

POLICIES and PROCEDURES For

# **TRANSPORTATION IMPACT STUDIES**

Related to Highway Occupancy Permits

Pennsylvania Department of Transportation  
Bureau of Operations

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## INTRODUCTION

State Highway Law and PennDOT regulations support mobility needs of the traveling public, which are balanced with the needs of property owners accessing the State highway right-of-way.

PennDOT regulation governing access to and occupancy of State highway, Title 67 PA Code Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads, provide the Department with regulatory authority to ensure the location and design of driveways and local roads within State highway right-of-way preserve safe and reasonable access.

PennDOT has established a Highway Occupancy Permit (HOP) Process to assist the Department in regulating design construction, location, maintenance and drainage of driveways for the safety and welfare of the traveling public.<sup>1</sup> The Department has regulatory authority to make such investigations and require such additional information as it deems necessary from property owners requesting access to the state highway system.<sup>2</sup>

As part of the HOP process, applicants may be tasked with identifying impacts of the proposed access on the transportation system in the surrounding area and identifying mitigations to offset that impact through development of a Transportation Impact Study (TIS) or a Transportation Impact Assessment (TIA).

Once a TIS or TIA is determined to be necessary in the HOP process, PennDOT will review it in accordance with these guidelines, PennDOT regulations governing access to and occupancy of highways by driveways and local roads, and the requirements of the Municipalities Planning Code (MPC). The MPC requires the Department to approve, reject or return the study submitted by the applicant as part of the permit application, for additional information in accordance with the established time period.<sup>3</sup> The regulations allow the Department to reject any study submitted for review if it is not satisfied with its genuineness, regularity or legality.<sup>4</sup>

The Department reviews the TIS or TIA to assure safe and reasonable access as well as safe and convenient passage of traffic on the State highway and to ensure that driveways safely and efficiently function as an integral component of the highway system based on the amount and type of traffic expected to be served and the type and character of roadway being accessed.<sup>5</sup> The Department will use the TIS or TIA to provide direction to the applicant on needed improvements.

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<sup>1</sup> 67 Pa. Code§441.2(a) and Wolf vs. Department of Highways 422 Pa 34.22 A 2d 868 (Pa Supreme Ct. 1966).

<sup>2</sup> 67 Pa. Code§441.3(k)

<sup>3</sup> 53 P.S. §10508

<sup>4</sup> 67 Pa. Code§441.3(k)

<sup>5</sup> 67 Pa. Code§441.2(a) & 67 Pa. Code 441.8(a)(1)

The purpose of these Guidelines is to provide direction to the applicant on the requirements of the TIS or TIA, and how it will be used by the Department and other levels of government involved in the development review process. The ultimate goal of the process is a safe and efficient transportation system.

Approval Process

The TIS or TIA is an integral element of the HOP process and the procedures are typically as follows:

- Phase 1: The applicant prepares a Scoping Meeting Application and attends a TIS Scoping Meeting if warranted.
- Phase 2: The applicant prepares and submits to the Department the TIS or TIA and HOP application.
- Phase 3: The Department reviews the TIS or TIA. The Department agrees on the Mitigation Improvements and approves the TIS or TIA.
- Phase 4: The applicant prepares the Engineering Plans.
- Phase 5: The Department reviews and approves the Engineering Plans.

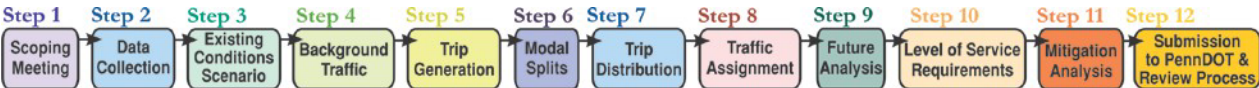


Figure 1

This publication covers Phases 1 through 3 of this process.

Figure 1 illustrates the detailed elements in scheduling the scoping meeting and preparing the TIS or TIA which has been divided into 12 Steps.

Roles and Authority

The roles of the participants in the HOP Process are described below:

The Department

The Department is the approving agency for all permits to access the state highway system or occupy state-controlled highway right-of-way.

The Department is divided into [11 Engineering Districts](#), which manages the HOP process in their respective regions. The [District Permit Office](#) manages the HOP application submission and issuance of the HOP.

The Department makes the final determination on design parameters for the TIS or TIA and concept plans. The Department will coordinate and copy the municipalities on all correspondence from the Department.

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The Department coordinates communications and reviews with Federal Highway Administration (FHWA) if HOP applications involve interstate highway access.

The District HOP Manager will be the sole point of contact for applicants and can provide assistance as needed. The District HOP Manager will be responsible for providing Department and FHWA review and comment coordination.

### FHWA

FHWA has approval authority on permanent occupancy and access HOP applications that involve interstate highway access. All correspondence and communication shall be coordinated through the Department. Individual applicants shall not contact FHWA directly.

### Metropolitan and Rural Planning Organizations

Metropolitan Planning Organizations (MPO) and Rural Planning Organizations (RPO) have a role in providing information to the applicant and Department regarding planned projects, visioning, and future growth. MPO's will typically be involved in projects that have multi-municipal impacts.

### Municipalities

Municipalities control the land development approval and zoning process. As described in these guidelines, municipalities are invited and encouraged to participate in the review of HOP applications within their jurisdictions.

Municipalities will have opportunity to provide input on mitigation strategies as well as concurrence on Alternative Transportation Plans through the HOP process.

Municipalities are asked to coordinate subdivision and land development approvals with the District Permit Office.

### Public Transit Authorities

Local transit authorities operate public transportation systems across the Commonwealth. They will be involved in the review process should the Department, municipality or MPO/RPO determine that the applicant's project impacts the operation of the transit system; that applicant's project could be designed to accommodate public transit; or the mitigation of site impacts involves the improvement to the public transit system.

### Applicants

The applicant is responsible for preparing an HOP application and TIS or TIA consistent with these guidelines. Changes to the proposed use, site layout or other planned

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elements of the project should be communicated to the Department and updates to the HOP application or TIS/TIA will be required when necessary.

The applicant is responsible for all data collection efforts and assessing the overall impact that the development will have on the transportation system and developing realistic improvements that mitigate impacts.

The TIS or TIA must be conducted under the supervision of a person who possesses a current Professional Engineer's (PE) license issued by the Pennsylvania Department of State and preferably possessing a Professional Traffic Operations Engineer (PTOE) certificate. The TIS must be signed and sealed by a PE licensed in Pennsylvania.

Applicants are requested to design their site plan so impacts are consistent with local and regional transportation planning efforts, through sound land use and congestion management practices. Applicants are responsible for notifying the municipality, local transit authorities, and MPO or RPO of the status of the HOP application as well as inviting them to Department meetings and ensuring they are copied on any correspondence to the Department. The Department may request evidence that the location and type of highway access has been reviewed by the municipality as outlined in 67 Pa Code Section 441.7.

The applicant should be prepared to explain how the project advances the municipality's comprehensive plan land use and transportation goals.

Beyond the technical requirements, applicants should be mindful of smart transportation methodologies that can be found in [PennDOT Design Manual, Part 1](#) and [PennDOT Design Manual, Part 2](#). The principles are reflected in the TIS Guidelines.

Transportation Impact Study Warrants

The Department requires a TIS for all HOP applications meeting any one of the following characteristics:

- The site is expected to generate 3,000 or more average daily trips or 1,500 vehicles per day.
- During any one hour time period of any day of the week, the development is expected to generate 100 or more vehicle trips entering the development or 100 or more vehicle trips exiting the development.
- For existing sites being redeveloped the site is expected to generate 100 or more additional trips entering or exiting the development during anyone-hour time period of any day of the week.
- In the opinion of the Department, the development or redevelopment is expected to have a significant impact on highway safety or traffic flow, even if Study Warrants 1, 2, or 3 above are not met.

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In determining the need for a TIS, the applicant is to assume only one access point. If the development has multiple stages or phases, the warrant for a TIS shall be based on new trips generated at full build out of the development.

#### Transportation Impact Assessment Warrants

If the warrants for a TIS are not met, the District Permits Manager or Traffic Engineer may require the preparation of a Transportation Impact Assessment (TIA).

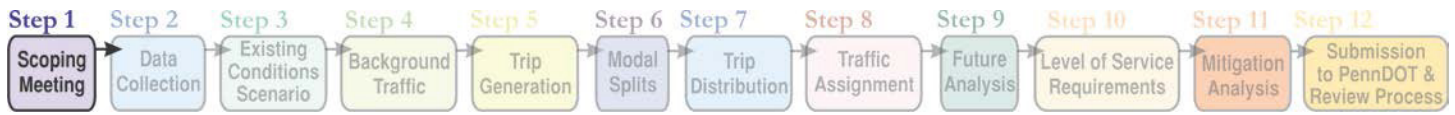
Factors in determining if a TIA is necessary include but are not limited to, location of proposed access and site configuration, congestion and delay of surrounding roadway network, and/or safety concerns.

The TIA must be conducted under the supervision of a person who possesses a current Professional Engineer's (PE) license issued by the Pennsylvania Department of State and preferably possessing a Professional Traffic Operations Engineer (PTOE) certificate. The TIA must be signed and sealed by PE licensed in Pennsylvania.

The purpose of a TIA is to assess the impact of the application on specific intersections or elements of the state transportation system.

As such, the scope of a TIA will be limited and targeted to the concern of the Department or the municipality; it would generally be limited to an opening year analysis. An example of a TIA would be to determine the best access plan for a corner property that would not generate traffic sufficient to warrant a TIS but could impact queuing patterns at the intersection. A TIA should be prepared at the same point in the application process as a TIS and in the same manner as a TIS, as applicable.





## STEP 1: PREPARE AND ATTEND A TIS SCOPING MEETING

### Purpose

The purpose of the Scoping Meeting is for the applicant to receive direction from the Department and municipality regarding the elements that should be included in the Transportation Impact Study (TIS), and guidance for the applicant's engineer to perform the analysis and complete the study. The study area shall be identified, including all intersections and roadways to be evaluated.

At the meeting, concurrence should be reached on the scope of the study, trip generation, methodology for trip distribution, analysis years, and growth factors. The applicant will also receive information from the Department regarding any known and/or foreseeable issues associated with the project location or proposed improvements. It is expected that the applicant will submit a TIS to the Department within a reasonable time after the Scoping Meeting is held.

Applicants may request to submit to the Department a Preliminary TIS for larger projects in which the project's data collection and trip forecasting elements are provided prior to addressing operations and mitigation options.

### Land Development Process Status

A scoping meeting for the TIS should be held with the Department early in the land development process. Ideally, a scoping meeting should be held during the sketch plan phase of the land development process if one exists for the municipality involved. It is noted that not all municipalities require a sketch plan phase. Therefore, the scoping meeting should be held as early as possible, typically in advance of the preliminary land development submission to the municipality.

Figure 2 illustrates the relationship between the HOP process and the land development process.

The goal is to insure that the land development approval and HOP approval are timely and consistent with the development review times specified in the [PA Municipalities Planning Code](#).

In addition, the Department recommends that applicants submit a TIS to the Department simultaneous with the submission of the same TIS to the municipality.

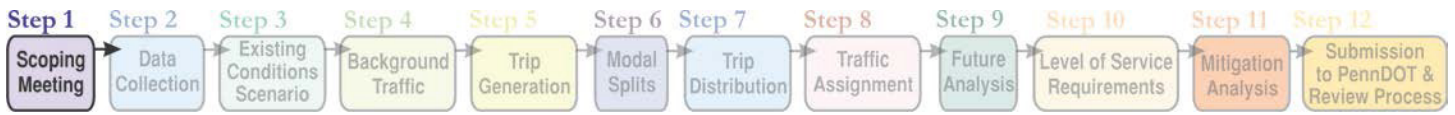
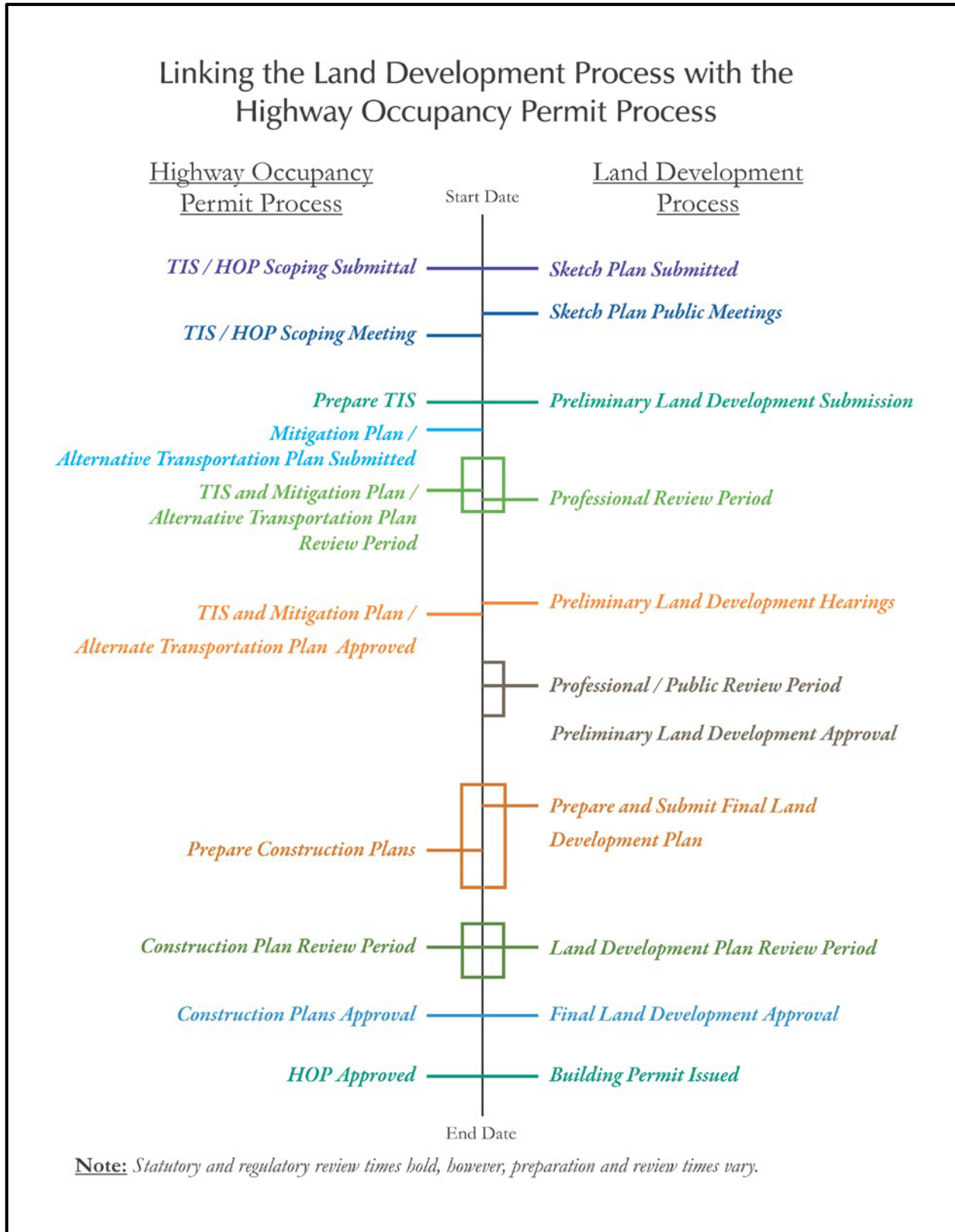
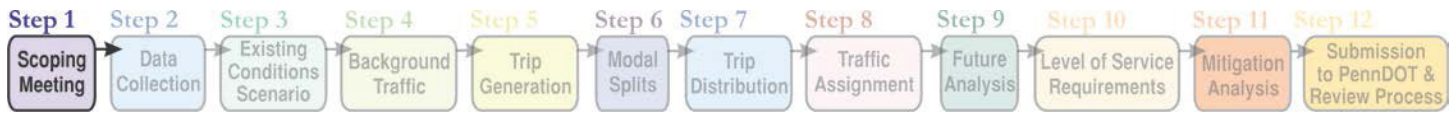


Figure 2: HOP & Land Development Process





## Scoping Meeting

All applicants are required to initiate the process of scheduling a scoping meeting through the District Permit Manager with the appropriate District Office. To determine if a meeting is appropriate, the applicant must submit a completed Scoping Meeting Application via PennDOT's EPS and copy the municipality and the county planning office on the correspondence. After review of the scoping meeting application, the Department will promptly notify the applicant if a scoping meeting is required.

It is the applicant's responsibility to invite the developer, its engineer, municipal representatives, as well as other agencies such as local transit authorities, MPOs or RPOs within the proposed study area limits to the scoping meeting, and obtain all information required at the meeting.

The applicant is required to notify the Department if it intends to bring legal counsel to the scoping meeting so that the Department may have appropriate legal representation. If the applicant has legal counsel in attendance at the meeting and has not provided the Department advance notification, the meeting may be rescheduled or cancelled.

The applicant is responsible for developing meeting minutes and distributing them to attendees within 7 business days of the meeting.

