TRAFFIC IMPACT ANALYSIS GUIDELINES

May 8, 2025

Table of Contents

DEFINITIONS & ABBREVIATIONS

85th Percentile Speed: The speed at or below which 85 percent of vehicles in the traffic stream travel on a road segment, expressed in miles per hour.

95th Percentile Queue Length: The queue length that has only a 5% probability of being exceeded during a given analysis period, expressed in feet.

Access Management: The systematic control of the location, spacing, design, and operation of entrances, median openings, traffic signals, and interchanges for the purpose of providing vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system.

Accessible Pedestrian Signals (APS): Signal devices designed to assist pedestrians who are visually and/or hearing impaired by providing information that they can interpret to understand when they may cross at a signalized intersection.

Adjacent Street Traffic: The sum of all traffic on street abutting the site that has direct access to the development site.

Alignment: The geometric control of a roadway.

All-Way Stop (Multi-Way Stop): A form of intersection control by placing stop signs (R1-1) and all-way plaques (R1-3P) at a road intersection to stop traffic in all directions.

American Association of State Highway and Transportation Officials (AASHTO): An organization that advocates transportation-related policies and provides technical services to support states in their efforts to efficiently and safely move people and goods. All geometric design shall follow the most recent version of the AASHTO's "A Policy on Geometric Design of Highways and Streets" if not specified by Harris County Guidelines.

Annual Average Daily Traffic (AADT): The mean traffic volume across all days for a year for a given location along a roadway, expressed in vehicles per day.

Auxiliary Lane: A lane striped for use as an acceleration, deceleration, right-turn, or left-turn lane, but not for through traffic use.

Average Daily Traffic (ADT): The average number of vehicles that travel through a specific point of a road over a short duration time period, typical less than a week but no less than two days, expressed in vehicles per day.

Background Conditions: The Existing Conditions projected to the Build-Out Year by applying a Growth Factor.

Boundary Street: A public street that is adjacent to and/or abutting one or more sides of the proposed site.

Build-Out Conditions The proposed traffic patterns, volumes, roadway geometry, intersection configurations, lane assignments, and traffic control types at the Build-Out Year.

Build-Out Year: The proposed year of completion of the land development project, when its capacity for attracting and producing traffic is maximized.

Capacity: The maximum sustainable hourly flow rate at which vehicles reasonably can be expected to traverse a point or a lane on a roadway during a given time period under prevailing roadway, traffic, and control condition, expressed in vehicles per hour per lane.

City of Houston (COH): The municipal governmental body for Houston. Houston Public Works is responsible for streets, drainage, producing and distributing water, collecting and treating wastewater, and for the permitting and regulating of construction. Some Plan Sets and Traffic Impact Analyses (TIAs) may require coordination with the COH prior to Office of the County Engineer (OCE) approval.

Collector: Roadways that carry moderate volumes of traffic. Collectors can be classified as major or minor, depending on the type of facilities to which they are connected, length, type of surrounding land use, and existing and/or projected traffic volume and characteristics. These facilities typically have the primary function of carrying traffic from local roadways or other collectors to intersections with like and/or higher-class facilities.

Controller: A device that controls traffic at an intersection by alternating the right-of-way between conflicting streams of vehicular traffic, or vehicular traffic and pedestrians/bicyclists crossing a roadway.

Coordinated Progressive Signals: Several intersection signals operating through coordination to maintain a constant flow of traffic.

Coordinated Traffic Adaptive Signals: Signals that identify the approaches with peak demand and adjust the signal timings accordingly.

County Engineer: The holder of the statutory office of County Engineer for Harris County or the employee designated by the County Engineer to perform a task by these guidelines.

Crash Records Information System (C.R.I.S.): A query tool for Texas crash data provided by the Texas Department of Transportation (TxDOT).

Cycle Length: The time required to complete a full sequence of signal indications at a signalized intersection, expressed in seconds.

Delay: The additional travel time experienced by a driver, passenger, or pedestrian/bicyclists, expressed in seconds.

Directional Design-Hour Volume (DDHV): The proportion of AADT in the peak-hour in the predominant direction of traffic flow, expressed in vehicles per hour.

Directional Factor: The traffic volume proportion moving in the higher volume direction during the peak hour to the combined volume in both directions, usually expressed as a percentage.

Directional Flow Rate: The traffic flow rate in one direction of a transportation facility, where flow rate is the equivalent hourly rate at which vehicles pass over a given point or section of a lane or roadway during a given time interval of less than 1 hour, usually 15 minutes, expressed in vehicles per hour per lane.

Driveway: An improved surface used for vehicular access from the edge of a county roadway to the right-of-way or easement line.

Driveway Spacing: The distance, in feet, between driveways, measured along the edge of the traveled way from the closest edge of pavement of the first driveway to the closest edge of pavement of the second driveway.

Effective Green Time: The duration during which vehicles in a given traffic movement proceed through the signalized intersection, expressed in seconds.

Engineer: A person licensed to engage in the practice of engineering in Texas.

Engineer of Record: The Engineer who signs and seals the drawings, reports, or documents.

Existing Conditions: The existing traffic patterns, volumes, roadway geometry, intersection configurations, lane assignments, and traffic control types as obtained by traffic counts and other data collection methods.

Federal Highway Administration (FHWA): An agency within the U.S. Department of Transportation that supports state and local governments in the design, construction, and maintenance of the national highway system and various federal- and tribal-owned lands.

Free Flow: A situation where traffic movement is unaffected by upstream or downstream conditions.

Free Flow Speed (FFS): The speed achieved by a single vehicle when there are no other vehicles in the corridor, expressed in miles per hour.

Growth Factor: An adjustment factor to reflect traffic change on a facility or in an area over a given time period.

Growth Rate: The decimal percentage of the yearly percentage of traffic growth.

Harris County Office of the County Engineer (OCE): For the purpose of these guidelines, OCE can be defined as the regulatory approval body for developments within the unincorporated areas of Harris County, Texas, and for those areas where Harris County maintains the right-of-way.

Highway Capacity Manual (HCM): A publication by the Transportation Research Board (TRB) containing concepts, guidelines, and computational procedures for computing the capacity and quality of service of various highway facilities.

Headway: The time difference between successive vehicles as they pass a point on a roadway, measured from the same point on each vehicle, expressed in seconds per vehicle.

Highway: A general term for denoting a public way for purposes of vehicular travel, including the entire area within Harris County's right-of-way.

Institute of Transportation Engineers (ITE): An international membership association of transportation professionals.

Intermediate Construction Phase: An intermediate phase of construction associated with a multiple-phase development project. There may be several intermediate construction phases that precede the final construction phase. The final construction phase is completed in the Build-Out Year.

Internal Capture Trip: A trip made between two distinct on-site land uses at a mixed-use site without using an off-site road system.

ITE Trip Generation Manual: A summary of the trip generation data that has been voluntarily collected and submitted to the ITE.

K-Factor: The proportion of AADT occurring in the peak hour, typically expressed as a percentage.

Left Turn Lane (LTL): A lane dedicated to left turning vehicles.

Level of Service (LOS): A quantitative stratification of a performance measure or measures representing quality of service. LOS is presented using a scale between A (best) and F (worst).

Local: Roadways that carry low volumes of traffic local to a given area. These facilities are typically very short (less than one mile in length). Their primary function is to provide access to homes and businesses and, where applicable, accommodate on-street parking and pedestrian activities.

Lost Time: The time in a signal phase when no vehicles are able to pass through the signalized intersection, expressed in seconds.

Major Thoroughfares: Long, continuous facilities that are designed to carry high volumes of traffic and generally serve as high volume travel corridors that connect and provide access to commercial, mixed use, and residential areas.

Major Thoroughfare and Freeway Plan (MTFP): An annual plan published by the governing agency that identifies sections of roadways (either thoroughfares or major collectors) that are in need of expansion, either by lengthening or widening.

