

November 10, 2010

TRAFFIC ENGINEERING DIRECTIVE

106-2

Supersedes TED 106 -1

SUBJECT: PROCEDURE FOR CONDUCTING TRAFFIC IMPACT STUDIES

In order to establish uniform Traffic Impact Study content, the following criteria shall be used:

WHEN A TRAFFIC IMPACT STUDY IS REQUIRED

A traffic impact study (TIS) will be required under the following conditions.

1. When the proposed development is projected to generate 100 or more trips per hour during the peak generating time for the development.
2. For smaller developments under one of the following three conditions:
 - a. when the proposed new approach is to an intersection already operating at Level of Service (LOS) "D" or worse,
 - b. when the developer is requesting a new traffic signal,
 - c. when modification of an existing traffic signal is being requested.
3. An older TIS may need to be updated when the data is more than two years old.

A TIS may not be required in situations where the project's impact on traffic is obvious and where the Division of Highways is agreeable to the proposed mitigation measures without conducting a TIS.

CERTIFICATION BY PROFESSIONAL ENGINEER

All traffic impact studies must be certified by the WV registered professional engineer who conducted and/ or supervised the study. A professional engineer registered in West Virginia must certify all traffic impact studies by stamping and signing all copies of the study. A current Certificate of Authorization (COA) from the WV PE Board is also required.

SCOPE OF WORK

Prior to beginning the TIS, the consultant shall contact the West Virginia Division of Highways (WVDOH) Traffic Operations Section of the Traffic

Engineering Division to discuss the scope of the study. The consultant will provide a list of intersections that are proposed to be studied in the traffic impact study and the type of development being planned. Once the scope of work is approved, and prior to beginning detailed analyses as part of the traffic impact study, a preliminary submission should be made to the Traffic Engineering Division. This submission should include proposed locations of new approaches, existing turning movement counts, trip distribution percentages, pass-by percentages, and internal capture (if applicable) for all intersections and interchanges. Where applicable, actual signal timing data should be obtained from the DOH by the consultant. It would be in the developer's best interest not to proceed with completing the TIS until being notified by the Traffic Engineering Division that the preliminary submission is acceptable.

The consultant shall also provide, prior to beginning any work, the legal name of the proposed development, a contact person for the development, and the postal address, phone number, and email address of the developer and/or consultant. An agreement may be prepared with the developer indicating that they must pay for the cost of review of the traffic impact study.

TRAFFIC PROJECTIONS

Traffic projections should be made utilizing the latest edition of Trip Generation published by the Institute of Transportation Engineers (ITE). Additional studies and references can be provided as needed to supplement the information in Trip Generation. The projected trips for each entity of the development shall be displayed on a chart showing the entering and exiting volume per hour during all affected peak hours.

Shopping centers and other commercial facilities shall be designed for a typical Friday afternoon and Saturday mid-day. Background traffic counts shall be conducted during favorable weather conditions at a minimum for every hour on a Friday afternoon between 3:00 and 6:00 p.m. and for every hour on a Saturday between 11:00 a.m. and 2:00 p.m. Each intersection shall be counted on the same Friday and Saturday and these days shall be consecutive. The traffic volumes should be balanced between intersections if no major access points are existing between the intersections. All trip distribution percentages and their justification shall be included in the report. Residential and industrial development shall be designed for the Friday morning and evening peak hour of the roadway which will usually be between 7:00 a.m. and 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. The percent of trucks on the main highway and in the development may be a consideration and should be counted where appropriate. For developments to be located in an area that is directly affected by a College/University or Public K-12 School, counts should be conducted while classes are underway (typically August - June). Counts should not be conducted during a sporting or special event.

For most residential and commercial developments, the consultant shall provide the traffic projections and analyses for the year that final build-out is expected. For larger developments, the WVDOH may require projections further into the future. In the case of phased construction/development, traffic projections and analyses shall also be provided for intermediate stages of build-out. The consultant shall contact the WVDOH Program Planning and Administration Division to acquire appropriate growth rate to be applied to the count data.

