

VIRGINIA DEPARTMENT OF TRANSPORTATION
TRAFFIC ENGINEERING DIVISION
INSTRUCTIONAL & INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: Administrative Traffic Signals	NUMBER: IIM-TE-387.1
SPECIFIC SUBJECT: Signal Justification Reports (SJRs) For New and Reconstructed Signals	SUPERSEDES: IIM-TE-387.0 DATE: November 12, 2019
APPROVAL: <div style="text-align: center;"> <p>/original signed by/ Raymond J. Khoury, P.E. State Traffic Engineer Richmond, VA 11/12/2019</p> </div>	

Changes are shaded.

CURRENT REVISION – SUMMARY OF REVISIONS

- Removed references to the “draft” Arterial Preservation Network; the Network has now been established as described on VDOT’s [Arterial Preservation web page](#).
- Revised requirements for when roundabouts and other innovative intersections shall be considered (screened in VJuST).
- Changed all “alternative intersection” references to “innovative intersections”.
- Clarify additional applicability of this IIM to:
 - Locally-maintained signals that are a part of proposed HSIP or SMART SCALE projects.
 - Signals proposed as part of an IMR/IJR.
 - Cases where a proposed development or surrounding conditions have significantly changed since proffer approval.
- Added new content:
 - General background information on benefits and drawbacks of traffic signals.
 - Standards and guidance regarding signal warrant analyses.
 - Prohibition of Intersection Control Beacons installation as an interim measure when the traffic signal is only justified based on anticipated growth in future years.
 - Clarification regarding VDOT approvals, including for cases where a proposed development or surrounding conditions have significantly changed since proffer approval.
 - Requirement for the SJR document to list all anticipated Access Management Exception/Waiver requests that would be triggered by the proposed intersection control method.
- Reference the state’s Innovative Intersections Committee established in May 2018.

BACKGROUND

One of VDOT's core priorities is to maximize multimodal mobility and minimize crash risk by focusing advancements on integrated corridors that: connect regions and major activity centers, promote the safe and efficient movement of people and goods on high volume corridors essential to the economic prosperity of the state, and address statewide goals.

With greater operational and technological solutions available today to address transportation challenges, VDOT is also seeking more suitable alternatives to traditional traffic signal control that enhance corridor operations and throughput. This is further established in VTrans 2040's Guiding Principle #4 to "*Maximize capacity of the transportation network through increased use of technology and operational improvements as well as managing demand for the system before investing in major capacity expansions.*"

In order to advance this Guiding Principle, certain roads within Virginia that are maintained by VDOT have been designated as the **Arterial Preservation Network (APN)** (as described on VDOT's Arterial Preservation web page).

The Commonwealth Transportation Board (CTB) has expressed concern that the proliferation of new signals on the APN, whether due to land use development or installed via VDOT or locally-administered construction project, can collectively degrade the travel time and travel experience within and between urban centers, adversely impacting the Commonwealth's economy.

Traditional traffic signals are not a "cure-all" for operational and safety issues. Traditional signalized intersections can improve travel time and reduce delay for vehicles entering the major road from the minor road. Installation of a new traffic signal can also reduce crash risk at existing unsignalized intersections with a high Potential for Safety Improvement (PSI) ranking. However, traditional signalized intersections also have negative impacts, including:

- **Operational impacts:** Traffic signals, particularly traditional traffic signals which have up to eight phases, interrupt traffic and increase delays for through traffic on the major road. These extra delays are cumulative on longer distance passenger travel and freight trips. Signals may create additional operational issues if they result in queues that extend to adjacent intersections and commercial entrances.
- **Safety impacts:** Traffic signals can sometimes increase the risk and frequency of rear-end crashes. Traditional traffic signals typically have more crash risk than Innovative Intersection configurations.
- **Cost impacts:** traffic signals represent significant installation costs – including support structures, electronics/communications infrastructure, and hardware – as well as ongoing maintenance costs.