Measures of Effectiveness (MOE): A factor that quantifies operational and safety objectives and provides a basis for evaluating the performance of the transportation network.

Median: The portion of a divided street separating opposing traffic flows, may be traversable or non-traversable.

Model Calibration: A modeling process where the modeler modifies calibration parameters that cause the model to best replicate field-measured and observed traffic volumes, speeds, travel times, and queues.

Model Validation: A modeling process where the modeler checks the overall model-predicted traffic performance for a network against field measurements of traffic performance not using data from the calibration process.

Multi-Phase Development Project: Any land development project that is developed with more than a single phase of construction.

National Association of City Transportation Officials (NACTO): An association of North American cities and transit agencies formed to exchange transportation ideas, insights, and practices and cooperatively approach national transportation issues.

NCHRP Report 348: A report prepared by the TRB to provide guidance on access management.

Network Link: A link connecting two nodes in a microsimulation model.

Node: An intersection of two or more roadway segments in a traffic model. A node may represent an actual intersection or a point where roadway characteristics or geometry change.

Pass-By Trip: A vehicle trip made as an intermediate stop on the way from an origin to a primary trip destination without a route diversion.

Passenger Car Equivalent (PCE): The number of passenger cars that will result in the same operational conditions as a single heavy vehicle of a particular type under identical roadway, traffic, and control conditions.

Peak Hour (PH): The hour of the day in which the maximum volume occurs.

Peak Hour Factor (PHF): A measure of traffic demand variation within the analysis hour describing the relationship between full hourly volume and the peak 15-min flow rate within the hour.

Percent Green Time: The percentage of green time allocated for through traffic at signalized intersections.

Permissive Movement: A movement where vehicles are required to yield but may proceed if there are available gaps in the conflicting flow.

Plan Set: A set of documents, following Harris County Design Guidelines, Specifications, and Regulations, created by an Engineer for the purpose of construction. All Plan Sets submitted to the permitting system must be signed and sealed by a Professional Engineer prior to approval.

Protected Left Turn Movement: A phasing sequence which provides a separate phase for left-turning traffic only, allowing left turns to be made only on a green left arrow signal indication.

Protected / Permissive Movement: Where protected phase and permissive phase modes can occur during the same cycle.

Project: A project, for the purpose of review, is defined as one unique project submitted in the permitting system with a Project Number (PRJ).

Proposed Conditions: The Background Conditions with trips generated by the proposed development. Typically, trip generation is estimate using the ITE Trip Generation Manual (latest version).

Right Turn Lane (RTL): A lane dedicated to right turning vehicles.

Road Log Number: The number assigned to a segment of road that is maintained by Harris County.

Roadway Classification: Roadways within Harris County are classified as Thoroughfare, Collector, or Local. Roadway design is based on the roadway classification.

Saturation Flow: The number of vehicles per hour per lane that could pass through a signalized intersection if a green signal was displayed for the full hour and the flow of vehicles never stopped, expressed as vehicles per hour per lane.

Saturation Headway: At signalized intersections, the average headway between vehicles occurring after the fourth vehicle in the queue and continuing until the last vehicle of the initial queue at the beginning of the traffic signal green time clears, expressed in seconds per vehicle.

Segment: The length of roadway between two points where traffic volumes and physical characteristics generally remain the same.

Segmental Analysis: A LOS analysis performed on a Segment.

Shared Access: A single connection serving two or more adjoining lots or parcels.

Split Phase: A signal phasing sequence where one approach is given exclusive right-of-way into the intersection followed by the opposing approach being provided exclusive right-of-way into the intersection.

Stopped Delay: The amount of time that a vehicle is slowed to 5 mph or less, expressed in seconds.

Study Area Boundary: The limits of the area for which a TIA is conducted.

Synchro: A traffic signal timing software primarily used for modeling traffic flow, traffic signal progression, and optimization of traffic signal timing.

Texas Board of Professional Engineers and Land Surveyors (TBPELS): A state agency that licenses engineers and land surveyors to practice in the state of Texas.

Texas Department of Transportation (TxDOT): A government agency generally associated with the construction and maintenance of the state highway system. Some Plan Sets and TIAs may require coordination with the Texas Department of Transportation prior to OCE approval.

Texas Manual for Uniform Traffic Control Devices (TMUTCD): A manual that defines the standards used by road managers statewide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel. All traffic control devices must adhere to the most current version of the TMUTCD.

Traffic Impact Analysis (TIA): A traffic operations analysis that assesses the effect of a proposed land development project on a transportation system and recommends improvements to reduce the impacts.

Traffic Signal: A traffic control device positioned at road intersections, pedestrian crossings, and other locations to control traffic flows.

Transportation Research Board (TRB): A division of the National Academy of Sciences, Engineering, and Medicine, which serves as an independent adviser to the President of the United States, Congress, and federal agencies on scientific and technical questions of national importance.

Turning Movement Count (TMC): The collection of vehicle movement information data at an intersection.

Uncoordinated Fixed Time Signals: Signals that are not coordinated (free), with the signal timings pre-timed to suit the existing traffic demand.

Uncoordinated Traffic Actuated Signals: Signals that use vehicle detection systems to detect the minor street traffic and thereby activate the minor street signal timing.

Vehicle Density: The number of vehicles occupying a given length of a transportation facility at a particular instant, expressed in vehicles per mile.

Volume-to-Capacity Ratio: The ratio of current or projected demand flow rate to capacity of a segment.

Warrant: A threshold condition based upon average or normal conditions that, if found to be satisfied as part of an engineering study, shall result in analysis of other traffic conditions or factors to determine whether a traffic control device or other improvement is justified.

1.0 GENERAL

1.1 PURPOSE

The Harris County Office of the County Engineer (OCE) has developed these guidelines to assist in the development of Traffic Impact Analyses (TIAs). TIAs are tools that have historically been utilized to evaluate the interaction between existing transportation infrastructures and proposed land development projects. TIAs provide a large amount of information that can be used for several purposes, including documenting the growth of an area, assisting with planning activities, assessing immediate and long-term needs relative to infrastructure improvements, etcetera. Historically, these documents have been applied in a variety of ways to maximize the efficiency and safety associated with ingress and egress facilities.

The goals of TIAs developed within Harris County are:

- To identify all potential adverse traffic impacts to the existing transportation system, surrounding communities, and to proposed developments.
- To assist public and private sector entities in identifying and recommending on-site and off-site mitigation measures to address mobility and safety impacts associated with the proposed development for all modes of transportation (i.e., passenger vehicles, trucks, pedestrians, bicycles, and transit) such as location of driveways, turn lanes, traffic signals, and other transportation facilities.
- To assist public and private sector entities with long term planning such that the extension and growth of the transportation infrastructure may occur in a manner that is comprehensive in nature and supportive of the public good.

1.2 REQUIREMENTS

TIAs shall be signed and sealed by an Engineer licensed to practice in his, her, or their area of competence in the State of Texas in accordance with the Texas Board of Professional Engineers & Land Surveyors (TBPELS). TIAs must comply with the most recent versions of the Texas Manual of Uniform Traffic Control Devices (TMUTCD), the Highway Capacity Manual (HCM), the ITE Trip Generation Manual, Harris County standards and guidelines, American Association of State Highway and Transportation Officials (AASHTO) publications, and all applicable governing regulations. In addition, all TIAs shall follow design elements that are consistent with national mobility design best practices as outlined in the latest editions of the National Association of City Transportation Officials' (NACTO) Urban Street Design Guide, Urban Bikeway Design Guide, Transit Street Design Guide, and the Federal Highway Administration (FHWA) Bikeway Selection Guide.

TIAs should be prepared as reports or as technical memoranda. TIAs shall be submitted for approval through Harris County's permitting system, submitting as many times as required to address all OCE comments. The submittal shall include all collected data and applicable software files (e.g., Synchro). Failure to submit the study data may result in the TIA being returned without review. Approval of the project development plans is conditional upon the approval of the TIA. Construction items determined necessary in the TIA shall be installed prior to OCE providing final approval (approving the commercial civil development plans for permitting) for the development project.