The District HOP Manager will be responsible for inviting the appropriate District personnel (i.e., Traffic Unit, Design Unit, Bridge Unit, Right-of-Way Unit, etc.) as well as Office of Chief Counsel (OCC), and/or FHWA or other agencies depending on the scope of the project.

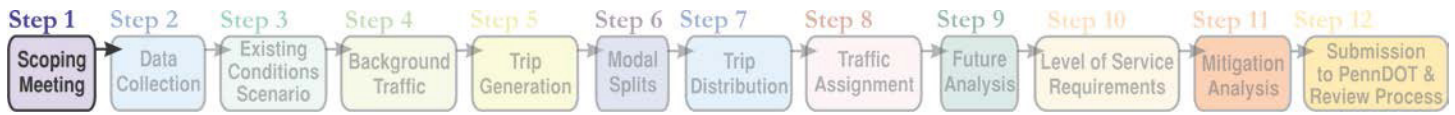
## Preparation for the Scoping Meeting

Preparation should involve discussion with municipal officials as well as public transit providers regarding multi-modal transportation issues and the need to enhance the transportation network for the community. Permits for driveways will be evaluated on their ability to safely and efficiently function as an integral part of the highway system.

The ability of a driveway to safely and efficiently function as an integral component of a highway system requires that its design and construction be based on the amount and type of traffic that it is expected to serve and the type and character of roadway which it accesses.

The evaluation of the driveway will consider these elements.

Elements of the Scoping Meeting Agenda should be prepared in a concise format for meeting review purposes and all elements should be discussed at the meeting, as applicable. See Attachment B.



Most items in the scoping meeting agenda should be familiar to transportation professionals or can be found in the ITE Recommended Practice for Traffic Access and Impact Studies for Site Development.

A five-mile radius map for regional overview and a local area map shall be prepared as well as preliminary trip generation/distribution information. The purpose of the five-mile radius map is to provide an overall regional perspective of the area. Within a one-mile radius of the study area, any readily available information such as volumes, intersection controls, or planned developments should be indicated on the map to assist in providing an overview of the roadway network of the area.

### Study Area

Determining the extent of the study area is a critical task. It requires a working knowledge of the area of the development; the type and intensity of the development; an understanding of the current transportation conditions and functionality of the existing roadways in the vicinity of the development.

The limits of the site property under control of the developer and proposed site access locations shall be indicated on the map as well as the applicant's proposed study intersections and roadways. This map shall be used to reach concurrence on the proposed study area scope. Guidance is provided in [ITE, Transportation Impact Analyses for Site Development, Chapter 2](#) on the selection of study intersections. The applicant shall prepare a list of intersections proposed for study prior to the meeting.

### Approval of Analysis Years/Growth Rates

Analysis years for the TIS shall be agreed upon at the scoping meeting. Based on ITE Recommended Practice for Traffic Access and Impact Studies for Site Development, the Department will require three analysis years in the TIS:

1. Existing Analysis for baseline perspective.
2. Opening Year Analysis. Opening year should be assumed to be the last phase of construction (build-out).
3. Design Horizon Year Analysis. The Design Horizon Year shall be assumed to be 5 years after the Opening Year.

*For projects involving FHWA review (i.e., projects involving the interstate), a determination of the design horizon year shall be based on input from FHWA and will generally be longer than 5 years.*

Projects involving multi-phased development may require additional analysis, and the analysis of opening years after each major phase should be considered (Figure 3).

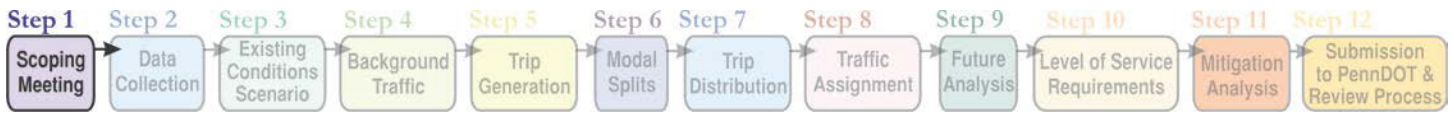
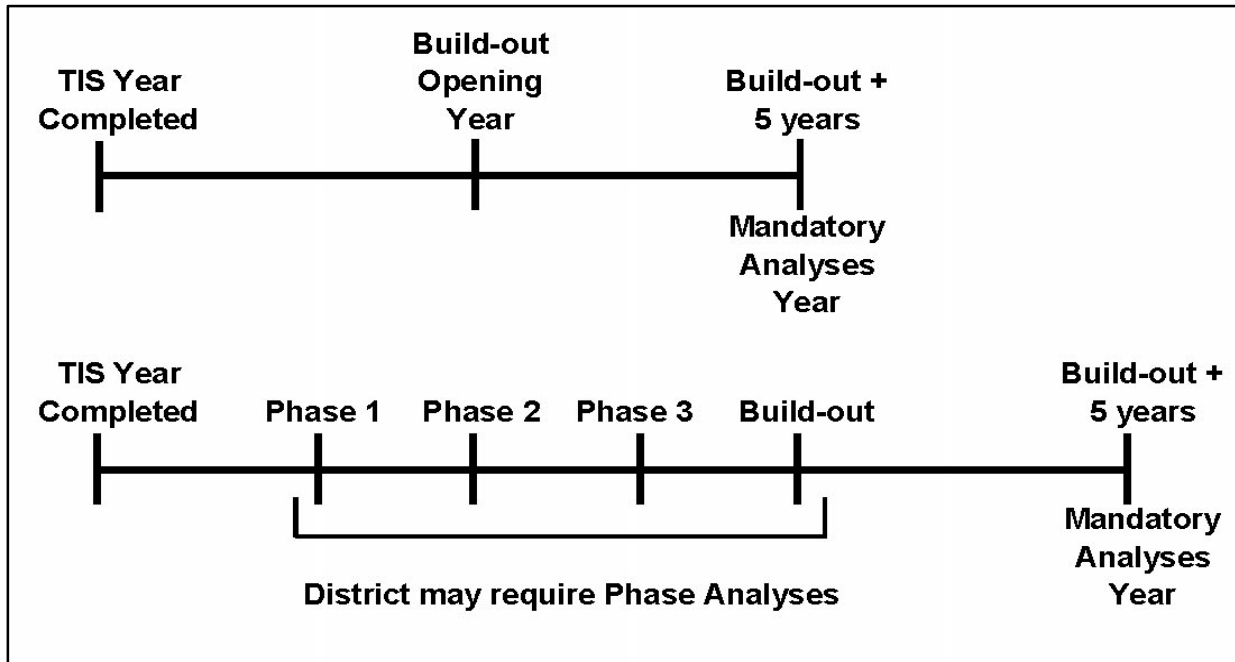


Figure 3: Mandatory Analysis Diagram



The objective for additional analysis is to provide a clear view of transportation system operations, given the characteristics of the future development of the site and study area.

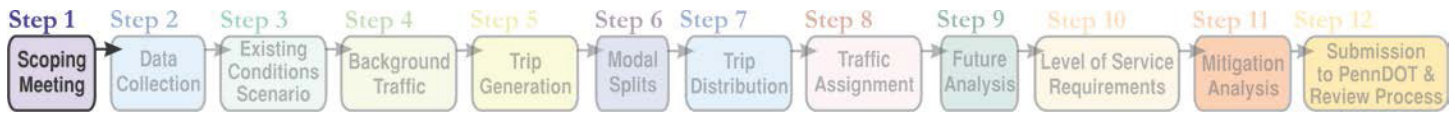
Growth factor assumptions shall be agreed upon at the scoping meeting. The background growth factor should be obtained from any of the following three sources:

1. The Department District Permit Office (to be generated from the Department’s Bureau of Planning and Research).
2. The Metropolitan Planning Organization (MPO) or the Rural Planning Organization (RPO) covering the study area, or
3. Other Department approved method.

Growth factors obtained from the Department shall be applied as an annually compounded growth rate to reflect the proposed traffic conditions at Opening Year and the Design Horizon Year. Growth factors obtained from MPO or RPO’s shall be applied in a compounded or linear fashion as directed by the MPO or RPO and concurred by the Department.

Land Use Context

The applicant must evaluate the existing “land use context(s)” of the study area surrounding the subject property, and whether the proposed land use will alter the land use context. The Department will approve the land use context at the Scoping Meeting.



Land use context is important in determining the ideal roadway design. It provides guidance on aspects such as roadway design, travel lane width, on-street parking, and on the types of landscaping and lighting provided. It also plays a role in suggesting the desired operating speed.

*Land use context, roadway classification and desired operating speed shall be evaluated by the applicant. However, the Department, with input from the municipality, shall make the final determination of land use context, roadway classification and desired operating speed.*

Land use context is a unique combination of different land uses, building density, and other features. There are seven different land use contexts, in order of intensity: rural, suburban neighborhood, suburban corridor, suburban center, town/village neighborhood, town center, and urban core. For more information on land use context, See [PennDOT "Design Manual Part 2"](#) Chapter 2.

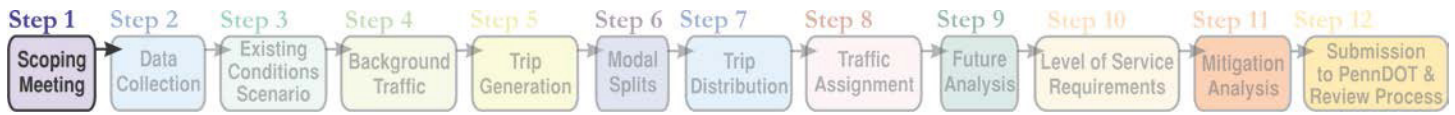
### Roadway Classification

The applicant must document and provide data for determination of the “functional classification” and “type” of all roadways adjacent to the subject property in the TIS. The Department will approve this information at the Scoping Meeting.

The functional classification – principal arterial, minor arterial, major collector, minor collector, local - can typically be determined by checking the [Department’s Functional Class Maps](#). These maps identify the functional classification for all state roadways and occasionally important local or county owned roadways.

As defined by [PennDOT "Design Manual, Part 2"](#), Table 1.2, the “roadway typologies” is an overlay on the conventional functional classification system, which describes the role played by the roadway within the larger community. In the case of an arterial, is the roadway more important in accommodating regional traffic movements, or in accommodating motorists on trips to businesses, schools or other destinations in the area? If the former, the roadway type might be a “regional arterial”; if the latter, it might be a “community arterial.” Typical running speed on the roadway, intensity of access points, and knowledge of travel patterns on the roadway (use of the roadway by motorists conducting regional trips) should all be evaluated when determining the roadway type.

After documenting the existing roadway type, the applicant should evaluate whether any planned transportation projects, or major land use developments, have the potential to change the roadway type in the future.



### Desired Operating Speed

[PennDOT "Design Manual, Part 2"](#) formally defines desired operating speed as the speed at which drivers are observed operating their vehicles during free-flow conditions. The 85th percentile of the distribution of observed speeds is the most frequently used measure of the operating speed associated with a particular location or geometric feature. The Department will evaluate the desired operating speed on state roadways adjacent to the development if requested by municipal officials. All such requests should indicate the proposed desired operating speed. Refer to the existing operating speeds and crash history, and describe the benefits to existing and projected roadway users from the proposed desired operating speed. The applicant may be requested by the Department to provide data for this evaluation and the municipality may be required to address any changes to the regulatory posted speed. The Department will make the final determination on desired operating speed and posted speed for all state roadways.

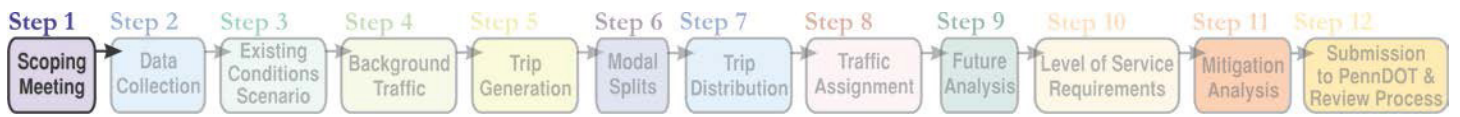
It should be noted that for purposes of determining sight distance at proposed driveways, existing roadway conditions/speeds should be utilized in accordance with [67 PA Code Subsection 441.8\(h\)](#).

### ADA Compliance

The applicant must comply with all pertinent federal and state legislation and regulations on accommodating pedestrians with disabilities. These laws and regulations are summarized in Chapter 6 of [PennDOT "Design Manual, Part 2"](#), and include the Americans with Disabilities Act of 1990; the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG); and the [Draft "Public Right of Way Accessibility Guidelines \(PROWAG\)"](#).

*Applicants must adhere to a core principle of ADA; if pedestrian facilities are provided, these must be accessible to persons with disabilities.*

ADAAG focuses on facilities at sites, but its guidance is also applicable to public right-of-way. Although PROWAG is a draft, the Department uses these Guidelines as a best practice for public right-of-way where ADAAG is silent or inapplicable.



Sidewalks are the most visible pedestrian facilities, and curb ramps are regarded as an integral part of the sidewalk system.

New construction projects with pedestrian needs will routinely accommodate persons with disabilities. When applicants alter existing transportation facilities as part of mitigation, the facilities must accommodate persons with disabilities if it is feasible.

Both DM-2 and PROWAG offer examples of common questions and answers on when ADA-compatible facilities must be provided as part of alteration projects, and applicants are encouraged to review these sections prior to submitting the Scoping Meeting application and preparing the TIS.



*Photo 1: ADA Ramp*

For additional information related to ADA requirements, refer to ["Publication 72M Roadway Construction Standards"](#) and ["Publication 149, Traffic Signal Design Handbook"](#).





## STEP 2: DATA COLLECTION

Preparation of the Transportation Impact Study (TIS) will involve data collection, which is the sole responsibility of the applicant. Review of previous studies and inclusion of data gathered for other studies may be acceptable to the Department provided:

- The data is not greater than 3 years old when the TIS is submitted to the Department and
- Traffic volumes or patterns have not significantly changed.

### Volume Counts/Data

Traffic volumes shall be obtained through data collection efforts at locations and times agreed upon during the scoping meeting.

It is required that new data obtained from 24-hour automatic traffic recorder counts include classification and speed data unless modified at the scoping meeting.

New data obtained from turning movement counts shall incorporate heavy vehicles, pedestrian and bicycle data. Transit vehicles shall also be reflected in traffic counts if present. Walking school children and school bus stops shall also be noted.

For information related to peak hour factors and multi-period analyses, applicants should refer to "[Publication 46, Chapter 10](#)". As directed by the District at the scoping meeting, traffic volumes along corridors should be balanced between intersections when appropriate.

At intersections, pedestrian activity as well as pedestrian accommodations should be recorded and reflected in the TIS. If regular pedestrian activity surpassing 15 pedestrians per hour is observed at midblock crossings in the study area these locations should be counted as well.

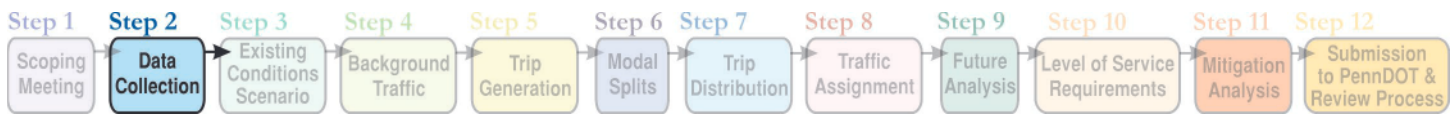
A high number of bicyclists riding on the sidewalk should be documented, as this may indicate the need for additional facilities.

Roadway data shall be collected including speed limits, grades by approach, lane geometry (widths/shoulders). Information should be included in the TIS in the form of field sketches, existing signal permit plans, or tabular format.

The method of data collection as well as seasonal adjustments if required and balancing shall be summarized in the TIS report.



*Photo 2: Pedestrian Activity*



## Land Use Context

As discussed in Step 1, Scoping Meeting, the applicant must document the land use context of the subject property, and along key area roadways.

Using the written description of land use contexts in [PennDOT "Design Manual, Part 2"](#),

*Certain areas may have characteristics common to more than one land use context, and other areas will be hard to identify. The applicant should identify the land use context that seems most representative of a roadway segment as whole. Land use contexts should not be defined in too fine a manner; avoid segments of less than 600-feet in length.*

the applicant should first conduct a “windshield screen” field view along roadways in the study area and identify the different land use contexts present prior to the Scoping Meeting. If the land use context is not obvious from initial field views, the applicant can use aerial photographs and municipal zoning ordinances.

## Sight Distance and Site Access

Adequate sight distance at existing and proposed intersections and driveways is critical to safe traffic operations within the study area. The applicant shall conduct sight distance measurements at locations agreed upon during the Scoping Meeting.

Intersection sight distance, stopping sight distance, and existing/measured sight distance at the access locations shall be provided in the TIS. Sight distance shall be obtained and measured in accordance with Chapter 2 of this publication (Publication 282).

