VDOT TRAFFIC SIGNAL STUDIES

Virginia Section of ITE: Technical Session 3

Sanhita Lahiri, P.E., PTOE
Michael Tantillo

June 17, 2025

Agenda

- Introduction
- Why a new IIM?
- History of Traffic Signal Studies in Virginia
- IIM-TOD-401 Development Process
- Possible IIM Content
- Q & A

Holistic Contextual Design Solutions

- Holistic Contextual Design Solution at intersections is "business as usual" for VDOT
- Moving away from traditional signal control

Consideration of Signalization of Intersections

Holistic Contextual Design Solutions in VDOT Instructional & Informational Memorandums (IIMs)

- Virginia Intersection and Interchange Control Assessment Program (iCAP) Policy and Guidance *(IIM-TOD-397)*
- Signal Justification Reports (SJRs) For New and Reconstructed Signals *(IIM-TE-387.1) to be Revised to IIM-TOD-401*
- Innovative Intersection/ Interchange Committee *(IIM-TE-389)*
- Process for Designating Arterial Preservation Network (APN) Corridors and Conducting Planning Studies on the Network *(IIM-TMPD-2.1)*
- Strategically Targeted Affordable Roadway Solutions (STARS) Program *(IIM-TMPD-3.1)*
- Development of Justification for Additional or Revised Access Points; Creation of Interchange Access Reports (IAR) and Operational and Safety Analysis Reports (OSAR) *(IIM-LD-200.11)*
- Review of site plans and subdivision plat *(IIM-LU-500.3)*
- Access Management Spacing Exceptions/Waivers *(IIM-LU-501.3)*

* Links to IIMs in Resource Page

Holistic Contextual Design Solutions in VDOT Manuals and Tools

- Traffic Operations and Safety Analysis Manual (TOSAM)
- VDOT Road Design Manual:
  - VDOT Road Design Manual, Appendix A: Innovative Intersection/ Interchange Design Guidelines
  - Appendix F: Access Management Design Standards for Entrances and Intersections
- Administrative Guidelines for Traffic Impact Analysis Regulations
- Technical Guide for SMART Scale Funding Application
- *VDOT Junction Screening Tool Used to Screen Intersection Design Types for further Analysis*

VJuST

ALL CYAN HIGHLIGHTS ARE CURRENTLY UNDER REVISION!

Evolution…

2017

VJuST

2019

SJR

** Eventually Migrate to a holistic Intersection Control Evaluation process*

2020

TOSAM ver 2.0

Incorporates existing guidance from IIMs

2023

iCAP

** iCAP released - overlaps with SJR*

2025

Updates

- ***Streamline SJR***
- ***Update iCAP***
- ***Remove Redundancies***

Ongoing Revisions

Signal Justification Reports (SJRs) For New and Reconstructed Signals *(IIM-TE-387.1)*

To be Revised to IIM-TOD-401

Virginia Intersection and Interchange Control Assessment Program (iCAP) Policy and Guidance *(IIM-TOD-397)*

Traffic Operations and Safety Analysis Manual (TOSAM)

VDOT Junction Screening Tool Used to Screen Intersection Design Types for further Analysis

New Traffic Signal Study Memo

Sunset IIM-TE-387.1 & Introduce a new Memorandum (IIM-TOD-401)

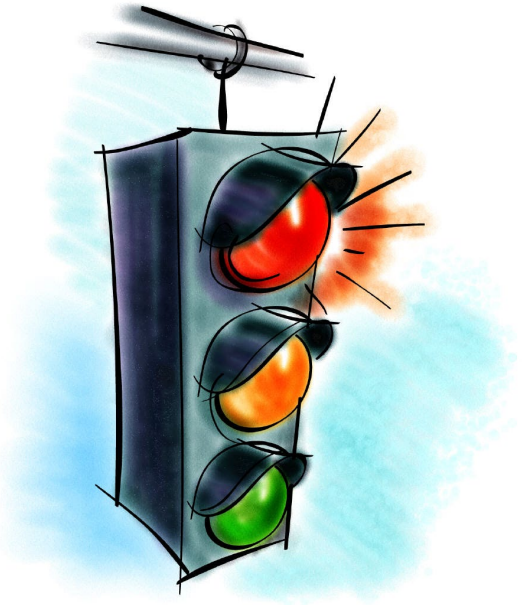
Guiding Principle:

Signal studies shall justify why a signal is not merely warranted per MUTCD, but also justified based on broader safety, mobility, and local contextual considerations.