In many cases, Innovative Intersection designs have additional operational and safety benefits above those of a traditional signalized intersection. Innovative Intersections are considered an important tool for achieving the Department's "Common Sense Engineering" philosophy, as outlined in [IIM-LD-255](#).

Innovative intersection designs do not necessarily cost significantly more than traditional intersection configurations. The construction costs for the options under consideration depend on the amount of signal equipment, turn lanes, widening, etc. required for the options under

consideration. Moreover, the “true” cost of an alternative includes not just construction costs but also life-cycle maintenance and operations costs, operational impacts, and safety impacts.

This Memorandum:

- Establishes Signal Justification Report (SJR) policies and procedures that apply to all new traffic signals.
- Establishes additional policies that apply to new traffic signals proposed on the APN.
- Serves as an important component of VDOT’s eventual migration to a holistic Intersection Control Evaluation process for screening and identifying the optimum intersection configuration and control that best meets the safety and operational needs of the intersection and surrounding corridor.

STANDARDS

1.1 Signal Justification Report (SJR) Basic Requirements

New traffic signals shall not be installed without completion of a SJR that has been signed and sealed in accordance with the latest effective revision to [IIM-TE-362](#), and approved by VDOT as described below.

SJR shall include signal warrant analyses in accordance with the [Manual on Uniform Traffic Control Devices \(MUTCD\)](#), the [Virginia Supplement to the MUTCD](#), and this Memorandum.

SJR shall justify why a signal is not merely warranted but also justified, as per the standard statements in Section 4C.01 of the VA Supplement, “*The satisfaction of a signal warrant or warrants shall not in itself require the installation of a traffic control signal ... In order for a traffic signal to be justified, evidence of the need for right of way assignment beyond that which could be provided by a stop sign or other unsignalized intersection configuration¹ shall be demonstrated. Examples of such a need include: excessive delay, congestion, unfavorable approach conditions, or surrounding conditions that cause driver confusion.*”

SJR shall also list all potential Access Management Waiver or Access Management Exception requests² that would be necessitated by the recommended intersection control method, due to substandard distance to adjacent traffic signals or commercial entrances. SJR approval does not negate the requirement to seek Access Management Waiver or Exception approval.

VDOT has established a standard SJR template that should be used for all SJR reports. Contact the local Traffic Engineering section for a copy of this template.

SJR are unnecessary for the following other types of traffic control devices:

- Intersection Control (Flashing) Beacons. Note that if an Intersection Control (Flashing) Beacon was installed with extra signal equipment to support future conversion to full-color traffic signal operation, then the signal shall not be placed into full-color operation without an approved SJR.
- Pedestrian Hybrid Beacons (PHBs). However, all proposed PHBs on VDOT-maintained roads shall be approved by the DTE, and all proposed PHBs on the APN shall be approved by the DE/DA and the STE.

¹ The requirement to consider other unsignalized intersection configurations will be added to the next revision to the VA Supplement to the MUTCD.

² VDOT is separately developing Access Management Waiver/Exception requirements for Innovative Intersections.

- Other unique devices covered by Chapters 4F-4N of the MUTCD (e.g. fire station squad signals, ramp meters, lane use control signals, and toll plazas signals).
- Warning sign beacons, speed limit beacons, Rectangular Rapid Flashing Beacons (RRFBs), or school zone speed limit signs.

1.2 Signal Justification Report (SJR) Approval

State Traffic Engineer approval and District Engineer/Administrator concurrence is required for SJR reports justifying new traffic signals on the APN.

SJR prepared external to VDOT shall be submitted first to the District Traffic Engineer for their review. If the District Traffic Engineer (DTE) and District Engineer/Administrator (DE/DA) concur with the request, then the DTE will forward the SJR to the Innovative Intersection Committee, which will aid the State Traffic Engineer in his review. The Innovative Intersection Committee (formerly the Roundabouts Committee) is further explained in [IIM-TE-389/IIM-LD-257](#).

The DE/DA is also responsible for informing the District's CTB Representative of the proposed signal.