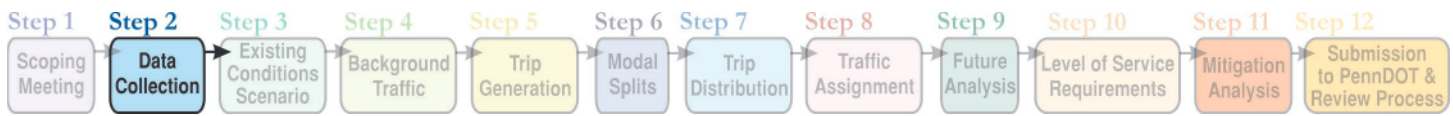
Applicants should utilize form [M-950S](#) which provide uniform methods for measuring and documenting actual driveway sight distance measurements.

## Photographs

Photographs should be obtained at all study intersections and proposed access driveways and labeled appropriately. It is recommended that two views be taken of each approach for intersections:

1. Approximately 200-feet from the intersection to provide an overview of the approach including pavement markings, shoulders, trees, and overall study area context and
2. Approximately 50-feet from the intersection and show the opposite approach.

Photographs should take into consideration elements such as horizontal/vertical alignment of roadways, trees, buildings or other roadside objects, pavement markings, drainage, signal heads & placement. Color photos reproduced at a 4"x6" size is recommended.



## Crash Data

Crash data for the study area shall be obtained as agreed upon at the scoping meeting. The most recent five years of crash data for each approach route should be obtained.

The applicant shall analyze the crash data to determine if there are any crash patterns within the study area. The applicant should also contact the municipality for input regarding non-reportable crashes. Analysis of the crash data should include review of causation factors and patterns. The Department will provide:

- a Crash Summary Report,
- a Crash Resume Report,
- a Crash grouped by Segment Report, and
- the current Statewide Homogeneous Report.

To request this information, contact the District Safety Engineer within the appropriate District Traffic Unit. Include the analysis of the crash data in an Appendix that is to be submitted under separate cover and sealed. Crash data is not for public consumption and is exempt from the Right to Know Law requests.

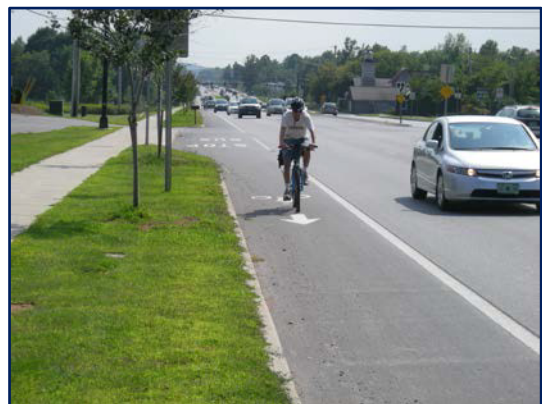
Additional information on the analysis of crash rates can be found in the [Appendix of "Publication 212, Item 2\(1\)"](#) and ["Publication 46, Chapters 11.1 and 11.3"](#).

## Pedestrian/ Bike/ Transit Facilities

Utilizing the checklist located in [Publication 10X, "Design Manual Part 1X"](#), Appendix S, the applicant shall identify any existing or proposed pedestrian or bicycle facility that would be affected by the proposed development.

Pedestrian facilities include sidewalks, intersection treatments, and off-road paths or trails. Bicycle facilities include on-street bike lanes, paved shoulders, and off-road paths or trails.

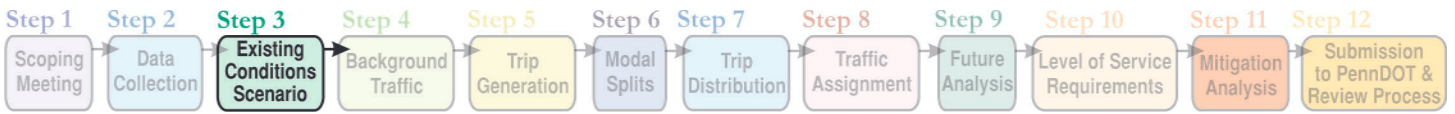
The applicant shall note any impact on pedestrian and bicycle facilities and shall also note any impact on the ability of pedestrians to cross roadways within the study area, both at intersections and at identified common mid-block crossings.





The applicant shall identify any existing transit facility that could be affected by the proposed development. At a minimum, this shall include any bus routes within  $\frac{1}{4}$  mile of the development, and any rail centers within  $\frac{1}{2}$  mile of the development.

The applicant shall also describe how the proposed development was designed to accommodate pedestrians, bicycles, and transit operations.



### STEP 3: EXISTING CONDITIONS SCENARIO

The applicant shall document existing transportation conditions within the study area, including, but not limited to volumes, capacity and level of service analysis, and crash analysis. In addition, the existing conditions shall discuss multimodal transportation such as bicycles, pedestrians and transit and describe existing facilities or lack thereof.

If pedestrian facilities are provided, a discussion of ADA compliance is appropriate.

Level of Service data shall be presented in the format as shown in Table 1. Some TIS may require gap studies, queue analysis and/or travel time studies which are further detailed in Attachment D.

Copies of existing permit plans for signals, flashing warning devices, or in-road warning lights within the study area shall be obtained and included in the report as outlined in Attachment C.

Capacity analysis shall be conducted utilizing appropriate traffic engineering software approved by the Department’s Traffic Resources Education and Computing Support Group, as identified in “[Publication 46, Chapter 12.2](#)” and agreed to at the scoping meeting.

Table 1: Levels of Service Table sample

SAMPLE TABLE: LEVEL OF SERVICE										
AM/PM PEAK		AM PEAK								
INTERSECTION		NORTH ROAD & EAST STREET								
EAST STREET										
Direction	Approach / Movement	Existing	Opening Year - With Out Development	Opening Year - With Development	Opening Year - With Development with Mitigation	Design Year - With Out Development	Design Year - With Development	Design Year - With Development with Mitigation		
Eastbound	Left Turn	C(29.6)	D(35.5)	E(66.6)	B(16.5)	F(94.2)	F(148.5)	D(49.1)		
	Through				B(18.9)			D(38.3)		
	Right Turn									
	Approach	C(29.6)	D(35.5)	E(66.6)	B(18.7)	F(94.2)	F(148.5)	D(39.2)		
Westbound	Left Turn	C(23.0)	C(26.6)	C(31.8)	C(25.4)	E(78.7)	F(93.1)	C(34.2)		
	Through				B(14.2)			C(21.5)		
	Right Turn									
	Approach	C(23.0)	C(26.6)	C(31.8)	B(15.1)	E(78.7)	F(93.1)	C(22.5)		
NORTH ROAD										
Northbound	Left Turn	C(22.3)	C(22.5)	C(24.2)	C(24.2)	C(24.6)	C(26.7)	C(26.7)		
	Through									
	Right Turn									
	Approach	C(22.3)	C(22.5)	C(24.2)	C(24.2)	C(24.6)	C(26.7)	C(26.7)		
Southbound	Left Turn	B(18.3)	B(18.3)	B(18.9)	B(18.9)	B(18.7)	B(19.4)	B(19.4)		
	Through									
	Right Turn									
	Approach	B(18.3)	B(18.3)	B(18.9)	B(18.9)	B(18.7)	B(19.4)	B(19.4)		
	OVERALL	C(25.6)	C(29.7)	D(45.8)	B(17.8)	E(77.2)	F(106.8)	C(30.2)		



## STEP 4: BACKGROUND TRAFFIC

### Growth Factor Traffic

Analysis years for the TIS shall be as agreed upon at the scoping meeting. As discussed in Step 1: Scoping Meeting, three analysis years will be required for the TIS: Existing, Opening Year and the Design Horizon Year. Any additional analyses as requested at the scoping meeting shall be included.

Future traffic volumes at Opening Year and the Design Horizon Year shall be projected by applying growth factors as determined in the scoping meeting to existing base traffic volumes.

### Planned and Permitted Development

In addition to background growth, planned and permitted developments in the area that will impact the transportation study area should be evaluated, and appropriate traffic added to the future analysis scenarios.

Projects that shall be considered include permitted developments for which HOPs have been issued.

The applicant, with input from the municipal officials, should identify any planned developments in the region that have potential to impact conditions within the study area. The applicant and municipality may recommend the TIS include planned development projects which have been reviewed by the Department, even if an HOP has not yet been issued.

The study should indicate if the planned development(s) is consistent with any formal land use plans such as comprehensive plans, congestion management plans, or Act 209 Traffic Impact Fee/Capital Improvement plans.

The Department will approve the planned developments to be included in the TIS at the scoping meeting. Traffic from these developments may also be requested to be added to future analysis scenarios.

Background traffic growth shall be documented and presented in the TIS Appendix as noted in Attachment C.



## STEP 5: TRIP GENERATION

### Trip Generation

Trip generation is defined as the total number of trips going to and from a particular land use on a specific site during a specific time period. For sites in suburban and rural contexts, and for many sites in urban contexts, vehicular trips will typically account for the large majority of trips. Trips by public transit, bicycles, or by foot may be important components of trip generation in urban contexts, sites that have regular access to transit routes or other multi-modal facilities, or for special traffic generators.

*The traffic characteristics of a proposed development are estimates of the following transportation attributes:*

- *Trip Generation: How much traffic the site will add to the surrounding transportation network.*
- *Trip Distribution: Where the trips arriving at the site originate from.*
- *Modal Split: What mode(s) of transportation is used to reach/depart the site.*
- *Trip Assignment: What route(s) are used to reach/depart the site?*

The Department has accepted the most current ITE "Trip Generation Handbook" and its updates for the development of trip generation. Instructions on the use of the data and step by step methodologies for estimating vehicular trips are described in the publication. The Trip Generation Handbook also provides guidance for the conversion of vehicular trips to person trips so that internal capture, walking trips, bicycle trips, and transit trips can all be accounted for before reaching a vehicular trip generation if the situation dictates.

As part of the scoping meeting, applicants are required to receive Department concurrence and approval on the land use codes and trip generation methodology used for the proposed site. Applicants should be prepared to describe the site's characteristics (urban, infill, etc.), identify transit and multi-modal accommodations or deficiencies, and justify the reason for selection of the analysis approach.

Convenience Markets with Gasoline Pumps, applicants should refer to Attachment G for additional guidance.

Figure 3.1 from ITE's "Trip Generation Handbook", 3<sup>rd</sup> Edition is recreated below for reference. This analysis approach determines if traditional trip generation methodology simply using ITE's generation rates or equations is acceptable, or if the more in-depth methodology converting to person trips is required. The following items may trigger the need for the enhanced methodology:

- The site is located in an urban area or classified as infill



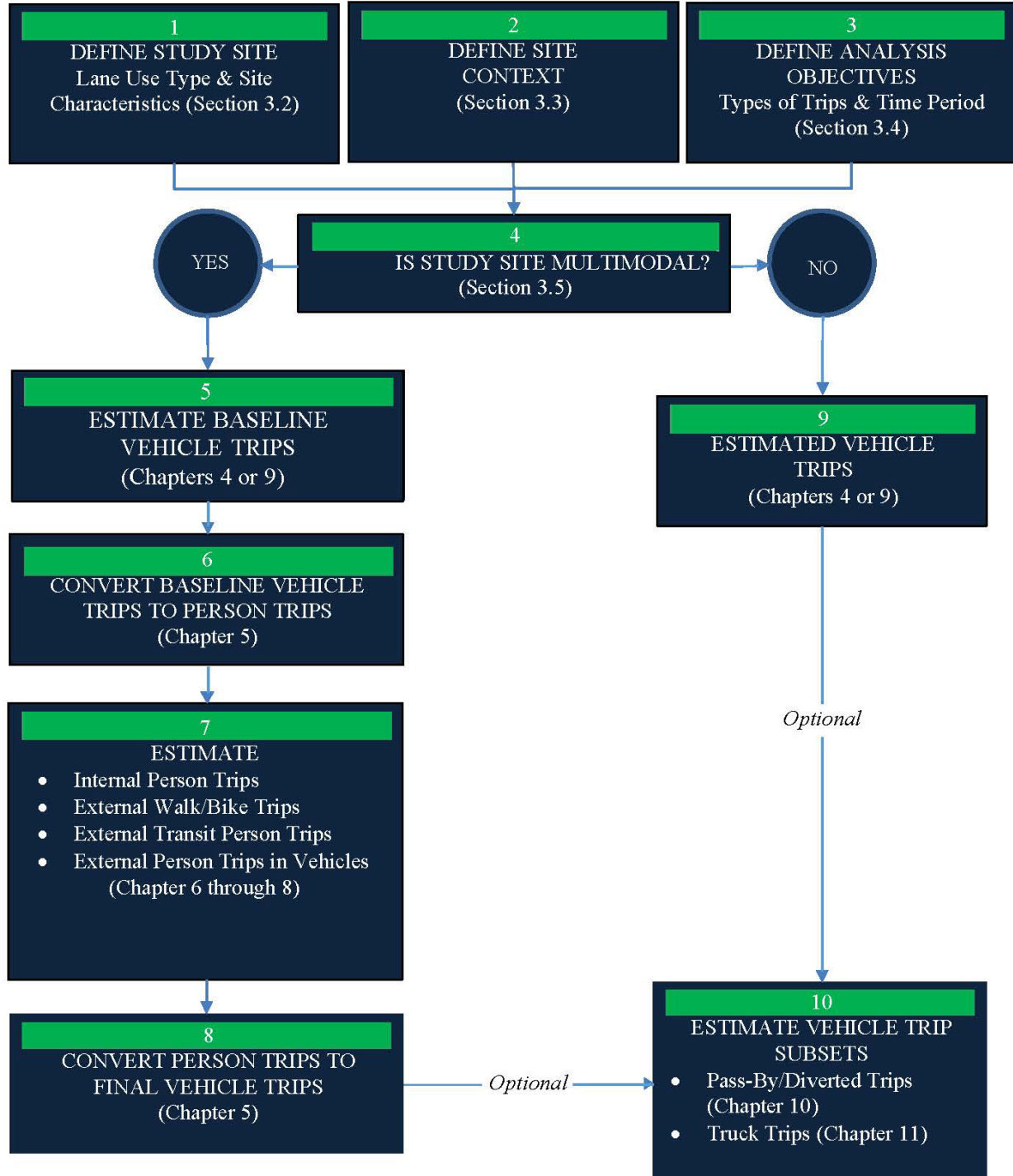
- The site has access to frequently used and regularly arriving/departing transit
- Multi-modal paths or accommodations are present in the area
- Significant pedestrian activity is present
- The site has multiple uses that will require the evaluation of internal capture

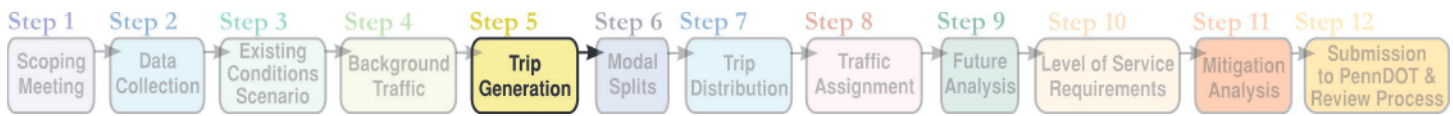




**Analysis Approach for Estimating Site Trip Generation (Figure 3.1 - Trip Generation Handbook)**

All Chapter and Section references are intended for ITE's Trip Generation Handbook





## Local Trip Generation Study

*Before using local data or a source for trip generation data other than contained in Trip Generation, concurrence of the District Traffic Engineer and approval of the Central Permit Office Manager are required.*

Localized trip generation may be requested by the applicant, municipality, or Department.

In general, local data should be collected in the following circumstances:

- The study site is not compatible with or does not relate to an ITE land use code definition.
- Local data must be collected when five or fewer data points are contained in the plot.
- The weighted standard deviation for the average rate is greater than 55% of the weighted average rate.
- The independent variable does not fall within the range of data in trip generation.
- Neither the weighted average rate line nor the fitted curve falls within the data cluster for the size of the development.

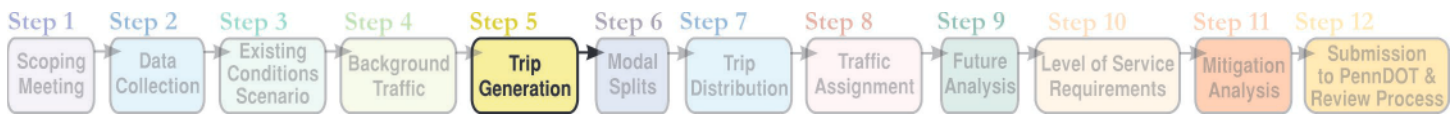
If local data is to be used, the applicant should submit a Trip Generation Study request, documenting the reason that local data is needed, and a plan of study developed in accordance with the ITE “Trip Generation Handbook”.