Existing roadway ADT's (Average Daily Traffic) shall be obtained from the WVDOH and discussed within the traffic impact study. Consultant shall also discuss projected ADT's based upon projected volume increases due to development to determine any need for roadway widening per AASHTO Green Book.

Pass-by trips and internal capture rates should be discussed with the WVDOH during the scoping process.

DATA DISPLAY

A diagram shall be provided showing the existing Friday and Saturday Peak hour turning movements at all affected intersections. A separate diagram shall be used to display the projected new trips and pass-by trips. A third diagram shall show the total combined trips. An exhibit should be included showing the distance between intersections and existing lane configurations. The length of storage lanes and proposed turning lanes and lengths should also be shown in at least one of the exhibits or diagrams. This is not to preclude using additional diagrams and figures as needed.

When referring to diagrams, exhibits and/or figures in the text of the report, both the exhibit number and page number should be indicated to make them easier to find.

CAPACITY ANALYSIS

Capacity analyses should be conducted using the latest edition of the Highway Capacity Manual (HCM) published by the Transportation Research Board. Highway Capacity Analyses software such as "HCS" distributed by McTrans and/or "SYNCHRO" distributed by Trafficware may be utilized. Other comparable software using the procedures of the HCM, such as "TEAPAC" distributed by Strong Concepts, may also be used if prior approval is obtained from the Traffic Engineering Division. The analyses shall be "operations analyses" rather than "planning analyses". SYNCHRO shall be used to analyze closely spaced intersections. Additionally, when using SYNCHRO, the roadway layout shall be drawn to scale.

The Level of Service (LOS) of all intersections affected by the proposed development should be no worse than the LOS before the new facility opens. If it is determined that the LOS of an intersection is adversely affected as a result of the proposed development, the traffic impact study shall recommend all reasonable improvements (i.e. construction of turn lanes, construction of through lanes, lengthening of turn lanes) to alleviate projected problems. In some instances it may be necessary to worsen the LOS and increase the queue length inside the development to insure that the state highway operates at an acceptable LOS.

Capacity analyses shall be conducted for all intersections for both the Friday and the Saturday peak hour (morning and afternoon peak hour for residential and industrial development). Any internal intersection that could potentially impact the main highway shall also be analyzed. Analysis worksheets showing inputs, LOS, delay, and back of queue shall be included in the report. Charts shall be used when possible to summarize capacity analysis results such as LOS, delay, and back of queue.

Guidelines for the Preparation of Intersection Capacity Analyses are discussed later and provide more specific requirements for the analyses.

QUEUING ANALYSES

Queuing analyses shall be included within the report to determine the length of any proposed or recommended auxiliary turn lanes, or if there is a need to extend any existing auxiliary turn lanes. It may also be necessary to conduct analyses to determine if there are overlapping queues for adjacent intersections. Queuing analyses must be based upon either simulation software or a mathematical computation utilizing the AASHTO method. Acceptable simulation software includes those packages previously noted under Capacity Analyses or prior approved queuing specific software.

The AASHTO queuing method is based upon a factor of safety of two (2) and the assumption that all approaches are signalized. This method utilizes the turning movement data and signal timing data to determine the volume in a particular lane during a normal signal cycle. This value is then multiplied by two to account for traffic surging with the peak hour. Once the volume per lane per cycle is known, this quantity is multiplied by 25 feet to calculate the length of queue in feet. If the intersection being studied is unsignalized, a cycle length of 90 seconds should be assumed.

GEOMETRIC IMPROVEMENTS

The latest edition of A Policy on Geometric Design of Highways and Streets (Green Book) published by AASHTO shall be utilized in conjunction with West

Virginia Division of Highways Design Directives to design geometric improvements needed for mitigation. Procedures recommended in the Green Book will be utilized in addition to the Highway Capacity Manual to determine the need and length of auxiliary lanes. If the construction of a development changes the classification of a roadway or section of roadway (refer to DD-601), then the developer may be required to provide mitigation to allow for safe and efficient traffic flow along the roadway.