- ✓ Remove Redundancy with iCAP process and guidance
- ✓ General signal warrant study information needs a home
- ✓ Reflect current practices related to signal warrant, clear guidance about which process applies when
- ✓ Updated Template
- ✓ Reflect IIM-TOD-401 in all relevant IIMs, Manuals, and Technical Guidance Documents in VDOT and OIPI

History of Traffic Signal Studies in Virginia

- **MUTCD Traffic Signal Warrant Studies**
  - "Meet warrant, install signal"
- **Signal Justification Reports (SJR)**
  - Includes VJuST analysis
  - Flexibility on application across districts
  - "Signals must be warranted and justified"
- **iCAP Process**
  - Stage 1 iCAP assessment
  - Full iCAP analysis
  - "Need to take a good faith look at alternatives, especially on APN or CoSS, before installing a signal"



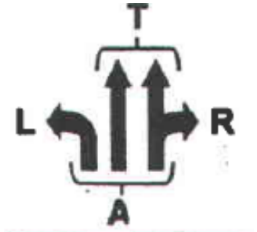
IIM-TOD-401 Development Process

- ***LIMITED ENGAGEMENT*** **with VDOT Staff**
  - District Traffic Engineers,
  - Signals and Freeway Operations Engineers,
  - Innovative Intersection Committee Members
- **Feedback on :**
  - New topics to include
  - Existing content to revise
- **Investigated "state of the practice" in other States and FHWA recommendations**
- **Develop Draft IIM Content** ← **WE ARE HERE**
- **Develop updates to other relevant VDOT documents/guidelines**
- **Stakeholder review of Draft IIM**
- **Publish IIM-TOD-401 and training webinars**

IIM-TOD-401 Proposed Content: Right-Turn Reductions

- Use modified Ohio DOT methodology to support warrant application
  - Already used in several VDOT Districts
  - In use by several other States
  - Balance between easy applicability and scientific rigor

Minor Street Analysis Parameters – Minor Leg Lane Configurations and Right Turn Reductions

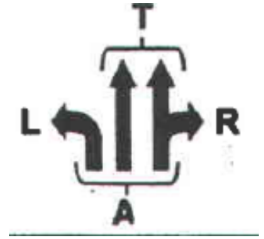
1		IF	R > 0.7A	THEN	Reduce R by 60%
			0.7A ≥ R > 0.35A		Reduce R by 40%
			R ≤ 0.35A		Reduce R by 20%
2		IF	R > 3T	THEN	Reduce R by 60%
			3T ≥ R > T/3		Reduce R by 40%
			R ≤ T/3		Reduce R by 20%
3		Any configuration with an exclusive right turn lane (usually ≥ to 600 ft. long)		Reduce R by 75% In all classes	
4		IF	R > (T + L)	THEN	Reduce R by 65%
			L > (T + R)		Use situation 2.
			L≈ T ≈ R (± 10 veh)		Reduce R by 40%
			L ≈ T > 3R		Reduce R by 20%
			R ≈ T > 3L		Reduce R by 50%
			All other classes		Reduce R by 30%
5		IF	R > T	THEN	Reduce R by 75%
			T ≥ R > T/2		Reduce R by 50%
			T/2 ≥ R > T/4		Reduce R by 30%
			R < T/4		Reduce R by 15%

Legend:
L = number of left-turning vehicles
T = number of through vehicles
R = number of right-turning vehicles
A = (L + T + R)

IIM-TOD-401 Proposed Content: Right-Turn Reductions

- **Ohio DOT Methodology Revision Recommendation – Lane configuration Category 3:**
  - Need minimum length of right-turn lane to ensure right-turning vehicles can bypass queued vehicles in adjacent lane
  - Recommend reduction – if 95th percentile queue is less than full-width right-turn lane length
  - Otherwise, must use Category 1 or 2 instead
  - Future research on length and reduction percentage

Minor Street Analysis Parameters – Minor Leg Lane Configurations and Right Turn Reductions