1.3 NEED FOR STUDY

If any of the following apply, a TIA will be required:

1. The development generates more than 50 trips during the highest peak hour, as determined by the ITE Trip Generation Manual (latest edition).
2. The development is greater than 5 acres;
3. The development is a place of worship, school, industrial warehouse, or major shopping center (lease space in excess of 100,000 square feet);
4. The development is proposing to deviate from a county standard;
5. Major thoroughfares or collectors are proposed within the development;
6. There are unsignalized major intersections within ¼ mile of the development that could warrant a traffic signal due to the development;
7. Any school renovation project that adds trips, alters circulation patterns, or reduces on-site parking;
8. There are known existing operational or safety issues or concerns at nearby roadways/intersections within the analysis area of the proposed development; or
9. The development is a low acreage, high traffic generating facility, i.e., a fast-food restaurant.

Should a TIA be warranted, the Engineer should coordinate preliminary scoping with OCE to determine the scope and establish the content, exhibits, magnitude of details, and format required for the TIA.

1.4 DOCUMENT LIMITATIONS

While these guidelines contain the steps and requirements necessary to complete a TIA for Harris County, the County does not intend this section to be a sole reference for the preparation of a TIA. For more specific information regarding the various aspects of TIA preparation, the Engineer is advised to refer to the Institute of Transportation Engineers' (ITE) current edition of Transportation Impact Analyses for Site Development.

2.0 SCOPING

2.1 PRELIMINARY SCOPING

In instances where TIAs are submitted, they must be completed in sufficient detail to allow OCE to evaluate the overall impact of the development on boundary facilities. To minimize the deliverables required and still ensure that the document is sufficiently comprehensive, the Engineer should coordinate a preliminary scoping meeting with or submit a study proposal to OCE. A request for a scoping meeting or study proposal can be sent to trafficpermits@harriscountytx.gov.

The Engineer should cover the following items and include exhibits, such as site plans, location maps, etcetera, as needed:

- Project background, location, and development type
- Build-Out Year
- Analysis area and features studied
- Data collection
- Crash data
- Growth rate
- Trip generation and distribution

The Engineer shall provide a meeting agenda and exhibits at least 48 hours prior to the meeting. After the meeting, the Engineer should document the discussion through minutes and distribute them to OCE for comment within 7 days. Should OCE not provide comments within 14 days of receiving the minutes, the minutes will be considered an accurate reflection of the discussion. Should the Engineer choose to submit a study proposal instead of a meeting, OCE will provide concurrence or comments to the study proposal within 14 days. At OCE's discretion, a meeting may be requested after the review of a study proposal. The Engineer is advised to include a copy of the minutes or study proposal and acceptance as an appendix to the TIA.

Any requests for exemption should be submitted to trafficpermits@harriscountytx.gov. Only developments generating fewer than 50 trips in the highest peak hour will be considered. The request shall contain a brief description of the project, a location map, trip generation, and a justification and recommendation from the Engineer that the development should be exempt. The exemption should be reviewed and responded to within 14 days. After review of the memorandum, a meeting may be requested by OCE with the Engineer to resolve any outstanding concerns. The approval shall be uploaded to Harris County's permitting system when permitting the site development plans.

2.2 PROJECT BACKGROUND, LOCATION, AND DEVELOPMENT TYPE

A description of the development and location shall be provided. The description shall include the existing and proposed land-use characteristics and be supported by visual aids. All affected roads shall be described, including their Major Thoroughfare and Freeway Plan (MTFP) classifications. All existing and proposed conditions/plans for pedestrian, bicycle, transit and freight networks shall be included. Any known proposed improvements shall also be discussed, including for pedestrian, bicycle, transit, and freight networks.

2.3 BUILD-OUT YEAR

OCE will approve TIAs projecting up to 5-years from the date of submittal. Should the proposed development extend beyond this timeline, the Engineer shall provide a commitment letter from the developer stating that an addendum will be submitted. The addendum shall update the collected data and make comparisons between the projected and the collected data. Should the collected data be below the projected, no revisions to the TIA will be needed. The addendum shall be provided to trafficpermits@harriscountytx.gov and added to the original TIA permitting system submittal.

2.4 ANALYSIS AREA AND FEATURES STUDIED

The analysis area shall be as defined in Table 1. All intersections, existing or proposed, within this area shall be studied. Roadway segments shall be studied as agreed with OCE. All known proposed developments shall be included in the analysis. OCE can provide information on submitted developments as part of preliminary scoping.

Table 1: Impact Boundary

Generated Peak Hour Trips (PHT)	Analysis Area (from plat boundary) *
50 ≤ PHT < 150	¼ mile
150 ≤ PHT < 300	½ mile
300 ≤ PHT **	1 mile

* Analysis area shall extend to the first signalized intersection even if outside of the boundary area and include any critical intersections as defined by Harris County.

**Shall include segmental capacity analysis for peak hour trips greater than or equal to 300 for all existing two-lane Major Thoroughfares and Collectors.

2.5 DATA COLLECTION

To complete a TIA, the Engineer is expected to evaluate the existing conditions, typically through a site visit(s) and data collection. The Engineer is expected to record intersection geometry, lane assignments, traffic control types, pedestrian facilities, existing signage, and identify existing traffic operations, sight distance issues, and land uses at and near the study limits. If photographical evidence is collected, it should be included as an appendix to the TIA.

OCE recommends collecting 24-hour traffic counts for all intersection in the study area and requires at least 13-hour counts (6 a.m. to 7 p.m.) for the purpose of performing signal or multi-way stop warrants. Traffic counts collected for the purpose of performing operational analyses shall be collected for a minimum of 2-hours in the morning (typically 7 a.m. to 9 a.m.) and 2-hours in the afternoon (typically 4 p.m. to 6 p.m.). For roadway segments requiring segment capacity analysis, OCE requires at least one 24-hour count per direction per segment. All counts should be conducted on a typical weekday (Tuesday to Thursday) when schools are in session, the weather is good, and without incidents. The Engineer should make every reasonable effort to collect traffic data that accurately reflects actual conditions, including the true peak period, accounting for seasonal variations or weekend peaks (e.g., churches), as required.

All turning movement collected traffic data shall contain the following as a minimum for each approach: left, right, U-turn, and through movements; vehicle classifications (including truck and bus); the peak hour

factor (PHF); and pedestrian crossings. Segment counts shall provide volumes broken into 5 mph intervals and the recorded 85th percentile operating speed, determined using technologies in conformance with 43 TAC §25.23. All traffic data shall be geo-located, summarized, and provided in 15-minute intervals in pdf format as an appendix to the TIA. All traffic data must have been collected within the previous 12 months of the study date.

Crash records shall be obtained through the Texas Department of Transportation (TxDOT) Crash Record Information System (C.R.I.S.). At least three years of records should be examined and categorized. A summary of the records shall be provided in pdf format as an appendix to the TIA. OCE may request a collision diagram based on the provided table. Crash records shall be supplemented by highlighting Harris County's Vision Zero High Injury Corridors, as applicable to developments.

Existing signal timing plans shall be collected and used when analyzing signal operations. Signal timing plans can be obtained by submitting a Records/Information (PIA) Request.

2.6 GROWTH RATE

The Engineer shall select rates based on engineering judgement and/or available data, as agreed with OCE.

2.7 TRIP GENERATION AND DISTRIBUTION

Typically, TIA trips are generated using the ITE Trip Generation Manual (latest version) and associated guidelines. When using the ITE Trip Generation Manual, the Engineer shall select the fitted curve equation or weighted average rate in conformance with the guidance provided in the ITE Generation Handbook, 3rd edition. Trip generations should be for Adjacent Street Traffic, except for schools and other similar facilities (e.g., day care facilities), where the Peak Hour Generator will apply. Internal capture and pass-by reductions will be permitted if supported by ITE practices and agreed with OCE. Other generation methods, such as data from similar sites within Harris County, may be used if agreed with OCE during preliminary scoping. Trip distribution will be based on a combination of factors, such as existing data, engineering judgement, and similar studies performed in that area.