A list or sketch shall be included in the report illustrating any recommendations for mitigation, including lane configuration, storage lengths, traffic control, etc. If improvements are needed based upon existing conditions and/or background growth, then they should be included in the recommendations and listed separately from improvements needed as a result of the development. Any improvement shown as an existing need (DOH responsibility) prior to development must be clearly corroborated with engineering data.

The report shall include labeled color photos of the project site and 2 or more labeled color photos of each approach to every intersection (existing and proposed) studied. All color photos shall be 4 inches by 6 inches or larger.

TRAFFIC SIGNALS

The need for any additional traffic signals shall be adequately justified utilizing one or more warrants of the Manual on Uniform Traffic Control Devices (MUTCD). Because full eight (8) hour warrant counts are not required, consultant should use existing and projected volumes and use engineering judgment to compare to warrants. The method for warranting traffic signals based upon ADT contained in the ITE Manual on Traffic Signal Design can also be considered.

The actual design of any new traffic signals will be performed or reviewed by the Traffic Engineering Division of the West Virginia Division of Highways. Any traffic signals not to be designed by the Traffic Engineering Division must be designed by a West Virginia Division of Highways approved consultant. Any recommendations for signal timing changes should be justified using highway capacity software such as SYNCHRO to account for interconnection of any traffic signals near the development. Final signal timings for traffic signal installations will be determined by the Traffic Engineering Division.

OTHER TRAFFIC CONTROL

The need for other traffic control devices such as STOP and YIELD signing, markings, and intersection channelization shall be indicated in the report with appropriate reference to MUCTD, HCM, WVDOH Design Directives, and/or AASHTO Green Book. The traffic control scheme for internal intersections should

be designed by the traffic engineer. Traffic control at these intersections may have to be designed in order that inbound traffic will have the right of way. In any event, the design shall be such that traffic does not back onto the state highway. No internal intersections, driveways, or parking aisles will be allowed within 100 feet of the state highway.

CONTENTS OF COMPLETED REPORT

All copies of the traffic impact study report shall be bound with plastic binding, three ring binders, or other appropriate professionally appearing binding. As a minimum the completed traffic impact study report shall contain the following:

1. Pages shall be numbered
2. Executive summary
3. Table of contents
4. Summary of the project scope and location map including city and/or nearest town
5. Existing roadway geometry including distances between intersections and existing turn lane lengths, sight distances (where limited) at intersections, and speed limit along the roadway shall be shown on intersection drawings
6. Existing peak hour traffic volumes and ADT's
7. Traffic projections for proposed development
8. Projected Trip distribution
9. Peak hour summary of new trips
10. Discussion of pass-by trips and, if needed, internal capture
11. Total peak hour trips at build-out and projected ADT's
12. Summary of HCS analyses
13. Summary of Queuing analyses
14. Summary of negative operational impacts
15. Summary of recommendations for mitigating the impact
16. If improvements are needed due to existing conditions and/or background growth, then they should be included in the recommendations and listed separately from improvements needed based on the development. Any improvement shown as an existing need (DOH responsibility) prior to development must be clearly corroborated with engineering data.
17. Photographs of the site and affected intersections
18. Aerial photos (if provided) shall be labeled to show the various intersections affected
19. Appendix with actual turning movement counts
20. Turning movement count data as well as 2 photos along each approach to each intersection and a written description of photo details shall be on the same page as the photo
21. Appendix with all calculations and analyses
22. Digital copy of report, photos, and all calculations and analyses