The following guidelines, as applicable, should be followed when seeking approval to conduct a Trip Generation Study:

- Trip Generation Study requests shall be made directly to the District Permit Office.
- The District Office will review and forward the request with recommendation to the Central Permit Office for consideration.
- Trip Generation Study requests must be made prior to conducting the actual study.
- The request should be made by the industry representing the land use type, (i.e., if the trip generation study is being requested for a bank, a representative from a bank or banking group shall apply for the study request).
- If determined necessary, the requesting party will meet with the Central Permit Office (CPO), the District Permit Office, and District Traffic Engineer to discuss the following:

- Selection of land use to study
- Scope of the study
- Site selection
- Sample size determination

*It is recommended that the applicant submit Trip Generation Study Approval requests in advance of the TIS scoping meeting. If a plan of study has not been established at that time, the applicant may make the request at the scoping meeting or as part of the formal TIS.*



- Independent variable selection
  - Development data requirements
  - Survey periods
- The study must be conducted and documented as per the methodology outlined in the ITE “Trip Generation Handbook”.
  - The applicant understands that the Department may forward the study data to ITE.
  - Statewide approval, if granted, will be limited in duration, generally until a new edition to the ITE “Trip Generation Manual” is published.
  - The requesting entity/analyst understands that the approved trip rates may be made available for use to other interested parties for a similar land use development.

Although a proposed development might correspond to an ITE land use code with adequate data points in the ITE “Trip Generation Manual”, if the Department has reason to believe that site trip generation will vary from ITE rates, it may allow the applicant to collect data at comparable sites.

### Internally Captured Trips at Multi-Use Developments

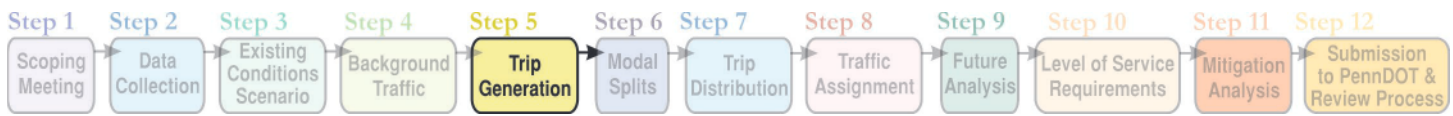
A multi-use development is a single development project that consists of two or more land use classifications and contains an internal roadway network such that trips can be made between the different land uses without leaving the site. Trips between land uses within the development are considered internally captured trips.

For multi-use developments, the Department requires use of the methodology contained in the ITE “Trip Generation Handbook” and using the NCHRP 684 Internal Trip Capture Estimation Tool spreadsheet as provided by ITE ([Link to Spreadsheet](#)). The ITE data set is not sufficiently large, and the Department may therefore request the applicant to conduct observations at a similar site in the region, in accordance with the cautions contained in the Handbook. The applicant must submit all worksheets used to calculate internally captured trips.

It is important to note that any site that will have internal capture characteristics must use the left side of Figure 3.1 from the ITE “Trip Generation Handbook” (Steps 5-8). This requires the conversion of baseline vehicular trips to person trips before removing the internally captured trips and converting back to vehicle trips.

### Pass-by Trips

Pass-by trips include vehicles already on the roadway that pass by the commercial site as an intermediate stop on a primary trip. They exit the site and continue travel in the same direction from which they entered. As such, they are driveway trips but not new trips



generated by the proposed development. Pass-by trips are estimated using the methodology in the ITE “Trip Generation Handbook” and are applied in Step 10 of Figure 3.1.

### Diverted Link Trips

Diverted Link Trips are trips already on the larger roadway network that are diverted from their primary route to the proposed development via other roadways leading to the site. They are considered new trips on the roadways immediately adjacent to the site. Diverted Link Trips are estimated using the methodology in the ITE “Trip Generation Handbook” and are applied in Step 10 of Figure 3.1.

### Existing Sites Being Redeveloped

The Department encourages redevelopment of existing sites in order to discourage sprawl. In cases in which an existing site is being redeveloped, the Department may consider permitting trips being generated by the existing development be applied to the proposed redeveloped site as a “trip credit”.

The number of “trip credits” to be applied will be determined on a case-by-case basis as part of the scoping meeting. The Department waives none of its powers or rights to require the future change in operation, removal, relocation, or proper maintenance of any access within the State highway right-of-way.

### Business Transportation Demand Management

Vehicular trips may be reduced for businesses up to 2% of trips if they have committed to a Transportation Demand Management (TDM) program, provided that the business enters into a legally enforceable agreement, such as a developers’ agreement with the local municipality, with a guarantee that the mitigation measures will be implemented. The credit for the TDM program depends upon the number of TDM strategies that the business is willing to implement. This trip reduction, if used, should be applied in either Step 5 or Step 9 of Figure 3.1 from the Trip Generation Handbook.

The options are:

- Parking pricing (employees must pay share of parking expense)
- Telecommuting
- Compressed/ Flexible Work Schedule
- Guaranteed Ride Home
- Locker and showers, and place to store bikes



- Car-sharing or car-matching services
- Free transit pass

The business may reduce trips by 2.0% if at least four of the elements listed above are part of the TDM program and may reduce trips by 1.0% if three elements are part of the TDM program.



## STEP 6: MODAL SPLITS

### Standard Assumptions for Alternative Trips

This section recognizes the potential for non-vehicular trips and offers “standard assumptions” for the modal split of alternative trips provided that pedestrian, bike, and transit-friendly characteristics are present.

Factors that lend themselves to a greater number of non-vehicular trips include presence

*If applicants can provide documentation indicating that the percentage of trips conducted via alternative modes will be even greater than shown below, such documentation may be considered by Department. Cities such as Pittsburgh and Philadelphia have transit studies that may be used and considered by the Department.*

*Applicants shall discuss the use of modal splits during the Scoping Meeting and obtain concurrence from the Department.*

of pedestrian, bike, and transit facilities; high density; mix of land uses in close proximity; good roadway connectivity; promotion of alternative trips (through work trip demand management programs); price of parking; and other factors.

The methodology presented in ITE’s “Trip Generation Handbook” should be utilized for modal splits. This process utilizes the left side of Figure 3.1 of the Handbook and converts vehicular trips to person trips before applying reductions for walking,

biking, or transit riding. Sites that are located in urban areas, are infill developments, or some suburban corridors may require the analysis of modal splits.

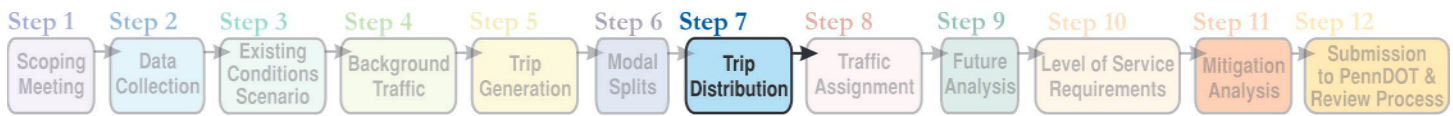
### Baseline Mode Share Assumptions

In Section 5.5.2 of the ITE “Trip Generation Handbook”, it states that most situations have at most 5% of person trips accessing a site doing so by walking, biking, or transit. This percentage is the maximum that can be used for most of the state. Locations in Pittsburgh and Philadelphia may be an exception to this allowance and exceed this mode share percentage.

All mode share reductions, even if less than or equal to the 5% allowance in the Handbook, should be documented and justified in the TIS. Refer to Section 5.5.2 of the Handbook for more guidance with mode sharing.

Photo 4: Roadway Connectivity





## STEP 7: TRIP DISTRIBUTION

Estimating the arrival and departure pattern of traffic to a site requires knowledge of:

- Transportation system (e.g., location of the major roadways, parking facilities and the traffic patterns of those roadways);
- Turning movement data at adjacent driveways or streets with similar traffic characteristics to the proposed site (e.g., if analyzing a proposed residential development, study the driveway of an adjacent residential development);
- Travel times in and around the proposed development; and
- Availability of public transportation and pedestrian accommodations.

*The Department typically prefers the following distribution models to be used with these certain land uses:*

- *Residential – gravity model based upon place of employment (US Census data);*
- *Commercial – gravity model based upon a market sector study prepared by a professional marketing firm retained by the developer;*
- *Employment center – gravity model based upon place of residence (US Census data); and,*
- *Existing institution (hospital, school) to be relocated or expanded – use existing employee zip code data for employees, and use US Census place of residence data for clients or students.*
- *MPO/RPO or local municipal model*

For business land uses, applicants should analyze the place of residence for employees using employee zip code data.

For retail goods and services, applicants should consider the prospective market area (e.g., where the anticipated customers live).

Once the available data has been collected, the applicant should select the appropriate trip distribution model.

Justification for use of the trip distribution model should be provided in the TIS. In addition, all supporting assumptions and calculations shall be included in the TIS to ensure that the trip distribution calculations can be verified by the Department.

Figures for trip distribution shall be provided as outlined in the Attachment C.

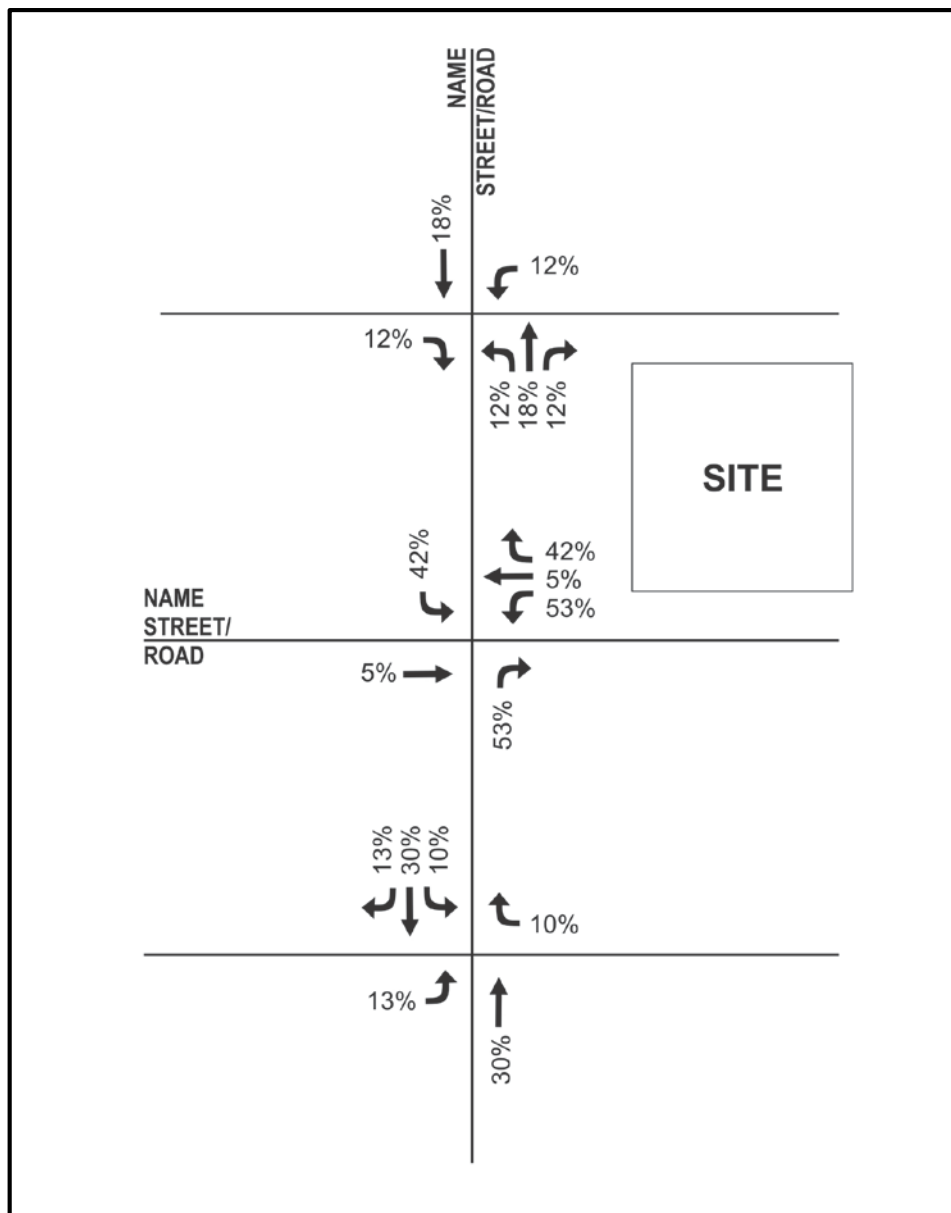


## STEP 8: TRAFFIC ASSIGNMENT

The applicant must provide a brief description of the proposed project including access with proposed permissible movements, and distance to nearby intersections. This information, combined with the site related trips, is used to assign and distribute trips onto the roadway, pedestrian and transit networks as well as driveway access point(s). The Department requires the assignment of vehicular traffic to be based upon travel time (quickest route), reflecting left turn and signal delays.

Trip assignment diagrams indicating the trip assignment percentages and volumes are required to be included in the TIS (Figure 4).

Figure 4: Trip Assignment Percentage Example







## STEP 9: FUTURE ANALYSIS

Future Year traffic volumes shall be generated for the study area, along with a spreadsheet clearly indicating the baseline traffic growth volumes and traffic generated by planned or approved projects in the study area. A traffic volume figure depicting the Future Year Volumes and roadway conditions shall be provided as indicated in the Attachment C.

### Without Development Future Year

The applicant shall conduct an analysis of the Without Development Future Year scenarios. Without Development Future Year analyses shall be calculated using the same methodology as the Existing Conditions Scenario.

Analysis of the Without Development Future Year shall be conducted for two future time frames as agreed upon during the Scoping Meeting:

- Opening Year
- Design Horizon Year

*Analysis of traffic signals should assume optimized signal timing for the without development and with development conditions. In the event that existing uncoordinated signals are recommended for coordination that involves signals outside the study area, the external signals may need to be analyzed to ensure efficient operation of the entire system. This should be discussed with the District Traffic Engineer as appropriate.*

Capacity and delay for the intersections in the study area shall be presented in the LOS Table format as indicated in Attachment C. Queue and turn lane analysis shall be conducted and provided as appropriate. Refer to [Publication 46, Chapter 11.16](#)).

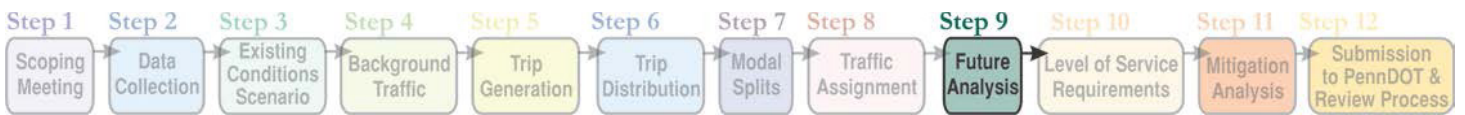
### With Development Future Year

Analysis of the With Development Future Year shall be conducted for two future time frames as agreed upon during the Scoping Meeting:

- Opening Year
- Design Horizon Year

With Development Future Year analyses are required for peak travel periods for study area intersections and for a corridor or roadway analysis. Queue and turn lane analysis should also be conducted as required.

1. No Improvement Scenario analysis shall be conducted to determine the impacts of the proposed development. The capacity and delay results shall be included in the LOS Table indicated in Attachment C.

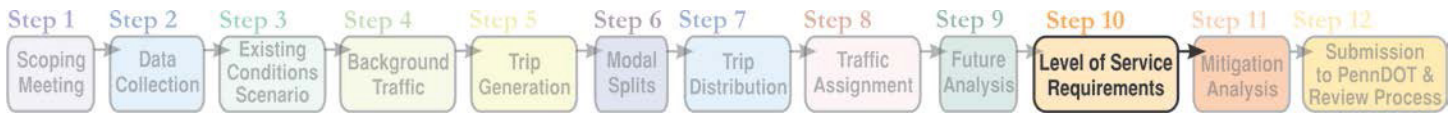


2. With Improvement Scenario analysis shall be conducted to indicate the improvements that are required to mitigate any LOS drops. This information will allow the municipality and the Department to understand the level of improvements that would be required to fully mitigate the LOS drops and provide a comparison basis for alternative mitigation measures. Cost estimates and concept plans are required for the With Improvement Scenario in the TIS.

*Concept plans of full mitigation shall be prepared with sufficient detail to describe their feasibility.*

*Development of construction cost estimates is required along with noting any proposed design exception(s). The plans must also show right-of-way lines. Acceptable base plans are aerial photographs or as-built plans. The applicant may provide a plan on a new survey base if the applicant believes it is needed at this stage. The plan scale should be in 50-scale unless otherwise agreed to at the scoping meeting.*

*Construction cost estimates shall be provided for the full mitigation scenario.*



## STEP 10: LEVEL OF SERVICE (LOS) REQUIREMENTS

The TIS shall compare the operating LOS and delay for the design horizon year both with and without the development. Evaluation of the Without Development and With Development Design Horizon Year scenarios determine the impacts the proposed development has on the study area transportation system.

Mitigation Analysis must be conducted to determine the level of improvements necessary to address LOS drops and safety concerns. It should be noted that the analysis of critical lane movements and approaches shall also evaluate available storage lengths and queues. If typical intersection improvements are not an option to address LOS drops, Step 11 describes alternative mitigation strategies available for consideration.