3.0 FORMAT

All TIAs shall be submitted to Harris County as a stand-alone document in a PDF electronic format. Accompanying appendices shall be contained within the PDF. The items identified below establish the outline and general submittal requirements of the report and appendices.

3.1 GENERAL OUTLINE OF REPORT

1. Executive Summary:

- The purpose and objectives of the analysis
- The project background, location, development type and size, and Build-Out Year
- The analysis area and intersections studied
- A summary of data, including collection, projection and applied growth rate, and trip generation and distributions
- A summary of findings and conclusions
- The proposed recommendations, including mitigation measures

2. Table of Contents

3. List of Figures and Tables

4. Introduction

- The purpose and objectives of the analysis

5. Study Area

- A description of the existing and expected land use and intensity:
    - If residential, the number and type of dwelling units
    - If commercial or industrial, the square footage and type
    - If redevelopment, the expected trip generation differential
    - If school, the number of expected enrollments
- A description of the existing and proposed roadway conditions, including posted speeds
- A description of the existing and proposed pedestrian, bicycle, and public transportation facilities
- A description of the existing intersections
- A vicinity map showing the surrounding streets and areas of interest
- An existing conditions layout on aerial photography, including pavement markings and lane usage, driveways, and intersecting streets
- A proposed site plan showing the existing and proposed conditions, including pavement markings and lane usage, driveways, and intersecting streets
- Field observations

6. Traffic

- Existing traffic presented as a traffic turning movement count diagram(s)
- Background traffic presented as a traffic turning movement count diagram(s)
- Trip generation from the ITE Trip Generation Manual (latest version) presented in tabular format (see Table 2 and Table 3 for example)

Table 2: Trip Generation Rate

Land Use	ITE Code	Daily Trips			AM Peak Trips			PM Peak Trips		
		Rate	In (%)	Out (%)	Rate	In (%)	Out (%)	Rate	In (%)	Out (%)

Table 3: Estimated Trip Generation

Land Use	ITE Code	Intensity	Units	Daily Trips			AM Peak Trips			PM Peak Trips		
				In	Out	Total	In	Out	Total	In	Out	Total

- Site generated traffic presented as a traffic turning movement count diagram(s)
- Build-Out Year traffic presented as a traffic turning movement count diagram(s)

7. Analysis

- Intersection capacity analysis presented in tabular format comparing the Background Conditions with the Build-Out Year Conditions (see Table 4 for example)

Table 4: Intersection LOS

Intersection / Scenario	AM / PM Peak									
	Northbound		Southbound		Eastbound		Westbound		Intersection	
	Approach Delay (s/v)	LOS	Approach Delay (s/v)	LOS	Approach Delay (s/v)	LOS	Approach Delay (s/v)	LOS	Approach Delay (s/v)	LOS

- Traffic signal and multi-way stop warrant analysis
- Turn lane warrant analysis
- Pedestrian crossing analysis
- Segmental capacity analysis comparing the Background Conditions with the Build-Out Year Conditions

8. Improvements

- Description and justification of improvements required to accommodate the proposed development
- Intersection capacity analysis presented in tabular format comparing the Background Conditions and Mitigated Build-Out Conditions (see Table 4)
- Segmental capacity analysis comparing the Background Conditions and Mitigated Build-Out Conditions
- Descriptions, schematics, and measures of effectiveness of other proposed mitigation measures

9. Conclusions and Recommendations

10. References

11. Appendices

- Existing conditions photographs
- Traffic counts

- Crash records summary and collision diagram(s)
- Existing signal timing plans
- Synchro (or other acceptable software) traffic analysis output data
- Signal and multi-way stop warrants
- Segmental capacity analysis output data
- Scoping meeting minutes or study proposal and approval
- Developer commitment letter
- Other agency approvals
- Background TIAs

4.0 TECHNICAL GUIDELINES

These technical guidelines are presented to standardize the methodology used when preparing TIAs to ensure that the content and quality of a given TIA will result in an accurate and useful analysis.

4.1 INTERSECTION CAPACITY ANALYSIS

An intersection capacity analysis shall be conducted at every intersection within the study area. An Existing Conditions model shall be developed using the existing signal timing plans, roadway/intersection geometry, and the collected traffic data to determine the current level of service (LOS). When creating the Existing Conditions model, the Engineer shall ensure that all model inputs, such as PHF, are based on collected data or engineering judgement and not program defaults. Further modeling guidance is provided in Appendix A.

Background Conditions and Build-Out Conditions models shall be created from the Existing Conditions model and compared to one another. The acceptable approach LOS is as follows:

1. When the Background Conditions LOS is LOS A, B, or C, the minimum acceptable Build-Out Conditions LOS shall be LOS C.
2. When the Background Conditions LOS is LOS D, E, or F, the minimum acceptable Build-Out Conditions LOS shall be equal to the Background Condition LOS.

Where these criteria are not met, the Engineer shall evaluate the appropriate mitigation measures required to conform. Example mitigation measures include changes in lane usage, lane additions, extension of existing turn lane(s), installation of new traffic control features, and signal phasing and timing adjustments. Left-turn signal phasing operations shall be assessed per Appendix B.

4.2 WARRANT ANALYSIS

Traffic signal warrants shall be performed per the latest TMUTCD (Chapter 4C). TIAs should focus on Warrant 1, Eight-Hour Vehicular Volume, and Warrant 7, Crash Experience. TIAs proposing signals based on the other warrants will be reviewed and evaluated by OCE on a case-by-case basis. Multi-way stop warrants shall follow the criteria and thresholds per the latest TMUTCD (Section 2B.07).

A traffic control device will not be installed unless an engineering study indicates that installing a traffic control device will improve the overall safety and/or operation of the intersection, as agreed with OCE. Engineering judgment should be used in applying the various warrants.

4.3 TURN WARRANT ANALYSIS

Right and left turn warrants shall be conducted in accordance with NCHRP Report 348. The required storage length for signalized intersections shall be determined from Synchro or other acceptable computer analysis software. The storage length for unsignalized intersections shall be calculated from Synchro, or other acceptable software, or by using Equation 1. No storage shall be provided below the minimum acceptable OCE lengths as published in the Geometric Design Guidelines (latest edition).

$$L = (\frac{V}{30})(2)(S) \qquad \text{(Equation 1)}$$

Where:

L = storage length in feet

V = left-turn volume per hour

2 = a factor that provides for storage of all left-turning vehicles on most cycles

S = queue storage length, in feet per vehicle:

% Trucks	S (ft.)
< 5	25
5 – 9	30
10 – 14	35
15 - 19	40

4.4 DETERMINATION OF PEDESTRIAN CROSSING TREATMENTS

The determination of pedestrian crossings shall follow the Harris County Pedestrian Crossing Guidelines. For crossings located within school zones, a commitment from the school to provide a crossing guard shall be submitted.

4.5 SCHOOLS

In addition to the requirements set forth in these guidelines for TIAs, schools shall include:

1. A queue length analysis to ensure adequate on-site storage for the morning and afternoon drop off and pick up, including a schematic showing that the queuing/stacking is contained within school property limits and that there will be no impact to Harris County maintained roadways. Queue lengths shall be calculated using 15 percent of the total maximum school enrollment (number of students) and a storage length of 20 foot per vehicle.
2. The need for a school zone shall be determined based on 43 TAC §25.22. If a school zone is warranted, a school zone signage schematic (Appendix C) shall be included. The school zone signage schematic shall include flashing school speed limit sign beacons along with advance school pedestrian warning signs, school pedestrian crossings (if applicable), end school zone speed limit signs, and any other signage or pavement marking improvements required.