Table 1: SJR Approval Responsibility

For new traffic signals ...	On the APN	Off the APN
On VDOT-maintained road (Note 1)	<ul style="list-style-type: none"> • DTE approval • DE/DA approval (Note 2) • STE approval (Note 2) 	<ul style="list-style-type: none"> • DTE approval
On locality-maintained road (to be installed using SMART SCALE or HSIP funds)	n/a - Locality-maintained roads are excluded from the APN	<ul style="list-style-type: none"> • DTE concurrence • SJRs must be included in the final SMART SCALE or HSIP application
On locality-maintained road (built with funds other than SMART SCALE or HSIP)	<ul style="list-style-type: none"> • This IIM does not apply. However, localities must still prepare signed and sealed signal warrant studies as required by the MUTCD. 	

DTE = District Traffic Engineer

DE/DA = District Engineer/District Administrator

STE = State Traffic Engineer

Notes:

- 1) This IIM does not apply for signals that are recommended by an approved Interchange Modification Report/Interchange Justification Report (IMR/IJR) and will be constructed in conjunction with the proposed interchange improvements. However, the IMR/IJR shall still demonstrate that a signal is warranted at each proposed signalized intersection.
- 2) For proposed signals located on APN corridors with an Arterial Management Plan/Corridor Master Plan, SJRs may be approved at the District Traffic Engineer level (no need for State Traffic Engineer approval) if (a) the Plan recommended a traffic signal at that location, (b) the Plan was approved by VDOT and the locality, and (c) neither land use development nor traffic conditions at that location have significantly changed from the conditions anticipated in the Plan (with VDOT having the discretion to define what constitutes a "significant" change). Refer to the latest effective revision of [IIM-TMPD-2](#) for Arterial Management Plan requirements.

The latest effective revision to the SMART SCALE Technical Guide provides more information on submitting SMART SCALE applications that include new traffic signals.

2.0 Screening of Intersection Control Alternatives

The VDOT Junction Screening Tool (VJuST) shall be used to screen intersection control alternatives, with the results worksheets attached to the SJR. The VJuST tool and accompanying training resources are available on VDOT's [Arterial Preservation web page](#).

The following intersection control types shall be screened in VJuST:

- Two-way stop control
- Conventional signal
- At least one potentially viable Innovative Intersection configuration. Other Innovative Intersection configurations deemed to be viable (as determined by engineering judgment) may be screened.
 - Note that roundabouts are explicitly encouraged by [House Joint Resolution 594](#), enacted in 2003. Other Innovative Intersections can offer similar operational and safety benefits as roundabouts, and thus their use instead of traditional traffic signals would also be consistent with the aims of HJR 594.
 - Unsignalized Innovative Intersection configurations (e.g. roundabout or unsignalized RCUT) are usually preferable as compared to conventional or Innovative junctions that require signals. Note that the most recent edition of VJuST allows for screening of unsignalized Innovative Intersections.

If the VJuST screening determines that a roundabout is feasible, then the VDOT Roundabout Tool shall be used to develop a planning-level cost comparison between the roundabout and the conventional signalized intersection alternative.

An analysis tool other than VJuST may be used to screen intersection configuration options if that method is appropriately applied in accordance with TOSAM.

When comparing intersection control alternatives in VJuST, all VJuST evaluation metrics shall be considered (not just v/c ratio). It is not uncommon for an innovative intersection to have slightly worse (but still acceptable) v/c ratio than the conventional signal, but significantly better safety score due to the reduced number of conflict points.

For Innovative Intersection designs that potentially involve multiple signalized junctions, a single SJR report should be used to justify the proposed Innovative Intersection configuration since all the signalized “intersections” are part of the same Innovative Intersection operation. However the SJR report should separately analyze whether signals are both warranted and prudent at each junction. For example:

- At Restricted Crossing U-Turn (RCUT) intersections, the U-turn crossovers may be signalized or unsignalized.
- At Quadrant Roadway (QR) intersections, the end points of the quadrant roadway may be signalized or unsignalized.

Warrant 8, Roadway Network, may be applicable when examining potential signalization of the various junctions that comprise the Innovative Intersection treatment.