### *Additional Requirements:*

*The Department may request the applicant to mitigate critical movements or approaches and perform additional analysis. This may include queue length analysis, auxiliary lane analysis or gap study analysis as outlined in Attachment D. Turn lane guidelines can be found in Publication 46, Chapter 11.16 as discussed as in Step 9.*

### Application of 10-Second Variance

The intent of the application of a 10-second delay variance is to provide the option to apply a reasonable capacity and delay contingency to overall LOS drops for both signalized and unsignalized intersections.

If evaluation of the With Development Horizon Year Scenario to the Without Development Horizon Year Scenario indicates that the overall intersection LOS has dropped, the applicant will be required to mitigate the LOS if the increase in overall intersection delay is greater than 10-seconds. If the overall intersection delay increase is less than or equal to 10-seconds, mitigation of the intersection will not be required. If the intersection LOS meets the level of service requirements, applicants may still be required to provide mitigation to address critical lanes or approaches. For locations where the level of service of the design horizon year without the development is LOS F and with development, the delay increases more than 10 seconds, the remedies shall provide an estimated delay which will be no worse than the delay for the design year without the development.

Table 3 provides examples of the application of the 10-second variance at various intersections.

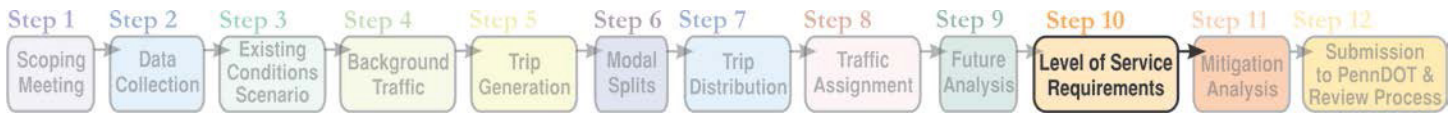


Table 3: 10-Second Variance Example

Intersection Number	Intersection	2015 Horizon Without Development	2015 Horizon With Development	10 Second Variance Calculation	Meets LOS Requirements
1	East St/Tally Ho Dr	C(21)	C(34)	N/A	Yes
2	East St/King Dr	D(40)	E(56)	D(46) 56-40= 16 Sec	No
3	East St/Seabiscuit Ln	D(47)	E(56)	D(46) 56-47= 9 Sec	Yes
4	East St/Queen Dr	F(82)	F(92)	F(82) 92-82= 10Sec	Yes
5	East St/Main St	F(82)	F(100)	F(90) 100-82= 18 Sec	No

As shown in Table 3, Intersection 1 indicates no LOS drop, therefore it meets the LOS Requirements.

Intersection 2 shows an overall intersection drop, but the delay difference is 16-seconds, which is greater than the 10-second variance. Therefore, Intersection 2 does not meet the overall intersection LOS requirements and mitigation is needed.

Intersection 3 indicates that the LOS has dropped, however the delay difference is 9-seconds which is less than the 10-second variance. Therefore, Intersection 3 meets the overall intersection LOS requirements.

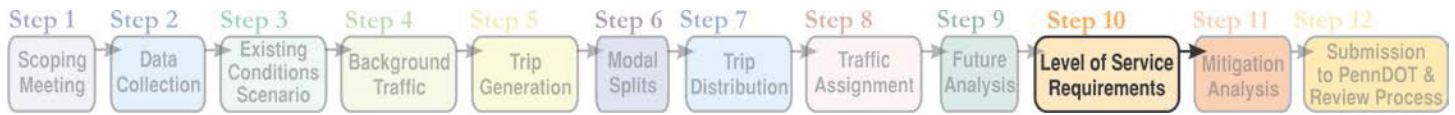
Intersection 4 is already operating at LOS F, but the increase in delay is only 10-seconds in comparing the With Development Horizon Year to the Without Development scenario. Therefore, Intersection 4 meets the overall intersection LOS requirements.

Intersection 5 is also already operating at LOS F, but the increase in delay is 18-seconds in comparing the With Development Horizon Year to the Without Development scenario. Therefore, Intersection 5 does not meet the overall intersection LOS requirements because the delay exceeds the 10-second variance.

For mitigation scenarios, applicants are expected to mitigate the overall intersection LOS to the original Without Development LOS; the 10-second delay variance is not applied to mitigation scenarios. Applicants may be required to address available storage and queue lengths at critical movements or approaches even if the overall LOS requirements are met.

Queue analysis should consider the following:

- Are existing or projected turn lane lengths exceeded?
- Is queue spillback between adjacent intersections expected?
- Are proposed site driveways blocked by projected queues on highway network?



- Will queues into the site interfere with site circulation or result in spillback onto the public street network?

Following are LOS Requirements for the TIS:

### Existing Signalized Intersections

With Development Horizon Year overall intersection LOS should be no worse than Without Development Horizon Year overall intersection LOS, except as noted previously.

Critical movements and approaches shall be evaluated, and queues shall be evaluated to ensure that available storage exists for critical movements.

### Existing Unsignalized Intersections

The evaluation of the performance of unsignalized/stop controlled intersections should include more than just the LOS and delay. Measures of effectiveness such as v/c ratios for individual movements and queue length shall be considered by applicants and presented in the TIS regardless of whether the following LOS requirements are met.

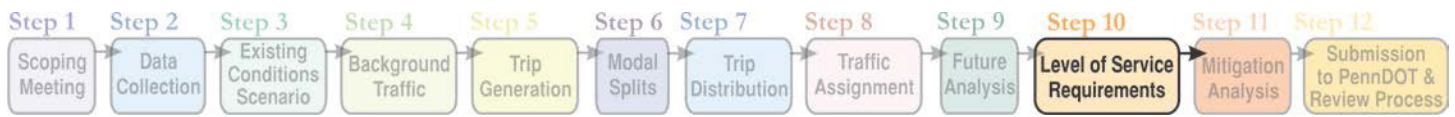
Intersection analysis software does not provide overall LOS for 2-way stop controlled unsignalized intersections but provides LOS for approaches. The applicant should develop an overall LOS for unsignalized intersections by using a weighted average of approach delays to calculate the overall intersection delay as shown in Figure 5 on the page 36.

Safety issues should be identified and, sight distance studies and gaps should be evaluated as well. Focusing on a single measure of effectiveness may result in making a less effective traffic control decision.

Following are LOS requirements for unsignalized intersections:

- Overall intersection LOS for With Development Horizon Year scenarios should be no worse than Without Development Horizon Year scenarios. If lane movement LOS drops occur, the toolbox for unsignalized evaluation should be considered.
- If signalization is the preferred alternative for mitigation, overall intersection LOS C in rural areas and LOS D in urban areas is acceptable.

- Toolbox for Unsignalized Intersection Evaluation**
- Alternative Routes and Connectivity
  - Queuing, Gap Evaluation
  - Turn Restriction Evaluation
  - Median Barrier Evaluation
  - Roundabout Evaluation
  - Traffic Signal Evaluation in accordance with [Publication 212](#)



- If a drop in LOS occurs but the intersection does NOT meet warrants for a traffic signal, other options should be explored to mitigate as discussed in Step 11, Mitigation Analysis.
- If other mitigation measures are not applicable, municipal input is required to seek Department approval for an unsignalized intersection Design (LOS) Waiver.

### New Intersections / Driveways

New signalized or unsignalized intersection established to serve as access to the development shall be designed to operate at minimum LOS C for rural areas, and minimum LOS D for urban areas.

The applicant shall identify and confirm that the proposed driveways/intersections are the best access plan. Plans should be evaluated based on operations of each driveway, impact on adjacent roadways, safety, and acceptability to the community. The applicant shall identify the different access options available to the subject property.

If proposing an access intended to serve more than 750 vehicles per day, the applicant shall conduct an Intersection Control Evaluation (ICE) consistent with Publication 10X (DM1-X), Appendix AI.

Gap studies, sight distance studies and queue length/auxiliary lane analysis should be conducted as part of the new intersection or driveway analysis.

The Department, on a case by case basis, will consider evaluation of new intersections to be designed to an overall intersection LOS E, with input from the municipality. An example would be designing an intersection to LOS E to maintain context with other intersections in the area, and to encourage pedestrian mobility through smaller intersection design.

In all cases, the applicant must coordinate with the District to determine the applicable land use context and acceptable levels of service for the site location, as outlined in Step 1: Scoping Meeting.

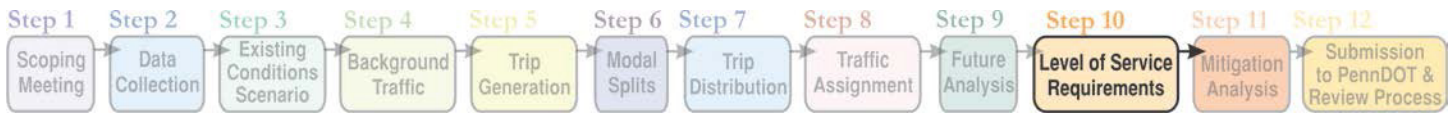


Figure 5: Sample Calculation

Calculate Average Intersection Delay Calculation for  
Two-Way Stop Controlled Intersections

$\Sigma (\text{Volume} \times \text{Delay} / \text{Total intersection volume} = \text{Average intersection delay}$   
Sample intersections shown below:

[[25x10.2)+(1609x10.2)+(888x0)+(15x0)+(8x74.3)+(55x74.3)] / 2600= 21,348 / 2600 = 8.2 seconds average intersection delay. Using HCS for unsignalized intersections 8.2 Seconds = LOS A

[(82x10.9)+(1609x10.9)+(888x0)+(34x0)+(30x795.9)+(107x795.9)] / 2750= 127,470 / 2750 = 46.4 seconds average intersection delay. Using HCS for unsignalized intersections 46.4 Seconds = LOS E

**No Build**

**Legend:**  
Volume(Delay in Seconds)

**Build**

**Legend:**  
Volume(Delay in Seconds)



## STEP 11: MITIGATION ANALYSIS

If the LOS requirements are not met, the applicant is responsible to construct improvements that will mitigate the LOS drop.

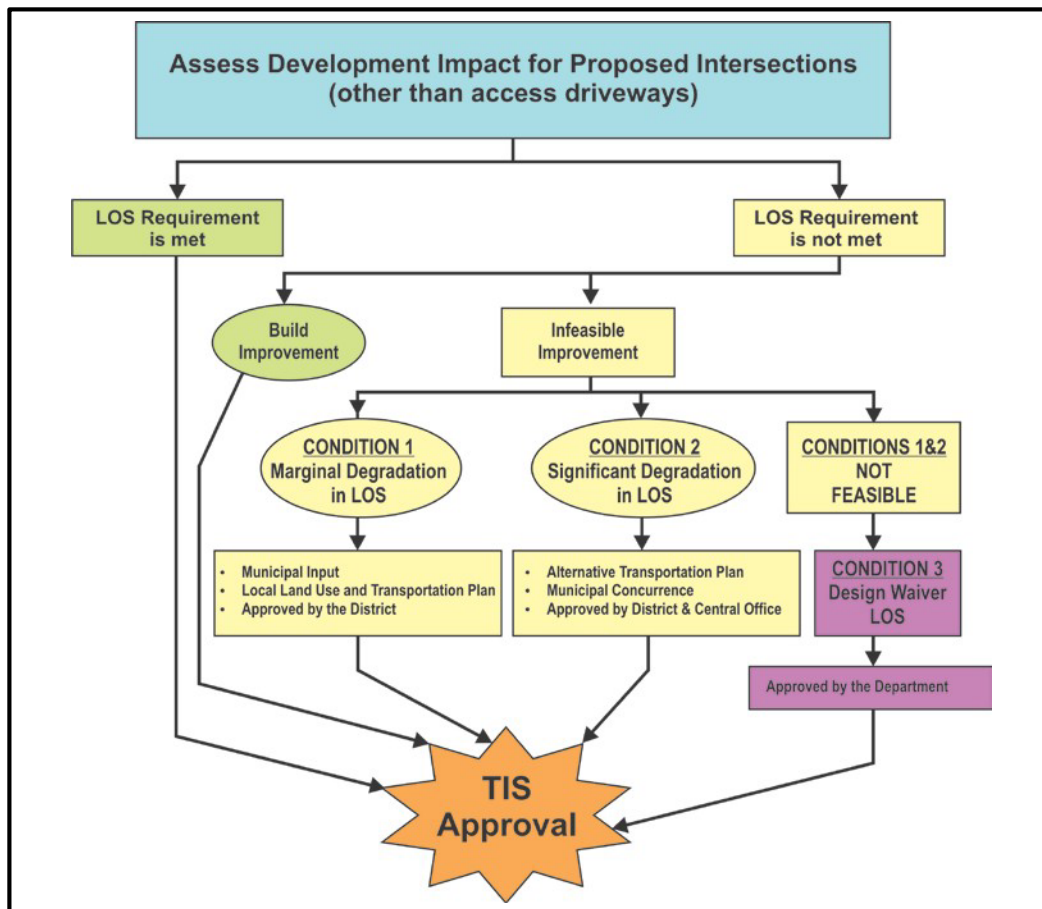
If the LOS requirements are not met, and the improvements are determined to be impractical or infeasible, there are three opportunities available for the applicant to pursue.

1. Local Land Use Transportation Plan with Marginal LOS Degradation
2. Alternative Transportation Plan with Significant LOS Degradation
3. Design Waiver - LOS

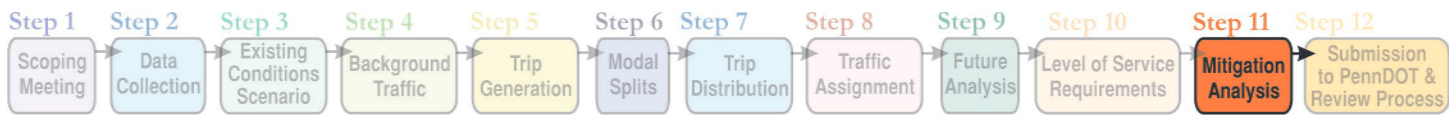
If the applicant documents that construction of improvements to mitigate the LOS drops is impractical or infeasible, the applicant may evaluate Conditions 1 and 2 as mitigation scenarios as shown in Figure 6.

If after evaluation of Conditions 1 and 2 it is determined that mitigation is not feasible, a LOS Waiver can be requested as the third and final option.

Figure 6: Mitigation Procedure







### Condition 1: Marginal LOS Degradation, Local Land Use and Transportation Plan

If the LOS requirements are not met and improvements required to mitigate the impacts are impractical or infeasible, the applicant may evaluate the use of the Marginal LOS Degradation condition. Marginal Degradation is defined as a drop in the overall intersection LOS within LOS range of LOS B to LOS C for rural areas, and LOS B to LOS D for urban areas.

The Department will consider accepting the Marginal LOS Degradation based on municipal input and review of the Municipal Land Use and Transportation Plan to ensure congestion and delay are managed in the study area. The Municipal Land Use and Transportation Plan and correspondence from the municipality should be provided as part of the TIS submission.

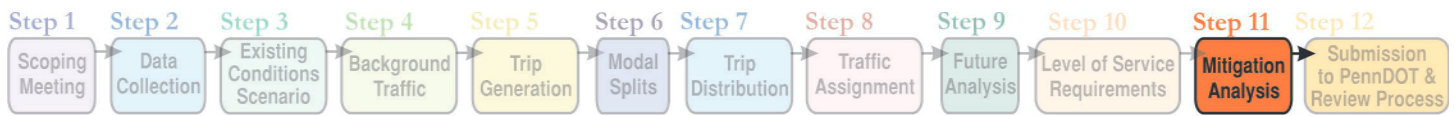
### Condition 2: Significant LOS Degradation, Alternative Transportation Plan

If the LOS requirements are not met and improvements required to mitigate the impacts are impractical or infeasible, the applicant may evaluate the use of the Significant LOS Degradation condition. Significant Degradation is defined as a drop in the overall intersection LOS below LOS range of C in rural areas and D in urban areas. A significant degradation may be acceptable if:

1. The Department concurs that improvements are demonstrated to be infeasible AND
2. The Department concurs that foregoing the improvements will jeopardize neither public safety nor the highway/bridge infrastructure; AND
3. The degradation to overall intersection is acceptable to the municipality; AND
4. The applicant prepares an Alternative Transportation Plan to address improvements to the transportation network which are accepted by the municipality and Department. The implementation of the Alternative Transportation Plan may not always completely mitigate LOS drops, as its purpose is to improve congestion and delay in the transportation network by promoting other transportation strategies.

### Alternative Transportation Plan

An Alternative Transportation Plan (ATP) should encompass a wide range of strategies that will enable the future improvement of conditions for motorists, pedestrians, bicyclists, and transit users within the study area. It extends beyond mitigation strategies that can be implemented by the applicant directly, to encompass strategies that should be implemented by public agencies.



Once approved by the host municipality(ies), the Department will review the ATP and evaluate the feasibility of implementation of strategies. The Department may request input from the County planning office, MPO/ RPO, and local transit authorities as well. The Department and applicant must agree upon the role of the applicant in implementing the strategies.