4.6 DRIVE-THROUGHS

In addition to the requirements set forth in these guidelines for TIAs, facilities offering drive-through services shall include a queue length analysis to ensure adequate on-site storage. The queue length analysis should be based on data collection from other local locations of the same chain. For facilities offering food services, a mid-day peak hour analysis shall also be conducted to include lunch services.

4.7 PARKING SPACES

Restricted reserves with private amenities, such as swimming pools and playgrounds, shall provide sufficient on-site parking to accommodate the peak hour trip generation as determine by the ITE Parking Generation Manual (latest edition).

4.8 SEGMENTAL CAPACITY ANALYSIS

A segmental capacity analysis following the HCM Two-Lane Highway procedure shall be performed for all existing two-lane Major Throughfares and Collectors within the defined study area as indicated in Table 1. Each roadway analyzed shall be divided into homogenous segments and then combined for the full stretch of highway. The analysis should be performed using collected data and not HCM defaults. An Existing

Conditions model should be developed using available software, such as Highway Capacity Software (HCS), and provided to OCE. Background Conditions and Build-Out Conditions models shall be created from the Existing Conditions model (updating traffic volumes, access points, etc.) and compared to one another. The acceptable LOS is as follows:

1. When the Background Conditions LOS is LOS A, B, or C, the minimum acceptable Build-Out Conditions LOS shall be LOS C.
2. When the Background Conditions LOS is LOS D, E, or F, the minimum acceptable Build-Out Conditions LOS shall be equal to the Background Condition LOS.

Where these criteria are not met, the developer is required to bear a portion of Harris County's roadway improvement costs in accordance with applicable laws by entering into a Developer Participation Contract as described under Section 232.105 of the Texas Local Government Code and/or other written agreements with Harris County. Examples of improvements to Harris County roadways include, without limitation, adjustments to the lane and shoulder widths, the provision of passing lanes, or an upgrade to a Multilane Highway Segment (analysis following HCM procedures). A Mitigated Build-Out Conditions model shall be provided to OCE.

5.0 REFERENCES

1. Agent, K.R. Development (1979) *Warrants for Left-Turn Lanes*, Research Report 526. Kentucky Department of Transportation.
2. City of Austin (1991) *Land Development Code*. Chapter 5
3. City of Houston and Harris County (2009) *Geometric Design Guidelines for Subdivision Streets for the City of Houston / Harris County.*
4. City of Houston (2023) *Code of Ordinances City of Houston, Texas.*
5. City of Houston Planning Commission (2023) *Major Thoroughfare and Freeway Plan*.
6. City of Houston Public Works (2023) *Infrastructure Design Manual.*
7. City of Houston Public Works (2020) *TIA Scoping Meeting – Typical Meeting Agenda.*
8. City of Houston Public Works (2020) *Traffic Impact Analyses (TIA) Content Guide and Format Requirements.*
9. City of San Antonio (2023) *City Code*. Chapter 19
10. City of San Antonio (2023) *Ordinance #84917*
11. City of San Antonio (2023) *Ordinance #85561*
12. City of Toronto (2021) *Guidelines for Using Synchro 11 (including SimTraffic 11).*
13. Dallas County (1999) *Draft Regional Standards for Subdivision Development.*
14. Federal Highway Administration (1985) *The Highway Capacity Manual,* Special Report 209. Federal Highway Administration.
15. Federal Highway Administration (2018) *Traffic Data Computation Method Pocket Guide,* Washington, DC: FHWA
16. Harris County Engineering Department (2005) *Regulations of Harris County, Texas for the Construction of Driveway and/or Culverts.*
17. Harris County Engineering Department (2023) *2023 Regulations of Harris County, Texas, for the Approval and Acceptance of Infrastructure*.
18. Institute of Transportation Engineers (2010) *Manual of Transportation Engineering Studies, 2nd ed.,* Washington, DC: ITE
19. Institute of Transportation Engineers (2017) *Trip Generation Handbook, 3rd ed.,* Washington, DC: ITE
20. Institute of Transportation Engineers (2021) *Trip Generation Manual, 11th ed.,* Washington, DC: ITE
21. Institute of Transportation Engineers Technical Committee 6A-57 (1995) *Statewide Programs to Assess Land Use Decisions on Transportation – An Examination of Seven Case Studies.*
22. Koepke, F.J. and Stover, V.G. (1988) *Transportation and Land Development*, Washington, DC: ITE
23. Pignataro, L.J. (1973) *Traffic Engineering Theory and Practice.* Englewood Cliffs: Prentice Hall
24. Texas Department of Transportation (2022) *Roadway Design Manual.*
25. Texas Department of Transportation (2014) *Texas Manual on Uniform Traffic Control Devices, Revision 2.*
26. Texas Department of Transportation Houston District (n.d.) *TxDOT Houston District Traffic Study Guidelines.*
27. Texas Transportation Institute (1988) *A Short Course on City Street Design*, Texas Transportation Institute, August 1988.
28. Transportation Research Board (2022) *Highway Capacity Manual, 7th ed.,* Washington, DC: TRB

29. Transportation Research Board (1992) *Access Management Guidelines for Activity Centers*, Research Report 348. Washington, DC: TRB
30. Virginia Department of Transportation (2020) *Traffic Operations and Safety Analysis Manual (TOSAM) – Version 2.0.*

APPENDICES

APPENDIX A – SYNCHRO GUIDELINES

TRAFFIC IMPACT ANALYSIS
SYNCHRO GUIDELINES

May 8, 2025

Table of Contents

1.0 INTRODUCTION

The Harris County Office of the County Engineer (OCE) has developed these guidelines to assist engineers in the development of traffic models using the Cubic/Trafficware Synchro software for the purpose of Traffic Impact Analyses (TIAs). These guidelines were written for use with Synchro Version 12 but may be applicable to other versions. These guidelines aim to provide clarity to the Engineer when preparing Synchro models for TIA approval with OCE. These guidelines are not intended to be a comprehensive user guide; the reader is referred to the Cubic/Trafficware Synchro Studio 12 User Guide for detailed user information.

2.0 EXISTING CONDITIONS MODEL

2.1 MAP SETTINGS

The proposed study location network must be created using imperial units. Link distances should be verified by independent means, such as field measurement, recent aerial photographs (e.g., Google Earth), or recent scaled maps. Link distances shall reflect the distance from the middle of one intersection to the middle of another, and not from stop bar to stop bar. The map should reflect the existing geometric layout as accurately as possible.

2.2 LANE SETTINGS

The Engineer shall verify the automatically generated naming convention for each movement and approach, and manually input names as required. Careful consideration should be given to skewed and irregular intersections. Traffic volumes shall be obtained from field counts no older than 12 months. The Link Speed shall be the observed posted speed, or prima facie speed in the absence of a posted speed. Lane Width shall be inputted based on observed/proposed conditions. The Grade should be set to 0% for intersections within Harris County. The Area Type CBD should be unselected. Storage Length shall be entered based on observed/proposed conditions, excluding tapers. Should the turn lane be continuous from one intersection to another, a value of "0" should be entered. Should more than one storage lane be present per movement, an average length, not sum, should be entered. Right Turn Channelization, Curb Radius, and Add Lanes (#) shall be inputted based on observed/proposed conditions. Ensure Right Turn On Red is permitted except in situations where prohibited, i.e., in the presence of an R10-11 sign. Saturation Flow Rate and Passenger Car Equivalent for Heavy Vehicles should be program defaults based on the Highway Capacity Manual (HCM).

2.3 VOLUME SETTINGS

The average Peak Hour Factor (PHF) should be calculated for intersections with uniform peaking characteristics. For intersections with sharp peaking characteristics, the PHF should be calculated and applied for each movement or approach. The Engineer should ensure the PHF reflects field data and not program defaults, unless engineering judgement determines the default to be more representative, in which case an explanation will need to be provided in the TIA, or the intersection is proposed, in which case HCM default values can be applied. A Growth Factor can be applied to the Existing Conditions model in order to adjust the traffic volumes to the Background Conditions model. Heavy Vehicles, Conflicting Pedestrians, and Conflicting Bicycles shall be inputted based on the collected traffic data. Other inputs, such as Adjacent Parking Lanes, shall be entered based on existing/proposed conditions.