GUIDELINES FOR THE PREPARATION OF INTERSECTION CAPACITY ANALYSES

1. A typical amber change interval used for intersections is between four and five seconds. Three seconds of amber can sometimes be utilized on low speed approaches, such as in a central business district (CBD), and would be considered an absolute minimum to comply with national standards. Amber times depend primarily upon the geometry of an intersection with consideration also being given to the speed. For high speed roadways, longer amber time should be used. A typical all red clearance interval of one second is employed following the amber change interval in most cases. This all red period can be omitted on low speed approaches and increased up to three seconds on high speed approaches, such as on a four lane divided highway. For existing intersections, change and clearance interval timing should be obtained from WVDOT. For proposed intersections, change plus clearance interval times should be calculated per the formula outlined in Table 13-2 in the Traffic Engineering Handbook published by ITE.
2. Typical cycle lengths range from 90 to 120 seconds in ten second increments. Downtown intersections typically have 90 second cycle lengths. The heavier volume intersections tend to have longer cycle lengths up to 120 seconds. For design purposes, especially for designing the length of turn lanes, cycle lengths of 90 to 120 seconds shall be used. For congested high volume arterial signal systems, cycle lengths will sometimes exceed 120 seconds and reach cycle lengths up to 150 seconds. For studies in these areas, actual signal timing should be used for analysis purposes.
3. Actuated traffic signals, although they vary in cycle length, utilize the same basic principles for analysis purpose. All signalized capacity analyses should use actuated signal operation for all phases in most cases. Pre-timed operation may be utilized for specific conditions, such as the intersection of two one-way streets in a CBD. Semi-actuated control, where the side streets are actuated and the mainline is non-actuated, is common on lower speed arterial systems in urban areas. For intersections that are part of a coordinated signal system, the signal timing utilized for the capacity analysis should reflect the existing and proposed system timing obtained from the WVDOT. For developments which propose to create a new coordinated signal system, the proposed signal timing can be obtained by utilizing software such as SYNCHRO.
4. The typical saturation flow rate used is 1900 passenger cars per hour per lane for signalized analyses and 1700 passenger cars per hour per lane for unsignalized analyses. It should be noted that this may or may not be the

default value of the HCS analysis. In any event, these values should be used for design purposes unless field data is provided to justify the use of another value. Saturation flow rates can be determined in the field by measuring the average time between vehicles as they proceed through the green phase of the traffic signal. The first five vehicles must be discarded and the average times between subsequent vehicles should be utilized. The headway between the vehicles is averaged and divided into 3600 seconds per vehicle to arrive at the saturation flow rate in passenger cars per hour. This value will usually be between 1700 to 1950 passenger cars per hour.

5. The primary information needed to conduct an intersection capacity analysis is as follows: traffic volume, number of lanes per approach, width and function of lanes, whether parking is prohibited on the approach, heavy vehicle percentage on each approach, the grade on each approach, the peak hour factor on each approach, the arrival type, and the green/amber time for each phase of the signal cycle.
6. The typical arrival type utilized is Type 3. This is for a random arrival of vehicles on an approach. Type 4 arrival rate would tend to be a platoon arrival resulting from an adjacent traffic signal that is or will be coordinated with the study intersection. Arrival Type 3 is a default value in the HCS program.
7. The HCS program utilizes several default values, many of which can be changed simply by inputting new values. Any changes to default values shall be justified with calculations or other documented information that is included with the analysis.
8. The default value for peak hour factor is 0.90. Use the traffic counts in 15 minute intervals to calculate the actual peak hour factor to be used in the analysis. The peak hour factor can be calculated by dividing the peak hour volume by four times the peak fifteen minute volume within that specific hour. If the peak hour factor is unknown or if the approach is new, use the default value of 0.90.
9. The existing geometric conditions and traffic volumes at an intersection should be analyzed first and used as a base analysis. Additional analyses to reduce the delay and improve the LOS of the intersection may be run by adding turn lanes, etc.
10. At a signalized intersection on an expressway having a speed limit of at least 50 miles per hour, a protected only left turn phase should be provided on the main line approaches. Right turns from the side street approaches can be allowed during the mainline left turn phase. Right turns on red will not be permitted from side streets during the mainline through movement's green time.

11. For the initial unmet demand, use the default of 0 vehicles. This simply indicates the number of vehicles waiting at the beginning of the signal phase.
12. Minimum green times for stand-alone traffic signal phases shall be 10 seconds.
13. An electronic version (disk or CD) of all analyses shall be included with the traffic impact study. Consultant shall name the files in a manner which is easy to determine the intersection and scenario the file references.


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