Attachment E contains a variety of strategies that may be used for the ATP.

*ATP Mitigation Strategy Toolbox (See Attachment E)*

- *Alternative Routes*
- *Access Management Plans*
- *Traffic Signal Asset Management Plan*
- *Multi-modal Plans*
  - *Pedestrian Facilities*
  - *Transit Facilities*
  - *Bicycle Facilities*
- *Park and Ride Facilities*
- *Intelligent Transportation Systems*
- *Act 209 Plan*

To be accepted as fulfilling part of the development’s mitigation obligations, the ATP must be legally binding and have received approval of the municipality’s (ies’) governing body. As a condition of approval, The Department will review the plan for certainty of funding and implementation schedule such that the public benefits of the ATP beginning at opening of the development.

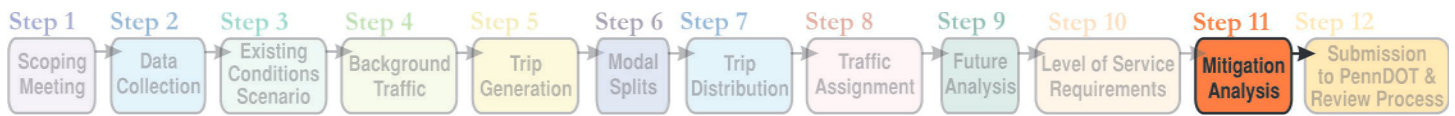
An Act 209 Plan prepared by a municipality may also qualify as an ATP, but the Plan should also include a Traffic Signal Assets Management Plan, and a summary of projects on the MPO’s TIP and Long-Range Plan that have the potential to address congestion in the study area.

Another plan that may qualify as an ATP is a Transportation Improvement Plan arising from a Land Use and Transportation Study for a municipality, a group of municipalities, or for a corridor in which the Department is part of the Steering Committee. Municipalities that have Official Maps indicating areas for improvements may also qualify as an ATP. To qualify as an ATP, the plan must be funded and have a feasible implementation schedule. Also, the costs associated with the implementation of the ATP should be comparable to the costs associated with the impractical or infeasible improvements the applicant is requesting to forego.

The applicant may fully or partially fund the ATP in order to guarantee implementation and schedule. The Department will make the ATP a condition of the HOP. It is recommended that the municipality make the ATP a condition of the municipal land use approval.

Condition 3: Design Waiver – LOS

In the event that Conditions 1 or 2 are unachievable, a Design Waiver - LOS may be applied for as outlined in Chapter 2 of this publication (Pub 282). Due to the variety of



alternative mitigation options available to applicants, a very small percentage of waivers are anticipated to be granted by the Department.

### Mitigation Strategies

Common strategies of traffic impact mitigation may involve changes to physical geometry, striping, and traffic controls. Traffic signalization is a common alternative; however, the Department also encourages the innovative transportation solutions and consideration of unconventional intersection treatments such as but not limited to roundabouts.

In the event that a traffic signal is required as part of mitigation, the applicant/permittee for the signal will be the municipality. It is recommended that the municipality execute an agreement with the HOP applicant that requires the HOP applicant be responsible for the costs associated with the signal installation as well as maintenance of the signal for up to at least one year after initial operation.

If the impact analysis indicates a need to add a through lane or turning lane at an existing intersection, change the lane configuration at an existing intersection, change control at an existing intersection, reconstruct an existing intersection, or construct a new intersection, conduct an Intersection Control Evaluation (ICE) consistent with “Design Manual 1X”, Appendix AI.

Due to the complexity and evolving criteria associated with roundabouts and Diverging Diamond Interchanges (DDI), all roundabout and DDI alternatives will require coordination with the Bureau of Design and Delivery (BODD), Highway Design and Technology Division (HDTD). The District HOP Manager shall remain the point of contact for the applicant and will coordinate with the District Roundabout Coordinator and BODD HDTD as required.

Following is additional information for consideration of signals and roundabouts as mitigation measures:

### Traffic Signals

Signal Warrant analysis should be performed for unsignalized intersections that operate at poor levels of service in accordance with the [Publication 212](#).

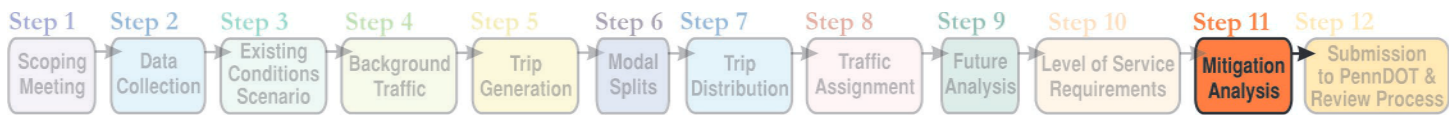
Note: The Department expects applicants to evaluate all signal warrants. The peak hour warrant shall only be applied in unusual cases, including but not limited to, office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

In the event that a signal is warranted in the Horizon Year, but not in the Opening Year analysis, a separate analysis shall be provided to project when the warrant is met.

As soon as the applicant determines that a traffic signal is a mitigation option,

*Policies and Procedures*

*Transportation Impact Guidelines*



coordination should be initiated with the municipality and Department. The scope of the coordination shall include:

1. Evaluation of the use of a roundabout in lieu of a signal
2. The limits of the traffic signal system to be analyzed
3. Performance requirements
4. The method of analysis
5. Technology and maintenance issues
6. Installation and maintenance agreement with municipality and the Department

### Method of Analysis

It should be noted that roundabouts shall be considered at all locations under signalization consideration and applicants shall refer to [Department "Design Manual, Part 2", Chapter 3](#), and [NCHRP Report 1043 – Guide for Roundabouts](#) for more information.

Based on roadway type and land use context established at the TIS Scoping Meeting, the applicant shall ascertain if either minimizing stops (such as along a major corridor) or minimizing delay (such as in a grid network) is the primary purpose of the traffic signal system. Based upon this, the applicant shall prepare an analysis using an acceptable software package to develop appropriate signal timing plans. Time space diagrams documenting the results shall be submitted.

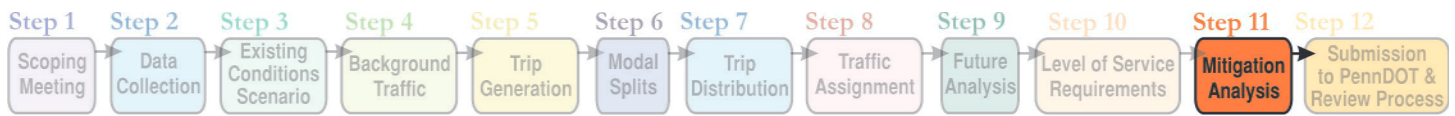
The Department may require the applicant's engineer to prepare a micro-simulation of the traffic signal system. In requesting the micro-simulation, the Department may specify the software package to be used.

### Technology and Maintenance Issues

A traffic signal system shall be sufficient to mitigate the impact of the applicant's development, but capable of being operated and maintained by the municipality. The applicant may be required to participate in and/or fund a portion of a Traffic Signal Assets Management Plan. Municipal concurrence is required for operating and maintaining the traffic signal system in accordance with the Traffic Signal Assets Management Plan. The municipality may require that the applicant retain the services of a traffic engineer to address and respond to complaints regarding signals for up to 1-year after the development opens.

### Roundabouts

A roundabout is a circular intersection consisting of a central island, a circulatory roadway, and splitter islands on each approach. Studies have shown that relative to other traffic controls at intersections, roundabouts are often better able to reduce conflict points;



reduce crash incidence and the severity of crashes; and reduce delay. Roundabouts shall receive particular consideration for existing study area intersections with high crash histories.

The feasibility of installing a roundabout shall include consideration of site constraints such as available ROW, environmental factors, and other design factors. Roundabouts may not be suitable when the intersection is within a well-coordinated signal system with acceptable crash histories; where a signal exists to serve emergency vehicle pre-emption; or where the intersection has functioned well for all users under existing traffic controls. If a roundabout is determined to be feasible and is anticipated to be superior to other traffic controls in addressing the needs of all users at an intersection, it should be considered the preferred alternative.

Due to the impacts and cost associated with expanding roundabouts, a design year of 20 years is typically used to allow for future expansion as necessary.

Applicants are encouraged to refer to [Department "Design Manual, Part 2", Chapter 3](#), and [NCHRP Report 1043 – Guide for Roundabouts](#) for more information.



## STEP 12: SUBMISSION TO THE DEPARTMENT AND REVIEW PROCESS

### General Formatting

To facilitate Department review, the TIS report shall contain a cover page, table of contents, body of report, and appendices containing data collection and analyses. As mentioned in Step 2, a sample TIS format is contained in Attachment C (Figure 7).

The Department may reject the TIS if it does not conform to the format provided in Attachment C.

To help ensure that the TIS is in conformance with these policies and procedures, applicants must complete the TIS/TIA Review Checklist provided in Appendix A, Attachment F and submit it with the TIS.

### Special Review

Median break studies or Point of Access Studies required or requested as part of the TIS shall not be approved prior to obtaining all necessary Department and/or FHWA approvals.

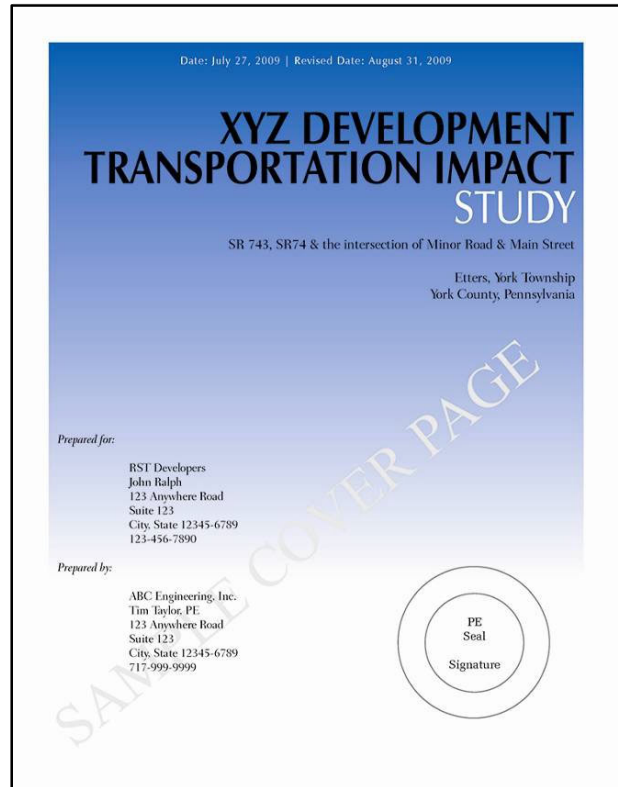
TIS reports that utilize Alternative Transportation Plans as a mitigation strategy shall not be approved by the District Permit Office prior to obtaining review and approval by the Central Permit Office.

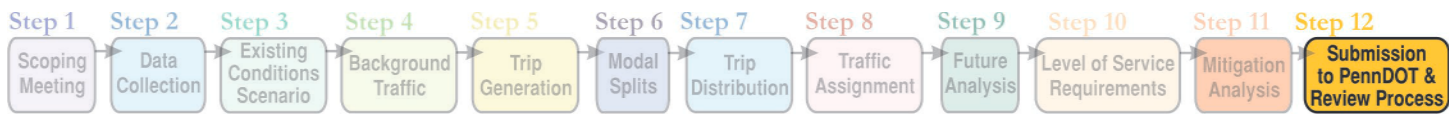
As mentioned in Step 2, applicants may request to submit to the Department a Preliminary TIS for larger projects in which the project's data collection and trip forecasting elements are provided prior to addressing operations and mitigation options.

### The Department Review Process

The District HOP Manager will be the point of contact for the entire permit process and related submissions. Upon receipt of a TIS, the Department will review the applicant's assessment of the need for capacity, safety or other enhancements to mitigate transportation impacts.

Figure 7: Sample Cover Page





TIS and TIA documents prepared in accordance with these guidelines shall be submitted to the Department with an appropriate HOP application (M-945A). The Department will review and return comments, if necessary, pertaining to the TIS within 45-60 calendar days of the submission. The District Office will issue an approval letter for the TIS when all Department concerns are addressed.

If the applicant pursues Condition 1 or Condition 2 under Step 11: Mitigation Analysis, the documentation from the municipality(ies) with respect to Marginal and Significant Degradation as well as the proposed ATP shall be submitted separate from the TIS.

If the Department approves the Marginal or Significant Degradation, related correspondence and the ATP shall be included in the appendix of the final TIS document. If the applicant pursues a Design (LOS) Waiver, the waiver request shall also be submitted as a standalone document.

If approved by the Department, the Design Waiver - LOS request as well as the approval shall be included in the appendix of the final TIS along with all documentation of applicant's attempts to comply with Condition 1 or 2.

The TIS and associated mitigation(s), if any, must be identified and agreed to by the Department before the applicant submits final HOP engineering plans for review.

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## REFERENCES

[\*A Policy on Geometric Design of Highways and Streets\*](#), Sixth Edition, 2011, AASHTO. Also known as the “Green Book.”

[\*Access to and Occupancy of Highway by Driveways and Local Roads\*](#) (67 Pa. Code, Chapter 441)

[\*PennDOT Design Manual, Part 1.\*](#) Department Publication 10

[\*PennDOT Design Manual, Part 2.\*](#) Department Publication 13M

[\*Roadway Construction Standards\*](#), Department Publication 72M

[\*Traffic Engineering Manual\*](#), Department Publication 46

[\*Traffic Signal Design Handbook\*](#), Department Publication 149

[\*Traffic Signal Standards\*](#), Department Publication 148

[\*Transportation Impact Analyses for Site Development: An ITE Proposed Recommended Practice\*](#), ITE (2010)

[\*HCM 2010\*](#)

[\*Guide for Roundabouts\*](#), NCHRP Report 1043



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## ATTACHMENT A: GLOSSARY

**AVERAGE TRIP RATE** – is the weighted average of the number of vehicle trip or trip ends per unit of independent variable.

**ACCESS** – is the ability to enter or leave a public street or highway from an abutting private property or other public street.

**ACCESS MANAGEMENT** – is the control and regulation of the spacing and design of driveways, ramps, medians, median openings, traffic signals, and intersections on arterial roads to improve safe and efficient traffic flow on the road system.

**AVERAGE DAILY TRAFFIC** – is the average number of vehicles crossing a specific point on a roadway on any given day.

**AVERAGE TRAVEL SPEED** – means the average speed of a traffic stream computed as the length of a highway segment divided by the average travel time of vehicles traversing the segment, in miles per hour.

**ALTERNATIVE TRANSPORTATION PLAN** – is a plan prepared by the applicant to address significant degradation of LOS. It encompasses a variety of multi-modal and congestion management strategies for improving the study area and transportation network.

**BACKGROUND TRAFFIC** – refers to an estimate of future traffic within the vicinity of the proposed development, without the site development traffic, but with existing traffic adjusted for expected growth, and addition of traffic from major vested projects.

**CAPACITY** – means the maximum rate of flow at which persons or vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specific time period under prevailing roadway, traffic, and control conditions; usually expressed as vehicles per hour (VPH) or persons per hours.

**CRASH RATE** – number of crashes per million vehicle miles traveled in a given segment of roadway.

**DEPARTMENT** – The Pennsylvania Department of Transportation.

**DESIRED OPERATING SPEED** - the speed of traffic that best reflects the function of the roadway and surrounding land use context.

**DESIGN SPEED** – is the speed used to determine the design features of the roadway.

**DESIGN HORIZON YEAR** – is the year for which the roadway is designed.

**FHWA** – The Federal Highway Administration is the division of the United States Department of Transportation that administers the federally funded transportation program and is responsible for

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disbursing federal highway funds to the states.

GRAVITY MODEL – is a mathematical model used to estimate the number of trips that will be drawn to a development based on population and travel time. In the case of a proposed retail development project, it is the attraction of the population of a segment of market to the site. In the case of a residential project, it is the attraction of the location of employment opportunities and in the case of an employment center; it is the residential locations of potential employees. Typically, a gravity model is represented by the following equation:

$$\frac{\text{Segment Population}}{(\text{Travel Time to Site})^2}$$

HOMOGENEOUS CRASH RATES – The Department monitors crash rates for different types and classes of highways across Pennsylvania. These rates form the base for comparison against the actual rates for the roadway segments within the TIS study areas.

INFILL DEVELOPMENT – a development site located in a fully developed urbanized area, often with different interactive land uses and with good pedestrian and vehicular connectivity and served by convenient/frequent transit and/or designated bicycle facilities.

INTERNAL CAPTURE RATE – is the percentage of the total number of trips from a site that are contained within on-site circulation systems only.

ITE TRIP GENERATION – is the most widely used reference source, published by the Institute of Transportation Engineers (ITE) since 1976, for trip generation data, by traffic engineers and transportation planners for site level planning and analysis.

LAND DEVELOPMENT PROCESS – the process by which municipalities review, approve, or reject land development proposals. The land development process is governed by the Municipalities Planning Code.

