway and site features
- Multiple variable regression analysis

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Regression Models

LOLA Model 1

Adjusted R Square = 0.996

Variables	Coefficients	t	p
Constant	264.636	31.632	0.000
RO Corner Radius	-4.319	-25.057	0.000
Total Island Area	-0.04331	-24.936	0.000
Delineators Used? (Yes = 1, No = 0)	-32.607	-21.279	0.000

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Regression Models

LOLA Model 2

Adjusted R Square = 0.999

Variables	Coefficients	t	p
Constant	269.381	62.019	0.000
RO Corner Radius	-4.575	-39.903	0.001
Total Island Area	-0.0449	-46.078	0.000
Delineators Used? (Yes = 1, No = 0)	-32.862	-43.68	0.001
RO Lane Width	0.455	3.27	0.082

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Findings

- A procedure and methodology was established to evaluate the impact of various characteristics on violation rates

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Findings

- Though not conclusive, regression analysis points to the following characteristics influencing violation rates:
  - Shape and size of the raised island
  - Width of RO lane
  - Existence of vehicle storage on the arterial
  - Volume of traffic on the arterial
  - Existence of delineators

Unofficial Findings

- The Legal Alternate rate is a good measure of effectiveness

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Unofficial Conclusions

Characteristics to consider that may impact violation rates:

- Setting
- Driveway lane width
- ADT per lane on adjacent arterial
- Visibility of alternate legal LILO
- Signage
- Site and parking layout
- Number of lanes on adjacent arterial
- RI deceleration lane and RO acceleration lane
- Vehicle storage on adjacent arterial
- Distance to legal alternate

Additional Research Needs

Additional research is needed

- More sites with a wide variety of characteristics
  - Geometry
  - Site design
- Compare to full access driveways in similar locations
- Analyze additional hours
- Additional measures of effectiveness
  - Accidents
  - Delay
- Cost/Benefit analysis for warrants

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Thank You

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