3.0 SJRs Based on Anticipated Future Development

If the justification for a proposed traffic signal is primarily driven by traffic anticipated to be generated by a future land use development, then the SJR shall include a conceptual analysis of the threshold (e.g. number of completed housing units or percent completion of commercial development) necessary to reach the volume signal warrant thresholds. Trip generation calculations shall be as per VDOT's [Traffic Impact Analysis \(TIA\) regulations](#) and as approved by the District Traffic Engineer or designee.

When traffic signals are proposed in conjunction with land use developments with multiple phases of development, and it is determined that the signal will not be warranted or justified until later stages of development, then VDOT may require that traffic signal construction be delayed if or until that later stage of development begins active construction.

Intersection Control Beacons shall not be installed as an interim measure where a full-color-operation (red-yellow-green) traffic signal is not justified until later stages of land use development or background traffic growth, unless the beacon is justified based on existing conditions as a safety improvement due to the crash history at that intersection.

4.0 Signal Warrant Analysis Requirements

General

All warrant analyses shall consider, at a minimum, MUTCD warrants 1, 2, and 3 (eight-hour, four-hour, and peak-hour warrants).

For intersections that are proposed primarily because of a proposed land use development, the SJR shall include the projected additional trips as documented in the associated Traffic Impact Analysis, for the purposes of analyzing MUTCD warrants 1 and 2.

The ADT Estimate Warrant in the VA Supplement to the MUTCD may be used instead of MUTCD Warrants 1 and 2 if the DTE concurs that it is infeasible to project estimated opening-day volumes over 8 or more hours of the day, because the proposed signal will be on new alignment or will be part of a project that involves significant changes to existing traffic patterns.

As per MUTCD section 4C.04, signals shall not be considered warranted based solely on warrant 3 (peak-hour), except in unusual cases such as manufacturing plants or HOV facilities that attract or discharge large numbers of vehicles over a short time.

Right-Turn Volume Adjustment

Right turn lane volumes shall be adjusted to take into account the ability of right-turning vehicles at a signal to make a right turn on red and the resulting overall improvement to the right turning movement. In the case of an approach where the final configuration will have a shared through/right turn lane, right turn volume adjustments may still be appropriate if a high proportion of the traffic using the shared lane is turning right.

Some Districts may have a recommended or required methodology for right turn volume adjustment, but this IIM does not set forth any one single methodology. Potential right turn volume adjustment methods include (but are not necessarily limited to) the NCHRP Report 457 methodology, Pagones Theorem, [OhioDOT Traffic Engineering Manual](#) procedures, or PC

Warrants analysis. If the District does not have a required methodology, then engineering judgment should determine which method is most appropriate for a given site.

70% Factor

The MUTCD provides an Option to apply a 70% factor to various signal warrant thresholds. This factor may only be used if (a) the operating speed exceeds 40 mph or (b) the intersection “lies within the built-up area of an isolated community having a population of less than 10,000.” Note that FHWA [Official Interpretation 4-346\(I\) clarifies that](#) developing suburban areas do not qualify as “built up areas of an isolated community”.

There is no automatic presumption that the 70% factor (and, by extension, the 56% factor) should or shall be applied; rather, the MUTCD specifies it may be applied. **The 70% factor shall not be applied unless additional justification based on engineering judgment is applied to the specific location**, with the engineering judgment rationale documented in the SJR.

Warrant #7 (Crash warrant)

MUTCD Warrant 7 (crash experience) shall be analyzed for all warrant analyses, except that warrant 7 may be omitted based on engineering judgment where the proposed signal:

- is at the location of a new access point to a proposed land use development, or
- will be on new alignment, or
- will be within the limits of a major widening project

All warrant 7 analyses shall use the most recent available three years of available crash data as per [FHWA Interim Approval #19 \(IA-19\)](#)³. The IA-19 procedures using one year of available crash data may be used if the designer demonstrates that it is infeasible to use three years of crash data. The 2009 MUTCD methodology shall not be used.