LAND USE CONTEXT – a land area comprising a unique combination of different land uses, architectural types, urban form, building density, roadways and topography and other natural features. See PennDOT ‘*Design Manual, Part 1X*’, *Appendix B* for the seven contexts. One is rural and the remaining six (6) are considered urban in this document.

LEVEL OF SERVICE – a qualitative measure describing the operational conditions within a section of roadway or at an intersection that includes factors such as speed, travel time, ability to maneuver, traffic interruptions, delay and driver comfort. Level of service is described as a letter grade system (similar to a school grading system) where delay (in seconds) is equivalent to a certain letter grade from A through F.

LIMITED-ACCESS FACILITY – means a street or highway especially designed for through traffic that owners or occupants of abutting land or other persons have no right or easement of access.

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LOS DROP – represents a change in letter grade. Generally, all LOS drops must be mitigated to the no-development scenario LOS.

MARGINAL DEGRADATION – is a degradation in level of service that is within the ranges of LOS A to LOS C in rural areas and LOS A to LOS D in urban areas.

MITIGATION – is that collective process whereby a developer of land makes adequate provisions for the public transportation facilities needed to accommodate the impacts of the proposed development.

MULTI-USE DEVELOPMENT – (as defined by the Urban Land Institute) means land development that includes two or more different types of land uses; for example, residential, commercial and industrial.

MUTCD – (Manual on Uniform Traffic Control Devices) This federal publication established the methodology to study, design install and operate signs, signals and pavement markings on a uniform basis across the United States. While PennDOT regulations follow the MUTCD, there are differences and the traffic engineering community is cautioned to refer to PennDOT Publications. PennDOT publications take precedence where there are differences.

NEW DEVELOPMENT – any commercial, industrial, residential, or other project which involves new construction, enlargement, reconstruction, redevelopment, relocation, or structural alteration and which is expected to generate additional vehicular traffic.

OFF-SITE IMPROVEMENTS – those capital improvements which are not on-site improvements.

ON-SITE IMPROVEMENTS – all improvements constructed on the applicant’s property, or the improvements constructed on the property abutting the applicant’s property necessary for the ingress or egress to the applicant’s property, and required to be constructed by the applicant pursuant to any municipal ordinance, including, but not limited to, the municipal building code, subdivision and land development ordinance, Planned Residential Development (PRD) regulations, and zoning ordinance.

PASS-BY TRIPS – trips that are attracted to a site from existing traffic passing the site on the adjacent street or roadway that provides direct access to the site.

PEAK-HOUR FACTOR (PHF) – is the ratio of the hourly volume to four times the peak 15-minutes volume.

RIGHT-OF-WAY (ROW) – an area of land that is used by the public for travel and for the location of utilities.

RURAL AREAS – are areas not included in an urbanized area, a transitioning urbanized area, an urban area or a community.

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**SIGNIFICANT DEGRADATION** – is a degradation in level of service below LOS C in rural areas and LOS D in urban areas.

**SUBURBAN AREAS** – areas of low density and almost fully residential except for commercial that usually occurs at major intersections, schools, and other occasional isolated uses.

**TRAFFIC VOLUME** – is the number of vehicles passing a point on a highway during a specific time period.

**TRANSPORTATION IMPACT ASSESSMENT** – a limited analysis and evaluation of the impact of development of sites not warranting a Transportation Impact Study conducted under the supervision of a Pennsylvania Registered Professional Engineer. The purpose of the Transportation Impact Assessment is to conduct a limited evaluation to determine the key development impacts at a specific intersection(s) location.

**TRANSPORTATION IMPACT STUDY** – analyses of the impact of development conducted under the supervision of a Pennsylvania registered Professional Engineer to determine the full impact of proposed development on the transportation system.

**TRIP** – is a single- or one-way directional movement. Transportation engineers & planners refer to trips as “internal,” “external,” or “through.” Internal trips have both origin and destination within a particular projects area. External trips have only one end within the project area. Through trips neither originate nor end within the analysis area but pass through it.

**TRIP DISTRIBUTION** – is the arrival and departure patterns for trips to and from the site by geographic area.

**TRIP END** – is a term denoting the origin or the destination end of the trip in question.

**TRIP GENERATION RATE** – are average rates of vehicular travel to and from a development, usually cited per square foot, per housing units or per acre.

**TRIP GENERATION** – is the total number of vehicular trips going to and from a particular land use on a specific site during a specific time period.

**URBAN AREAS** – areas just outside of a Central Business District as indicated on PennDOT’s Type 10 maps.

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## ATTACHMENT B: SCOPING MEETING APPLICATION & AGENDA

### Scoping Meeting Agenda

- 1) Background of Proposed Project
  - a) Location and Type of Project
  - b) Status in Land Development Process
  - c) Site Plan Discussion
    - i) Proposed site access
    - ii) Proposed land uses
    - iii) Community linkages (access to neighboring properties, cross easements, pedestrian accommodations (sidewalks, crosswalks, etc.), bicycle and transit accommodations)
    - iv) Adjacent properties
- 2) Review of Study Area (5-Mile Radius Map)
  - a) Land Use Context (Refer to PennDOT Design Manual, Part 2)
  - b) Known Congestion Areas and Safety Concerns
  - c) Known Historical or Environmental Constraints
  - d) Pedestrian/Bike Review: Community Centers, Parks, Schools, etc.
  - e) Transit Review (current routes/stops)
  - f) 102" wide combinations (w/ trailer lengths greater than 28') permitted on SR (Refer to 75 PA. C.S. §4908)
- 3) Existing Planning Information
  - a) Comprehensive Plans
  - b) Act 209 Plans
  - c) Access Management Ordinances/Plans
  - d) Zoning/Land Use in the Study Area
  - e) Known projects/developments with HOP approval or a approved TIS
- 4) Study Area
  - a) Proposed Project Location/Best Access Plan
  - b) Proposed Study Roadways
    - i) Roadway Type (Present/Future)
    - ii) Location of Structures
    - iii) Current Speed, Desired Operating Speed
    - iv) Existing Right-Of-Way
  - c) Proposed Study Intersections
    - i) Type of Control (Stop/Signals)
    - ii) Coordinated Signals; Is expansion of study area required/needed?
- 5) Trip Generation
  - a) Methodology Used
  - b) Anticipated number of trips
  - c) Modal Split Reductions
- 6) Approval of Data Collection Elements and Methodologies to be used for evaluation
  - a) Turning Movement and 24-Hour Count Parameters
  - b) Balancing of Traffic Volumes / Seasonal Adjustment Factors
  - c) Gap, Queue Length, Turn Lane and Sight Distance Studies
  - d) Analysis Software
- 7) Approval of Analysis Years, Growth Rates
  - a) Opening Year and Design Horizon Year
- 8) Design Criteria
  - a) Lane/Roadway Widths, Design Speeds and LOS Criteria
- 9) Miscellaneous Department Discussions
  - a) Funding/Funded Projects
  - b) Right-of-Way, Utility and Drainage Impacts
  - c) Impacts to Access of Neighboring Owners
  - d) Recording of Permit
  - e) Condition Statements
  - f) Critical Milestones

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**ATTACHMENT C: SAMPLE TIS**

Date: July 27, 2009 | Revised Date: August 31, 2009

# XYZ DEVELOPMENT TRANSPORTATION IMPACT STUDY

SR 743, SR74 & the intersection of Minor Road & Main Street

Etters, York Township  
York County, Pennsylvania

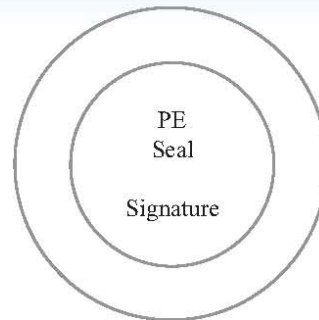


*Prepared for:*

RST Developers  
John Ralph  
123 Anywhere Road  
Suite 123  
City, State 12345-6789  
123-456-7890

*Prepared by:*

ABC Engineering, Inc.  
Tim Taylor, PE  
123 Anywhere Road  
Suite 123  
City, State 12345-6789  
717-999-9999



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## Transportation Impact Study (TIS) Format Guidelines

The purpose of the TIS will be to demonstrate the overall impact of traffic generated by the proposed development on the transportation study area. The report structure should follow the Table of Contents provided in the Attachment. Following are elements that need to be addressed in each section of the report. These elements should be presented as discussed and agreed upon during the Scoping Meeting.

It should be noted that all Figures, concept plans, calculations, etc. are to be contained in the Appendix of the report but should be discussed and referenced in the appropriate sections as shown.

### Executive Summary

The executive summary should be 2 or 3 pages long and concisely cover the project description, impact of the proposed development, proposed methods of mitigation, design waivers requested, and financial responsibilities.

A final executive summary can be greater than 3 pages and include any and all memorandum of understandings, agreements including obligation dates, major milestones, and approved or denied design waivers. The final summary should list any and all traffic impacts identified and mitigation options.

### Introduction/Project Summary

A brief, descriptive summary of the analysis undertaken in the study must be included; any assumptions used in the traffic analysis must be identified. The following items should also be addressed:

- Land Use Context (Existing/Proposed)
- Study Area, Transportation Facilities
- Figure 1: Study Area Map included in Appendix, and description of the study area and boundaries defined verbally.
- Figure 2: A site plan (1:50 scale minimum). Lot size, building size(s) and types (retail etc.) and location shall be clearly defined on the map/plans.
- Discussion and/or illustration of the site layout identifying the internal traffic circulation patterns, location of existing and proposed access points. Pedestrian crossings or paths should be identified, as well as locations for drive thru facilities and fuel pumps. Project phasing (if applicable) and schedules should be provided identifying the anticipated opening date, anticipated completion years for each phase of development and the anticipated full build out completion date.



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## Data Collection

Raw data collected as part of the study in accordance with the scoping meeting shall be contained in Appendix, however a brief summary of the data collected as well as methodology used to obtain the data must be included in this section.

## Existing Study Area Conditions

This section of the report should cover the existing traffic conditions, land use context, roadway type, traffic controls in the study area. The study area should also be described including the roadway network. Figures for existing traffic volumes (AM, PM, Site Peak/Saturday) as well as existing level of service (LOS) shall be referenced in this section and contained in the appendix.

Turning lane and queue analysis, crash analysis, gap analysis, and travel time studies should be included for discussion in this section as applicable.

Discussion of the need for sidewalks and crosswalk, and other pedestrian facilities shall be evaluated as part of the project. Evaluation of transit facilities, bus routes/service should also be included in this section.

## Opening Year Traffic Conditions without Development

This section shall contain the traffic count data that has been projected to the opening year utilizing background growth factors, as well as appropriate background traffic from permitted developments.

Capacity analysis shall be conducted. Signalized intersections shall be optimized for corridor prioritization if signals are coordinated. Single intersections shall be optimized for the best overall intersection LOS.

Figures shall be included in the Appendix.

## Design Horizon Year Traffic Conditions without Development

This section shall contain the traffic count data that has been projected to the design horizon year utilizing background growth factors, as well as appropriate background traffic from permitted developments.

Capacity analysis shall be conducted. Signalized intersections shall be optimized for either corridor prioritization if signals are coordinated. Single intersections shall be optimized for the best overall intersection LOS.

Committed transportation improvements in place prior to the opening year shall be described and included in the analysis.

## Development Description

The description of the proposed development should be presented in this section. Information that should be discussed and included in the appendix should include but not be limited to:

- 
- Proposed site access including distance from adjacent intersections and proposed control/movements. Discussion should be provided regarding how access relates to internal circulation and design.
  - Sight Distance Analysis (Intersection, Stopping Sight Distance and Existing/Measured Sight Distance)
  - Trip Generation (include any modal reductions)
  - Internal Capture Trips
  - Pass-By and Diverted Link Trips
  - Trip Distribution/Assignment. Methods of assumption shall be provided in this section, as well as back up information for verification of calculations.
  - If a post development study is necessary, it should be discussed here, including what financial security will be provided in the form and amount for the study and required mitigation.

#### Opening Year Traffic Conditions with Development

This section shall contain the opening year traffic volumes and capacity analysis discussion referring to the Figures contained in the Appendix.

As with the No Development Opening Year analysis, optimized signal timings should be utilized. Turning lane and queue analysis, gap analysis, travel time studies should be included in this section as applicable.

Signal warrant analysis, left turn signal phasing analysis, crash analysis, weaving analysis, or other applicable analyses should also be included in this section as applicable.

#### Design Horizon Year Traffic Conditions with Development

Design horizon year traffic volumes and capacity analysis shall be discussed in this section. Figures and worksheets shall be included in the Appendix as noted.

As with previous analyses, analyses should be performed assuming optimized signal timings. Turning lane and queue analysis should be discussed in this section. Auxiliary lanes and proposed lengths should be presented as appropriate. Alternative access locations should be discussed as appropriate.

Signal warrant analysis should be discussed in this section and included in the Appendix as noted.

#### Mitigation Identification and Recommendations

This section of the report should identify what mitigation measures are needed to meet LOS requirements and to address the traffic impacts of the project. A cost estimate and concept plan of the improvements necessary to mitigate the LOS drops is required to serve as baseline information. Final access design shall address both traffic flow and highway safety considerations, which should be discussed succinctly in this section.

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A description of the proposed mitigations, arranged by location and type of mitigation should be included in this section. A cost estimate and concept plans of proposed mitigations shall be prepared and included in the Appendix. The proposed mitigations must be constructible improvements; if right-of-way is a concern, the ability to obtain the necessary right-of-way must be specifically identified. Analysis of Proposed Mitigations shall be discussed, and capacity analyses included in the Appendix as noted.

If post development condition monitoring is requested by the Department, it should be discussed in this section. Elements to include in the discussion include what analysis will be provided to substantiate recommended improvements, optimize signal timings, or to determine if a traffic signal is warranted. If improvements are necessary as a result of the intersection monitoring, the applicant, or their successor, shall be responsible for the full expense of designing and constructing the necessary improvements. The Department may require financial security, a condition statement with these terms specifying the duration of the monitoring, as well as the reason for or extent of the monitoring.

If an Alternative Transportation Plan (ATP) is proposed as mitigation, it should be provided as a separate document and referred to in this section. The Department will require concurrence from the municipality regarding the ATP which should be included in the final TIS correspondence section of the Appendix as well as the ATP, if approved by the Department.

If a Design (LOS) Waiver is pursued, it shall be submitted separate from the TIS and referred to in this section. If approved by the Department, the Design (LOS) Waiver request and approval shall be incorporated into the appendix of the final TIS document.

### Conclusions

This section shall be a brief, concise description of the study findings, acceptable to the Department, and consistent with Publication 282. Proposed development plans shall include the recommended mitigation improvements to address future design year LOS and transportation network needs.

### Appendices:

The appendices shall be clearly marked and tabbed appropriately.

### Traffic Count Data:

- Table 1: Levels of Service Summary
- Table 2: Queue Length Summary

### Existing Conditions:

- Figure 1: Study Area
- Figure 2: Site Plan
- Figure 3: Existing Volume/LOS
- Figure 3a: Existing Signal Plan (if applicable)

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Figure 4: Trip Distribution Percentage and Volumes

Opening Year Conditions:

- Figure 5a: Opening Year Traffic Volumes without Development (AM, PM, Site Peak)
- Figure 5b: Opening Year Traffic Volume without Development & with Committed Development
- Figure 5c: Opening Year Traffic Volumes with Development
- Figure 5d: Opening Year Traffic Volumes with Development & Committed Development
- Figure 5e: Opening Year Levels of Service without Development
- Figure 5f: Opening Year Levels of Service without Development & with Committed Development
- Figure 5g: Opening Year Levels of Service with Development
- Figure 5h: Opening Year Levels of Service with Development & Committed Development
- Figure 5i: Opening Year Levels of Service with Development & Recommended Mitigation
- Figure 5j: Opening Year Levels of Service with Development, Committed Development, & Recommended Mitigation

Design Horizon Year Conditions:

- Figure 6a: Design Horizon Year Traffic Volumes without Development (AM, PM, Site Peak)
- Figure 6b: Design Horizon Year Traffic Volumes without Development & with Committed Development
- Figure 6c: Design Horizon Year Traffic Volumes with Development
- Figure 6d: Design Horizon Year Traffic Volumes with Development & Committed Development
- Figure 6e: Design Horizon Year Levels of Service without Development
- Figure 6f: Design Horizon Year Levels of Service without Development & with Committed Development
- Figure 6g: Design Horizon Year Levels of Service with Development
- Figure 6h: Design Horizon Year Levels of Service with Development & Committed Development
- Figure 6i: Design Horizon Year Levels of Service with Development & Recommended Mitigation
- Figure 6j: Design Horizon Year Levels of Service with Development, Committed Development & Recommended Mitigation

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List of Committed Developments

Site Photographs

Existing Conditions (Sketches, Transit Data etc.)