2.4 TIMING/PHASES SETTINGS

The Phase Settings should follow the OCE default as depicted in Figure 1. However, some signal timing plans may have different Phase Settings. In these cases, the Engineer shall coordinate with OCE. The Cycle Length, Yellow Time, All Red Time, Vehicle Extension, Maximum Split, Reference Phase, Offset Style (start of yellow), and Control Type shall all be inputted per the existing signal timing plans. The Allow Lead/Lag Optimize and Lost Time Adjustment options should not be implemented for the Existing Conditions model.

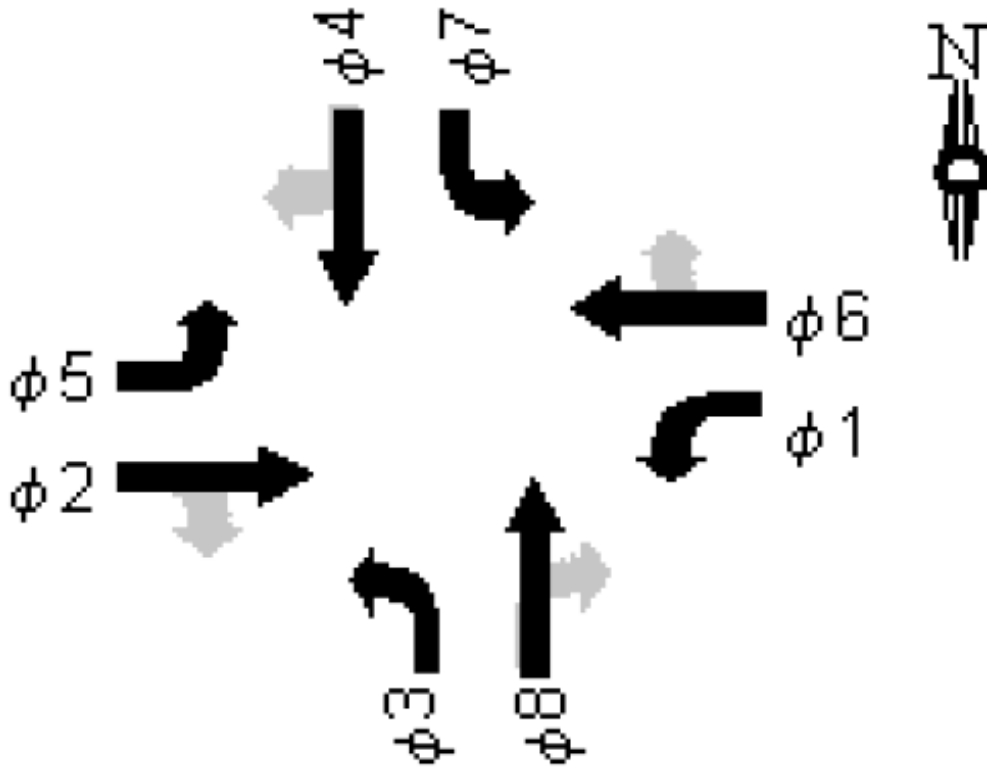


Figure 1: Phase Template (Cubic ITS, inc., 2023, p.11-21).

2.5 SIMULATION SETTINGS

The Taper Length and Crosswalk Width shall be entered based on verified independent measurements, such as field measurements, recent aerial photographs (e.g., Google Earth), or recent scaled maps. The Enter Blocked Intersection setting should be unchecked.

2.6 OUTPUT

Once the model has been created and run, the Engineer shall print an Intersection Report at each studied intersection. The report(s) shall be included as an appendix to the TIA.

3.0 BACKGROUND CONDITIONS MODEL

The Existing Conditions model shall be used to develop the Background Conditions model. The model should be unchanged from the Existing Conditions model other than the Engineer either applying a Growth Factor to the Existing Conditions model to project traffic to the Build-Out Year, or manually entering the projected traffic volumes. Any additional traffic data, such as adjacent developments, will also need to be included. The Engineer shall run the model and print an Intersection Report at each studied intersection. The report(s) shall be included as an appendix to the TIA.

4.0 BUILD-OUT CONDITIONS MODEL

The Background Conditions model shall be used to develop the Build-Out Conditions model. The model should be unchanged from the Background Conditions model other than the Engineer adding the site generated traffic and proposed roadway improvements. The Engineer shall run the model and print an Intersection Report at each studied intersection. The report(s) shall be included as an appendix to the TIA.

5.0 MITIGATED BUILD-OUT CONDITIONS MODEL

The Build-Out Conditions model shall be used to develop the Mitigated Build-Out Conditions model if the Engineer needs to evaluate appropriate mitigation measures to conform to OCE requirements. Example mitigation measures include changes in lane usage, lane additions, extension of existing turn lane(s), installation of new traffic control features, and signal phasing and timing adjustments. All mitigation measures shall be reflected in the site plans submitted for permit approval. The Engineer shall run the model and print an Intersection Report at each studied intersection. The report(s) shall be included as an appendix to the TIA.

6.0 REFERENCES

1. City of Toronto (2021) *Guidelines for Using Synchro 11 (including SimTraffic 11)*
2. City of Vancouver (2022) *Guidelines for Using Synchro Version 10, Revision 1.4*
3. Cubic ITS, Inc. (2023) *Synchro Studio 12 User Guide*, Sugarland: Cubic ITS, Inc.

APPENDIX B – MODE OF LEFT TURN OPERATION

Harris County Guidelines for Mode of Left Turn Operation

Roadway Evaluated:_____

Direction of Travel: NS / EW
(Circle One). Chart to be completed by roadway.

Start

Does the approach have a dedicated left-turn lane?
- No → **Permissive Only**
- Yes ↓

Does the location meet at least one of the following criteria:
a. Within 0.25 miles of a school?
b. Exceed minimum pedestrian volumes:
   - 20 peds per hour in any one hour
   - 18 peds per hour in any two hours in a 24-hour period
   - 15 peds per hour in any three hours in a 24-hour period

- Yes → **Protected Only**
- No ↓

Is the median width > 32 feet?
- Yes → **Protected Only**
- No ↓

Is left-turn driver sight distance to oncoming vehicles less than SD_c (See below)

Oncoming Traffic Speed (mph)	Minimum Sight Distance (SD_c)
20	165
25	205
30	245
35	285
40	325
45	365
50	405
55	445

- Yes → Can sight restriction be removed by offsetting the opposing left-turn lanes?
  - No → **Protected Only**
  - Yes ↓
- No ↓

How many left-turn lanes are on the subject approach?
- Dual or More → **Protected Only**
- Single ↓

How many through lanes + exclusive right-turn lanes are on the opposing approach?
- 4 or More Lanes → **Protected Only**
- Less than 4 Lanes ↓

Is the average left-turn volume per traffic signal cycle 2 vehicles or less during the peak hour?
- Yes → **Protected Only**
- No ↓

Has the reported number of crashes coded as “opposite direction – both left turns” or “opposite direction – one straight one left turn” equaled or exceeded the critical crash count?

Number of Left-Turn Movements	Critical Left-Turn Related Crash Count (C_{pt})		
	One Year	Two Years	Three Years
One (e.g. EB)	6	11	14
Both (e.g. EB & WB)	11	18	26

- Yes → **Protected Only**
- No ↓

Is the calculated 85th percentile speed of opposing traffic greater than 45 mph?