1		IF	R > 0.7A	THEN	Reduce R by 60%
			0.7A ≥ R > 0.35A		Reduce R by 40%
			R ≤ 0.35A		Reduce R by 20%
2		IF	R > 3T	THEN	Reduce R by 60%
			3T ≥ R > T/3		Reduce R by 40%
			R ≤ T/3		Reduce R by 20%
3		Any configuration with an exclusive right turn lane (usually ≥ to 600 ft. long)		Reduce R by 75% In all classes	
4		IF	R > (T + L)	THEN	Reduce R by 65%
			L > (T + R)		Use situation 2.
			L≈ T ≈ R (± 10 veh)		Reduce R by 40%
			L ≈ T > 3R		Reduce R by 20%
			R ≈ T > 3L		Reduce R by 50%
			All other classes		Reduce R by 30%
5		IF	R > T	THEN	Reduce R by 75%
			T ≥ R > T/2		Reduce R by 50%
			T/2 ≥ R > T/4		Reduce R by 30%
			R < T/4		Reduce R by 15%

Legend:
L = number of left-turning vehicles
T = number of through vehicles
R = number of right-turning vehicles
A = (L + T + R)

IIM-TOD-401 Proposed Content: Right-Turn Reductions

Ohio DOT right-turn reduction in Traffic Signal Warrant analysis method (for MINOR STREET):

1. Select the minor street lane configuration in table from previous slide
2. Determine the Critical Mainline Approach Volume per lane
3. Determine the Base Right Turn Reduction Percentage
4. Determine Mainline Congestion Factor
5. Subtract Mainline Congestion Factor from Base Right Turn Reduction Percentage to obtain Adjusted Right Turn Reduction.

Minor Street Analysis Parameters – Mainline Congestion Factors for Limiting Right Turn Reductions*

Volumes per Lane	Reduction
0 – 399	0%
400 – 499	5%
500 – 599	10%
600 – 699	15%
700 – 799	20%
800 – 899	25%
900 – 999	30%
1000 – 1099	35%
1100 – 1199	40%
1200 – 1299	45%
1300 – 1399	50%
1400 – 1499	55%
1500 – 1599	60%
etc.	etc.

*Mainline = Approach which right-turns turn into.

IIM-TOD-401 Proposed Content: Right-Turn Reductions

Ohio DOT Methodology Revision Recommendation – Lane configuration Category 3

Possible IIM Content*

[Incorporate Ohio DOT Method for Right Turn Reductions with Key change]

Allow inclusion of Right Turn Lane (minor leg configuration 3) that is 200' or greater in length if 95th percentile queue is less than turn lane length. Otherwise, use minor leg configuration 1 or 2.

*** NOT YET VETTED BY VDOT LEADERSHIP***

Minor Street Analysis Parameters – Minor Leg Lane Configurations and Right Turn Reductions

1		IF	R > 0.7A	THEN	Reduce R by 60%
			0.7A ≥ R > 0.35A		Reduce R by 40%
			R ≤ 0.35A		Reduce R by 20%
2		IF	R > 3T	THEN	Reduce R by 60%
			3T ≥ R > T/3		Reduce R by 40%
			R ≤ T/3		Reduce R by 20%
3		Any configuration with an exclusive right turn lane (usually ≥ to 600 ft. long)		Reduce R by 75% In all classes	

IIM-TOD-401 Proposed Content: 70% Factor Application

Use of the 70% factor in Traffic Signal Warrant analysis

- **Former FHWA MUTCD FAQ stated that this was created to allow additional opportunities for signals in rural areas**
- **No current information found other than what is stated in the MUTCD**
- **Use of the 70% factor is completely optional**
  - Should only be used in rare cases where there is an appropriate, documented rational for its use

Possible IIM Content*

- ***Use of the 70% factor in warrant analyses must be justified and approved by the VDOT District Traffic Engineer (or designee) with an appropriate, documented rationale for its use.***
- ***Intended for use in truly rural areas and small towns surrounded by rural areas.***

**** NOT YET VETTED BY VDOT LEADERSHIP***

IIM-TOD-401 Proposed Content: Pedestrian Volumes

Considerations for when pedestrian volumes do not meet signal warrant requirements

- **Oregon DOT recommends treatments based on similar method used in IIM-TE-384.1 for countermeasure selection**
  - AADT, posted speed, crossing conditions, stopping sight distance, connectivity, school proximity, and crash history

Possible IIM Content*

- ***Refer user to IIM-TE-384.1 for appropriate countermeasure selection (including signal, PHB, RRFB)***
- ***Include language stating that additional justification above and beyond what would normally be required can be used for signals that do not meet warrants if engineering judgement, safety, and local context indicate a need for a traffic signal.***

**** NOT YET VETTED BY VDOT LEADERSHIP***

IIM-TOD-401 Proposed Content: Progression Analyses

A progression analysis can show how well closely spaced signals can be coordinated.