For the purposes of IA-19, all tables listed as “rural” shall also be used for any intersection where the major speed approaches exceed 40 mph, regardless of location or functional class.

EFFECTIVE DATE

Existing traffic signals: This Memorandum does not apply to existing traffic signals, nor does it apply to projects involving reconstruction of existing signal equipment. Innovative Intersection designs shall be considered during the scoping phase of projects that involve partial or full widening of an existing signalized intersection in accordance with this Memorandum; however, neither District Engineer/Administrator nor State Traffic Engineer approval is required if the decision is made to maintain the intersection as a conventional signalized intersection.

Where existing traffic signals * require reconstruction due to the life-cycle needs of the existing signal supports, the District Traffic Engineer or designee shall conceptually consider whether:

- The existing traffic signal can reasonably be removed as per Section 4B.02 of the VA Supplement, without requiring geometric improvements beyond the scope of a typical signal reconstruction project, or
- The signal phasing can reasonably be modified/simplified to improve mobility and/or reduce potential for conflict.

³ VDOT has requested and received approval from FHWA to use Interim Approval 19, on behalf of both VDOT and all Virginia localities. VDOT and localities must abide by the conditions of Interim Approval as set forth in Section 1A.10 of the MUTCD.

This Memorandum does not apply to situations where existing signal supports require emergency replacement due to vehicle strike or other structural issue.

Existing construction projects involving intersections not currently signalized: The previous version of this Memorandum was effective for existing projects that had not yet advanced beyond the Design Approval phase as of July 5, 2017. This version of the IIM is effective for all projects where the SJR has not yet been started as of the date of issuance for this IIM. For SJRs that were in the process of development as of this IIMs issuance date, this IIM should be applied to the extent feasible and reasonable.

Land use permits for private developments: The previous version of this IIM had been be effective for all developments where the final signal warrant study had not been finalized and approved by VDOT as of July 5, 2017. This version of the IIM is effective for all developments where the first draft of the SJR has not yet been submitted to VDOT as of the date of issuance for this IIM.

If the locality has approved a proffer agreement that included a traffic signal as a condition of rezoning or other land use decision, and this proposed proffer was reviewed by VDOT prior to finalizing with no objections having been submitted to the locality, then VDOT will allow a traffic signal to be built to service that development assuming the traffic signal is warranted. However, if the proposed development or the predicted traffic has significantly changed from what was reviewed by VDOT at the time of the original proffer agreement, the District will require consideration of Innovative Intersection concepts in order to best meet the safety and operational needs of anticipated opening-day traffic. The threshold for what constitutes a “significant” change shall be at the discretion of the DTE or designee.

If VDOT has completed its review of a Traffic Impact Analysis (TIA) for a proposed development that included a recommendation for a new traffic signal, and did not add any qualifying conditions for the traffic signal, this Memorandum does not apply as long as the proposed development is under construction within 2 years and the traffic signal is under construction within 4 years following the TIA’s completion date.

Design-Build or PPTA projects: This Memorandum shall be effective for projects in which the design criteria package has not been completed for advertisement as of January 1, 2020.

REFERENCES

- [Road Design Manual](#), Appendices A and F
- [Traffic Operations and Safety Analysis Manual](#)
- [2009 Manual on Uniform Traffic Control Devices \(MUTCD\), with revisions](#)
- [Virginia Supplement to the MUTCD](#)
- [IIM-LD-255](#), Fundamentals of Common Sense Engineering
- [IIM-TMPD-2.0](#), Process for Designating the Arterial Preservation Network and Conducting Planning Studies on the Network
- [IIM-LU-100](#), Review of Comprehensive Plans and Comprehensive Plan Amendments
- [IIM-LU-200](#), Review of Rezoning Proposals
- [IIM-LU-500](#), Review of Site Plans and Subdivision Plats
- [IIM-LU-501](#), Access Management Spacing Exceptions/Waivers
- [SMART SCALE Technical Guide](#)
- IIM-TE-389, [Innovative Intersections Committee](#)