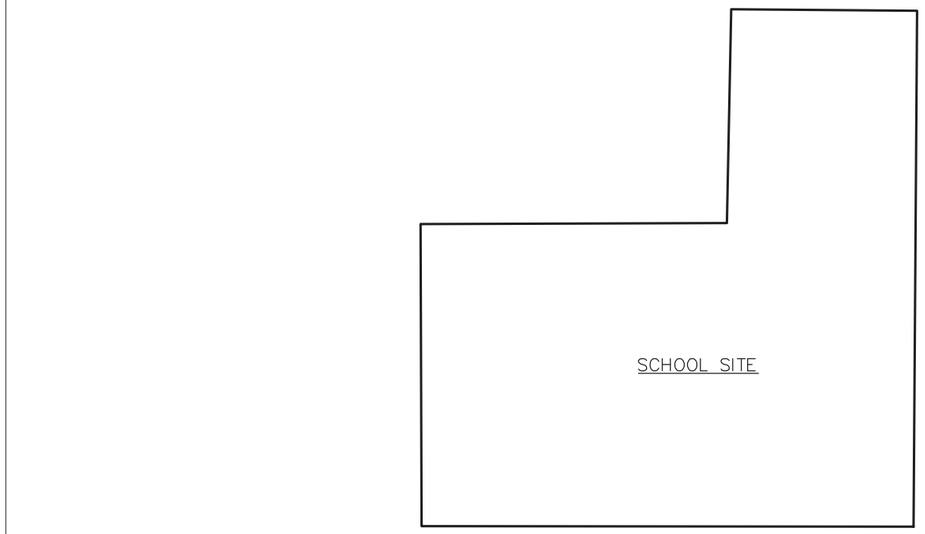
If 85th percentile speeds are not known, posted speed limits may be utilized.

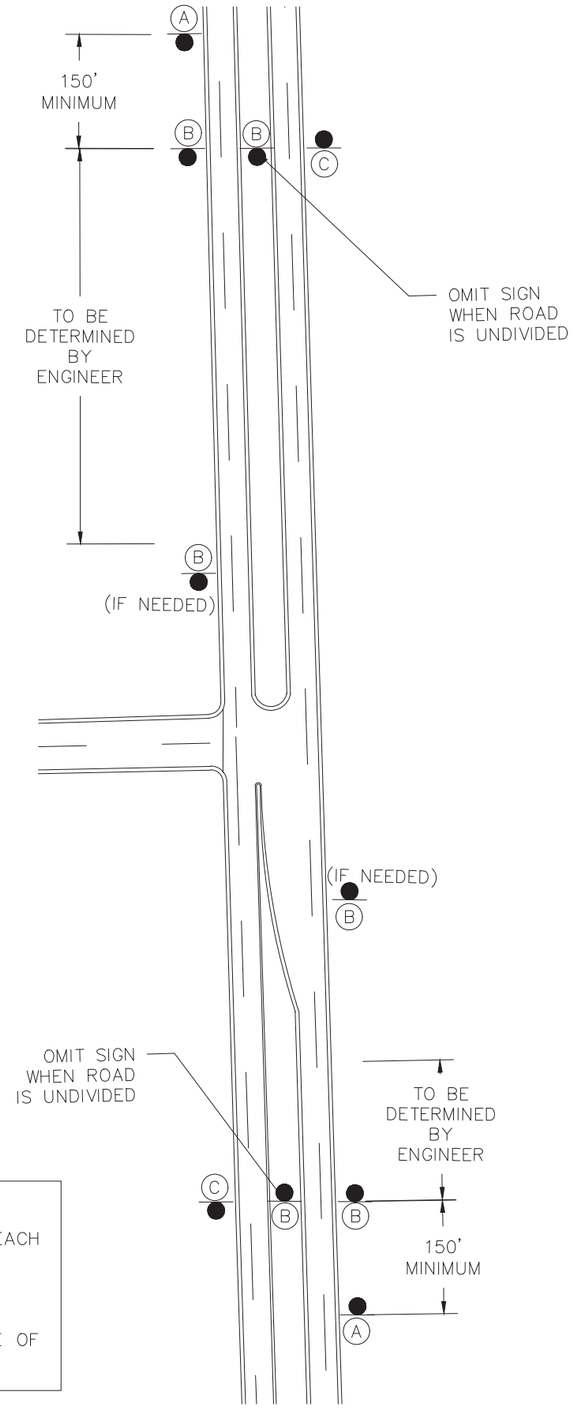
- Yes → **Protected Only**
- No ↓

Protected + Permissive

Time of Day for when the Permissive State is Operational shall be determined by a professional licensed engineer and agreed to by OCE.

APPENDIX C – SCHOOL ZONE SIGNAGE





LEGEND:

S1–1
36"X36"

SW16–9P
24"X12"

A

S5–1 "MODIFIED"
24"X48"

S7–1T
24"X18"

SCHOOL SPEED LIMIT
ASSEMBLY WITH
FLASHING BEACON

B

S5–2aTP "MODIFIED" (FLUORESCENT YELLOW–
24"X10" GREEN BACKGROUND)

R2–1
24"X30"

C

NOTES:

1. DISTANCES SHOWN ARE TYPICAL AND SHOULD BE EVALUATED BY AN ENGINEER FOR EACH SCHOOL SITE.
2. SEE THE LATEST VERSION OF THE TMUTCD FOR ADDITIONAL INFORMATION.
3. SCHOOL SPEED LIMITS SHALL BE REVIEWED AND APPROVED BY THE HARRIS COUNTY OFFICE OF THE COUNTY ENGINEER BEFORE INSTALLATION.

NO.	REVISIONS	DATE	NAME

HARRIS COUNTY
OFFICE OF THE COUNTY ENGINEER

PROJECT TITLE: SIGNING OF A SCHOOL ZONE WITHOUT A SCHOOL CROSSING

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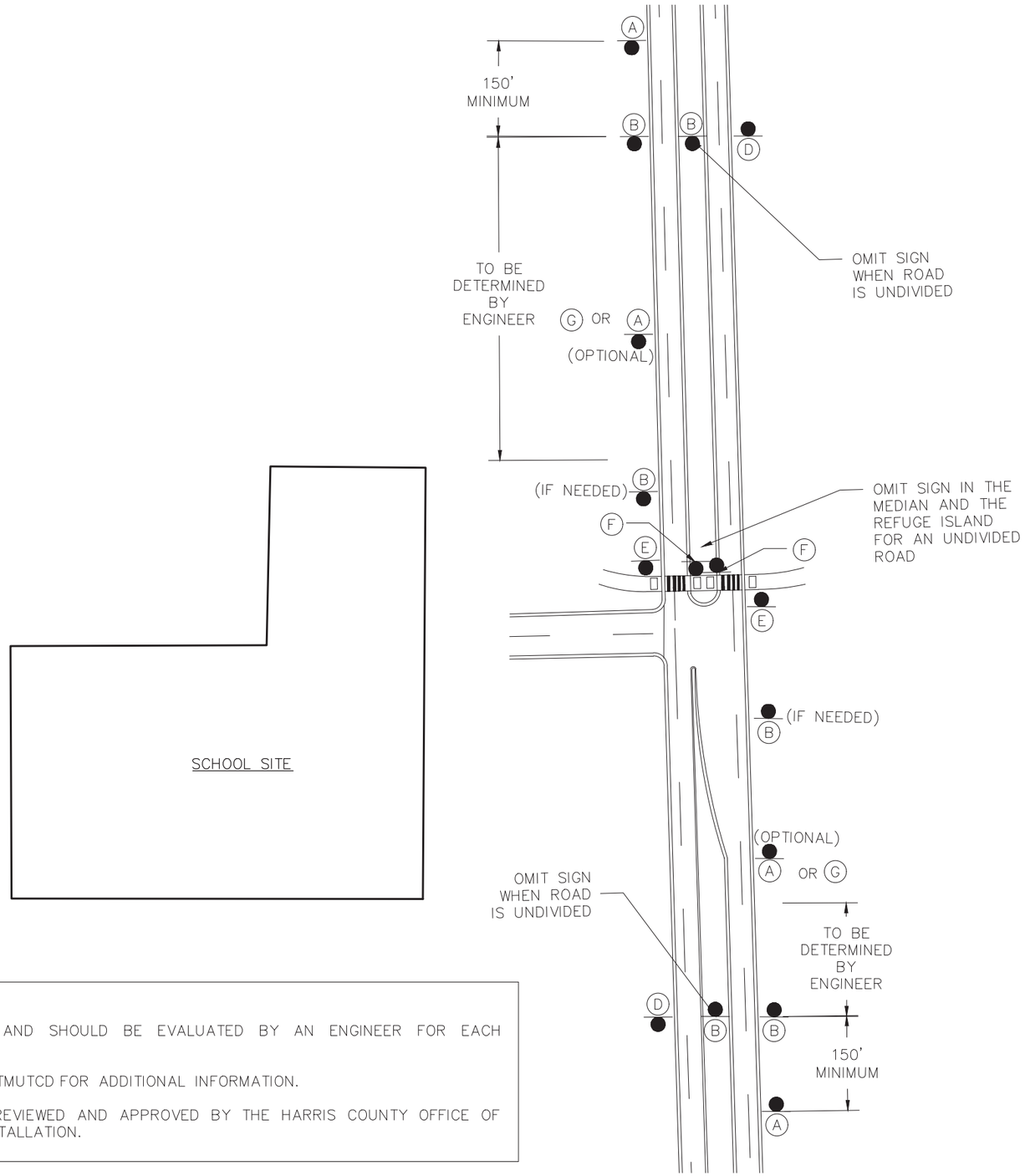
OO	NOT TO SCALE	1/1