- **In some cases, an additional signal will not have an operational impact**
- **In other cases, an additional signal can have a significant impact**

Possible IIM Content*

- ***Recommend a progression analysis when closely spaced signals are recommended.***
- ***Include language regarding impacts to the corridor are important and should be examined.***

**** NOT YET VETTED BY VDOT LEADERSHIP***

Questions??

If you have additional input for the

Future IIM-TOD-401,

Please contact Sanhita Lahiri at:
Sanhita.Lahiri@vdot.virginia.gov

Resource Page

VDOT Programs, Instructional & Informational Memorandums, Manuals	URL
iCAP Virginia Intersection and Interchange Control Assessment Program	https://www.vdot.virginia.gov/about/our-system/highways/innovative-intersections/virginia-icap/
Virginia Intersection and Interchange Control Assessment Program (iCAP) Policy and Guidance (IIM-TOD-397)	https://www.vdot.virginia.gov/media/vdotvirginiagov/about/vdots-transportation-system/highways/innovative-intersections/iim-tod-397-icap-policy-and-guidance.pdf
Signal Justification Reports (SJRs) For New and Reconstructed Signals (IIM-TE-387.1*) ***to be Revised to IIM-TOD-401**	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/location-and-design/roadway-design/TE-387_Signal_Justification_Reports_acc10202023_PM.pdf
Innovative Intersection/ Interchange Committee (IIM-TE-389)	https://www.vdot.virginia.gov/media/vdotvirginiagov/about/vdots-transportation-system/highways/innovative-intersections/iim-te-389-innovative-intersection-interchange-committee.pdf

Resource Page Continued

VDOT Programs, Instructional & Informational Memorandums, Manuals	URL
Arterial Preservation Program	https://www.vdot.virginia.gov/about/programs/arterial-preservation/
Process for Designating Arterial Preservation Network (APN) Corridors and Conducting Planning Studies on the Network (IIM-TMPD-2.1)	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/transportation-and-mobility/IIM2.1---Corridor-Planning-Studies-AMPs-(12.19)acc11252024.pdf
Strategically Targeted Affordable Roadway Solutions (STARS) Program (IIM-TMPD-3.1)	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/transportation-and-mobility/iim-tmpd-3.1-stars_acc2025-03-03.pdf

Resource Page Continued

VDOT Programs, Instructional & Informational Memorandums, Manuals	URL
Development of Justification for Additional or Revised Access Points; Creation of Interchange Access Reports (IAR) and Operational and Safety Analysis Reports (OSAR) (IIM-LD-200.11)	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/location-and-design/migrated/iim/IIM200_acc04162024.pdf
Review of site plans and subdivision plat (IIM-LU-500.3)	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/land-use-and-development/IIM-LU-500Approved.pdf
Access Management Spacing Exceptions/Waivers (IIM-LU-501.3)	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/land-use-and-development/IIM-LU-501Approved.pdf

Resource Page Continued

VDOT Programs, Instructional & Informational Memorandums, Manuals	URL
Traffic Operations and Safety Analysis Manual (TOSAM)	https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/traffic-operations/traffic-operations-and-safety-analysis-manual-tosam.pdf
Road Design Manual	https://www.vdot.virginia.gov/doing-business/technical-guidance-and-support/technical-guidance-documents/road-design-manual/

VDOT Networks	URL
Corridors of Statewide Significance – Virginia Department of Transportation	https://www.arcgis.com/home/item.html?id=dc3c258ab660487884f077eec7dd9174
Arterial Preservation Network	https://vdot.maps.arcgis.com/apps/webappviewer/index.html?id=6a024b2739e44b5b8599d86aa3b2c6d7