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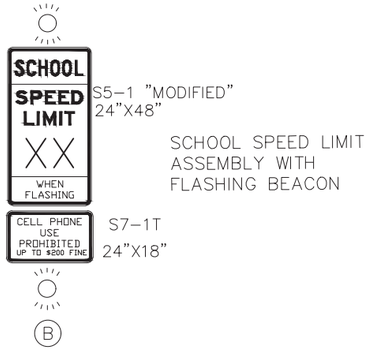

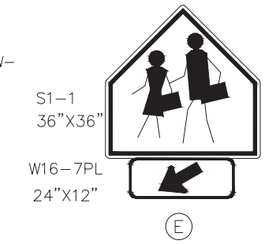

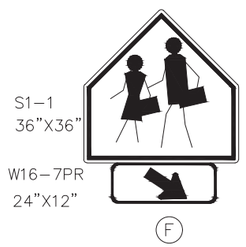

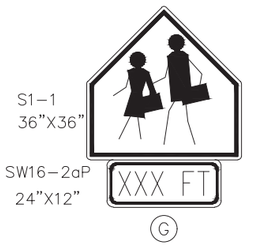

NOTES:

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3. SCHOOL SPEED LIMITS SHALL BE REVIEWED AND APPROVED BY THE HARRIS COUNTY OFFICE OF THE COUNTY ENGINEER BEFORE INSTALLATION.

NO.	REVISIONS	DATE	NAME

HARRIS COUNTY
OFFICE OF THE COUNTY ENGINEER

PROJECT TITLE: SIGNING FOR SCHOOL CROSSING IN A SCHOOL ZONE

SHEET DESCRIPTION:

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DT		05/08/25
CK'D BY:	SCALE:	SHEET NO:
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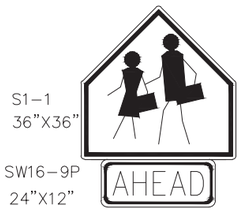

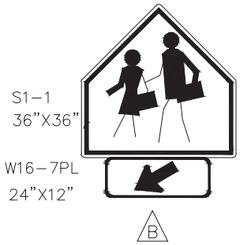

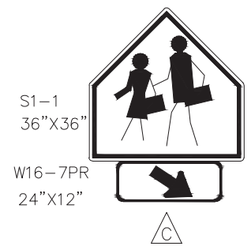

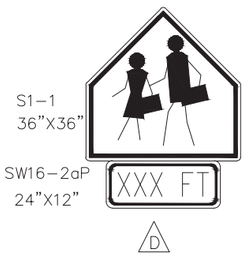

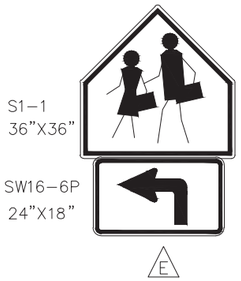

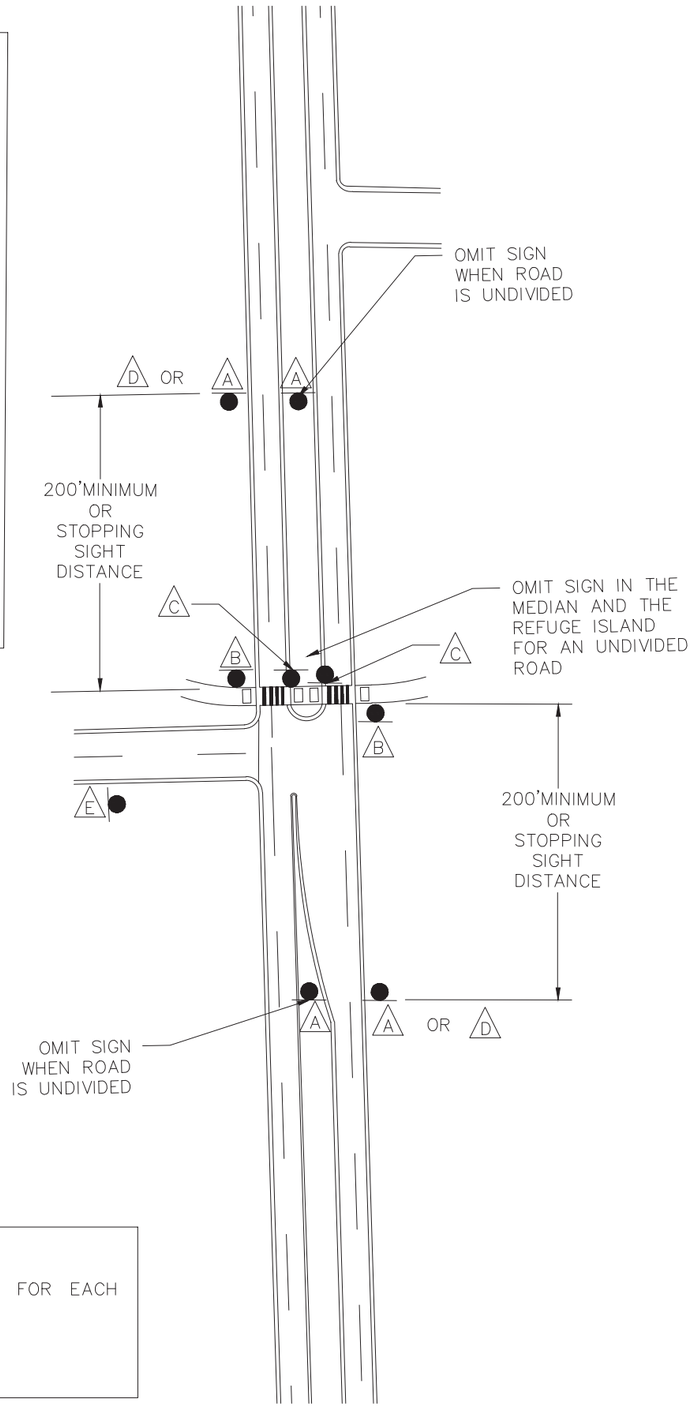

NOTES:

1. DISTANCES SHOWN ARE TYPICAL AND SHOULD BE EVALUATED BY AN ENGINEER FOR EACH SCHOOL SITE.
2. SEE THE LATEST VERSION OF THE TMUTCD FOR ADDITIONAL INFORMATION.

NO.	REVISIONS	DATE	NAME

HARRIS COUNTY
OFFICE OF THE COUNTY ENGINEER

PROJECT TITLE: SIGNIING FOR A SCHOOL CROSSING OUTSIDE OF A SCHOOL ZONE

SHEET DESCRIPTION:

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