Turning Movement Counts/24-Hour Volumes

Growth Rate Information

Seasonal Adjustment and Balancing Calculations

Intersection/Roadway Traffic Volume

Spreadsheets Trip Generation Worksheets

Capacity and Queue Analysis Worksheets

Crash Analysis

Gap Study

Intersection Control Evaluation

Traffic Signal Warrant Analysis

Turn Lane Analysis

Correspondence

Transportation Impact Study Scoping Meeting Application

Roadway Characteristics Checklist

Concept Plans and Cost Estimates

Alternative Transportation Plan (if applicable), bound separately

Approved Alternative Transportation Plan (If applicable)

Design (LOS) Waiver Request/Approval (if applicable)

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**ATTACHMENT D: GAP, QUEUE AND TRAVEL TIME STUDIES**

Travel Time Studies

The Department may ask the applicant to conduct travel time and delay studies to determine the efficiency of travel along major corridors in the study area, and to identify problem locations. These studies should be discussed at the scoping meeting. If they are not initially warranted, they may be requested by the Department after review of the traffic analysis and proposed recommendations.

Queue Studies

At the scoping meeting, it is anticipated that those intersections requiring queue analysis will be identified. Queue Analysis shall be performed for each approach at each intersection and the information shall be provided in a tabular format.

The applicant shall refer to the Department’s policy on queue length located in Publication 46, Chapter 11 – Turn Lane Guidelines. Use the 95<sup>th</sup> percentile queue when estimating required storage length from traffic engineering software packages, unless otherwise directed by the Department.

**QUEUE LENGTH (ft)  
Road & Street**

			2010 Signalized		2010 Signalized Improved		2030 Signalized		2030 Signalized Improved		Available Storage (ft)	Adequate Storage?
			AM	PM	AM	PM	AM	PM	AM	PM		
<b>Road &amp; Street</b>	<b>EB</b>	<b>L</b>	261	477	261	556	477	970	318	873	N/A	Y
		<b>T</b>										
		<b>R</b>										
	<b>WB</b>	<b>L</b>	205	344	39	50	376	701	48	77	100	Y
		<b>T</b>			166	353			203	554	N/A	Y
		<b>R</b>										
	<b>NB</b>	<b>T</b>	27	42	27	50	50	85	33	77	N/A	Y
		<b>R</b>										
	<b>SB</b>	<b>L</b>	14	0	14	0	24	0	16	0	N/A	Y
		<b>T</b>										
		<b>R</b>										

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### Gap Studies (Critical Headway Studies)

Gap studies are useful in evaluating the capacity and level of service of unsignalized intersections, driveways, and unprotected left turns. Gap studies should be discussed at the scoping meeting. If not initially warranted, a gap study may be requested by the Department after review of the traffic analysis and proposed recommendations.

With the publication of “HCM 2010”, TRB has ceased the use of the term critical gap and instead is providing an equation for critical headway. Refer to “HCM 2010” Equation 19-30 and Exhibit 19-10: Base Critical Headways and Follow-up Times for TWSC Intersections for more information.



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**ATTACHMENT E: ALTERNATIVE TRANSPORTATION PLAN STRATEGIES**

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## Alternative Transportation Plan Mitigation Strategies

As indicated in Step 11, Mitigation Analysis, it will not always be feasible or desirable to modify intersections to mitigate LOS drops. Such modifications could have excessive community or environmental impacts, or they might be less valuable to the community than other strategies which abet more comprehensive transportation improvements.

A variety of mitigation strategies are available for consideration in the development of an Alternative Transportation Plan, while some of the strategies may not mitigate LOS drops, they may still have significant value as congestion management strategies. Developer costs for funding these strategies should be similar to costs that would be assumed by the developer if they had funded physical improvements to roadways and intersections proximate to the development in order to achieve an acceptable LOS. All of the mitigation strategies should involve coordination with local officials and receive approval by the municipal governing body. Following are examples of elements that can be incorporated in the alternative transportation plan.

### Alternate Routes

As an alternative to adding capacity to existing intersections on major roads adjacent to the development, or as a supplement to such measures, the applicant should consider the option of improving the connectivity of the area roadway network. A well-connected roadway network can better serve the needs of area motorists, since it provides a greater choice of routes; and better serve pedestrians and bicyclists, by allowing them to travel on streets with lower traffic volumes.

Typically, this strategy would consist of altering the network such that area residents and workers can make better use of other arterial and collector roadways parallel to the major roadways. The Department will consider this mitigation strategy even if it is physically feasible to add capacity on the state highways adjacent to the development. One consideration will be whether the proposed improvement on the state highway would result in a roadway design out of character with other intersections or segments along the roadway.

It should be possible in many cases to estimate the traffic volumes that will be diverted to other intersections, thus reducing volumes at intersections on the major roadway. An analysis will reveal whether this strategy would permit the study area intersections to achieve desirable levels of service; even if these levels are not achieved, because of the benefits of a well-connected network, the Department will still consider this as a possible strategy.

In some cases, installation of a signal at existing unsignalized intersections proximate to the subject property, and providing access to the development, will permit the applicant to avoid constructing a new signalized driveway.

Coordination with local officials will be particularly important for this mitigation strategy. Any proposal for improving the roadway network should avoid significant diversion of traffic to

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local roads. The municipal transportation plan or official map should be consulted to determine if desired new roadway links in the area of the development are identified.

### Access Management Plans

An Access Management Plan will recommend comprehensive strategies for controlling access points along arterial roadways within the study area, by identifying opportunities for closing, combining or moving existing driveways, and by identifying optimal locations for future driveways and opportunities for frontage and mutual access roads on undeveloped properties.

Access management is a tool to improve vehicular flow and safety for motorists, pedestrians and bicycles through improved control of the location, spacing, design and operation of driveways along a roadway. Preparing and implementing recommendations for improving access management along arterial roadways in the study area, along and proximate to the subject property, is thus a possible mitigation strategy. This strategy should be primarily considered for existing or planned commercial corridors. As part of this strategy, the applicant should coordinate with adjacent landowners and identify the potential for eliminating and/or combining access points, thus reducing the overall number of driveways along the major roadways and removing them from the influence area of roadway intersections. Ideally, the municipality would pass an ordinance incorporating access management strategies such as minimum driveway spacing, and investigation of shared driveways.

Applicants are encouraged to refer to information from the Department on [Access Management Ordinances](#).

### Multi-Modal Plan

A Multi-modal Plan will recommend new facilities, programs, and other strategies for accommodating and encouraging pedestrians, bicyclists and transit users. This should not be limited to the study area, but should prioritize facilities wherever needed in the municipality, and comprehensive strategies for alternative modes.

### Pedestrian Facilities

The need for sidewalks and crosswalks, pedestrian signs and signals, and other pedestrian facilities shall be evaluated as part of all development projects. The need for sidewalks is assumed for all projects within urban contexts; the need for sidewalks is assumed as part of any projects within suburban or rural contexts that would generate regular pedestrian activity. In very low-density areas, where the number of existing pedestrians, and pedestrians projected based upon planned development is less than five per day, pedestrians can be accommodated through other means, such as shoulders.

As a mitigation strategy, in addition to installing sidewalks on the subject property, consideration can be given to the installation of sidewalks along other roadway segments in the study area. The applicant should identify key “missing links” along the roadways adjacent to the development, and along other arterial and collector roadways. Provision of

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an easement to permit installation of a sidewalk not along a public roadway, enabling pedestrian access between key roads, should also be considered. The focus should be on improving the connections between medium- to high-pedestrian generators, thus enhancing pedestrian mobility throughout the larger area. The municipal transportation plan or other pedestrian plans should also be consulted.

The applicant should evaluate the need for other pedestrian facilities at intersections and mid-block crossings in the study area, including pedestrian signals, signs and crosswalks. As mentioned in Step 1, applicants must adhere to a core principle of ADA: If pedestrian facilities are provided, they must be accessible to persons with disabilities.

### Transit Facilities

The applicant shall evaluate and discuss the potential for increased demand for bus use due to the proposal, addressing whether such increases will increase the number of stops, dwell time, or the frequency of service for existing bus routes in the study area. The applicant shall also evaluate the need for new bus routes. As a mitigation strategy, the applicant could provide funding for planning new transit routes or modification to existing routes, and for the operating costs of such service for the first one to two years of operation.

Improvements to the safety and security of transit stops and low-cost design elements, such as transit shelters and sidewalks in proximity to transit stops, should also be considered.

There are a number of transit agencies in Pennsylvania, and initiatives exist to encourage transit-oriented development. Applicants are encouraged to visit the [Pennsylvania Public Transit Association](#) website and the [Department page](#) on public transit by county.

### Bicycle Facilities

The applicant should evaluate the need for bicycle facilities on the subject property, whether a bike lane, bicycle-compatible shoulder, or multi-use path. On-road bicycle facilities are of greater priority on arterial and collector roadways. Off-road paths provide the greatest benefit in fairly limited situations – for example, as part of linear recreational or natural areas. This evaluation should consider the opportunity to connect to other bicycle facilities in the study area, and whether there is a comprehensive plan prepared for the municipality, county or regional planning office identifying desirable bicycle facilities within the region. Installed in isolation, bicycle facilities may have minimal value, and the benefit of this mitigation strategy should be viewed accordingly. The applicant may also agree to install bike racks or other bike parking facilities at high bicycle generators in the community, such as parks, schools, and retail centers.

### Park and Ride

Park-and-ride lots have great value in reducing the number of vehicular trips on roadways heading into a regional employment destination. For this mitigation strategy, the applicant may provide park-and-ride parking spaces on the subject property, such as by designating such spaces in a retail center parking lot; provide these parking spaces on other properties controlled by the applicant in the region; or rent spaces on other properties within the region.

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The park-and-ride lot provided by the applicant does not need to be in the study area but should be positioned convenient to regional arterial roadways or transit lines and be located between the study area and regional employment destination, to better capture motorists from this commuter shed.

### Intelligent Transportation Systems

A number of ITS strategies may be funded by the applicant to help offset the traffic impacts of the subject property. Along higher order roadways on which closely spaced traffic signals are not coordinated, the applicant could fund the physical interconnection of signals in order to create a coordinated traffic signal system. The applicant should evaluate different signal phasing plans and recommend the most efficient plan for the study area corridor. Another option would be the installation of Variable Message Signs (VMS) along regional arterial roadways within five miles of the development, focusing on roadways leading to regional employment centers, in order to better inform motorists of travel conditions on those roadways. In conjunction with VMS, or as a separate strategy, the applicant may fund the installation of traffic cameras along regional arterial roadways, in order to monitor traffic flow and incidents on these roadways.

### Traffic Signal Assets Management Plan

A Traffic Signal Assets Management Plan will provide recommendations on signal timing for all intersections within an agreed upon area in order to optimize traffic flow and detail a strategy for periodic re-evaluation and re-timing of signals in the future. It will also offer recommendations on a preventive maintenance program that can be adopted by the host municipality and set the funding responsibility by the applicant.

### Sample Alternative Transportation Plan

The alternative transportation plan shall be a bound document submitted to the Department separate of the TIS document. If approved by the Department, the ATP shall be included in the final TIS submitted to the Department. The ATP shall contain the following information:

- 1) Proposed project overview
  - a. Provide a map that encompasses the proposed development site as well as the impacted area.
  - b. Provide the development description.
    - i. Type of Land use, Size, Trip Generation.
    - ii. Trip assignment figure.
    - iii. Total traffic volume assignment figure.
    - iv. Additional information as needed to describe the extent of the development.
  
- 2) LOS Table highlighting the specific impacts.

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- 3) Picture(s) of intersection(s) impacted.
  - 4) Construction cost estimate for highway improvements, including, but not limited to, R/W and utility costs, which will fully mitigate impacts.
  - 5) Conceptual plans at a reasonable scale that depicts the highway improvements which will fully mitigate impacts.
  - 6) Conceptual plans at a reasonable scale that depicts highway improvements the applicant intends to implement which will partially but not completely mitigate impacts (as applicable).
  - 7) Detailed justification as to why all or a portion of the highway improvements are not feasible.
  - 8) Detailed justifications as to why foregoing the particular highway improvements will jeopardize neither public safety nor the highway/bridge infrastructure.
  - 9) Proposed ATP
    - a. Description of the ATP.
    - b. Description how the ATP addresses mitigation (Is it reasonable?).
    - c. Explanation/documentation of how the ATP will be legally enforced.
    - d. Cost estimate to implement the ATP.
    - e. ATP implementation schedule.
    - f. Evidence that all key stakeholders concur.
  - 10) Signature Lines for District Executive and Central Permit Office Approval

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**ATTACHMENT F: TRANSPORTATION IMPACT STUDY (TIS) / TRANSPORTATION  
IMPACT ASSESSMENT (TIA) REVIEW CHECKLIST**

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## TIS / TIA Review Checklist

Instructions: Complete all applicable items in the checklist. **Please note that not all items listed are required for TIAs.** Mark items as Completed (C), Not Applicable (N), or See Additional Notes (S). For items marked See Additional Notes, provide necessary additional information on the Additional Notes section on the last page of this checklist. Checklist items with multiple requirements shall be completed as shown. If part of the checklist item is not completed, provide reason(s) or justification in the Additional Notes section.

Checklist regulation and publication references can be found in the following documents:

- [67 Pa. Code Chapter 441 – Access to and Occupancy of Highways by Driveways and Local Roads](#)
- [Publication 10X – Design Manual Part 1X - Appendices to Design Manuals 1, 1A, 1B, and 1C](#)
- [Publication 46 – Traffic Engineering Manual](#)
- [Publication 149 – Traffic Signal Design Handbook](#)
- [Publication 282 – Highway Occupancy Permit Operations Manual](#)

### Section 1 – General Requirements

C N S

- (1) Provide signature and seal of licensed PA P.E. on the front cover (**Pub. 282, App. A, Introduction**)
- (2) Follow TIS example format as identified in **Pub. 282, App. A, Att. C** or as agreed upon by the PennDOT District
- (3) Provide any additional information as required by the PennDOT District (**67 Pa. Code §441.3(k)**)

### Section 2 – Executive Summary

C N S

- (1) Provide a high level, concise summary of the following: (**Pub. 282, App. A, Att. C**)
  - Project location and scope
  - Proposed development
  - Anticipated development impact
  - Mitigation strategies and improvements
  - Financial responsibilities of improvements
  - Design waivers requested (if applicable)

### Section 3 – Introduction/Project Summary

C N S

- (1) Provide a summary of the scope of the project including description of the following: (**Pub. 282, App. A, Att. C**)
  - Traffic analyses and assumptions
  - Study area/roadway network
  - Site layout
  - Project phasing

### Section 4 – Data Collection

C N S

- (1) Describe data collection efforts and methodology per Step 2 in the Policies and Procedures for Transportation Impact Studies Related to Highway Occupancy Permits: (**Pub. 282, App. A, Step 2**)
  - Volume counts
  - Land use context
  - Sight distance and site access
  - Study area photos
  - Crash data
  - Multimodal facilities



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## Section 5 – Existing Study Area Conditions

### C N S

- (1) Discuss the following existing conditions: (**Pub. 282, App. A, Step 3 and Att. C**)
  - Surrounding land use
  - Existing traffic volumes and level of service/delay
  - Crash analysis (**Provide full crash analysis as separate bound document**)
  - Pedestrian/bicycle/transit activity and accommodations
  - Queue analysis (if applicable)
  - Gap analysis (if applicable)
  - Travel time studies (if applicable)
  
- (2) Document traffic engineering software utilized to perform capacity and crash analysis (**Pub. 282, App. A, Step 3**)

## Section 6 – Opening Year and Design Year Traffic Conditions without Development

### C N S

- (1) Discuss background traffic utilized to calculate opening and design year traffic volumes using growth factor and planned and permitted developments (**Pub. 282, App. A, Step 4**)
  
- (2) Include opening year and design year without development traffic volume and capacity analysis as figures (**Pub. 282, App. A, Step 9**)
  
- (3) Include opening year and design year without development queue and turn lane analysis (if applicable) (**Pub. 282, App. A, Step 9**)
  
- (4) Describe and include committed transportation improvements (**Pub. 282, App. A, Att. C**)

## Section 7 – Development Description

### C N S

- (1) Provide brief description of proposed site access – permissible movements and distance to intersection (**Pub. 282, App. A, Step 8**)
  
- (2) Provide brief description of sight distance analysis (**Pub. 282, App. A, Step 2**)
  
- (3) Provide brief description of proposed trip information: (**Pub. 282, App. A, Step 5 and 7**)
  - Total number and peak hour trips generated (include modal reductions if applicable)
  - Internally captured trips
  - Pass-by and diverted link trips
  - Trip distribution/assignment
  
- (4) Provide brief description of post development study (if applicable) (**Pub. 282, App. A, Att. C**)
  
- (5) Indicate if planned developments are consistent with formal land use plans (**Pub. 282, App. A Step 4**)

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## Section 8 – Opening Year and Design Year Traffic Conditions with Development

### C N S

- (1) Provide brief description of strategies to manage anticipated demand (**Pub. 282, App. A, Step 11**)
- (2) Include traffic assignment diagrams with percentages and volumes indicated as figures (**Pub. 282, App. A, Step 8**)
- (3) Include opening year and design year capacity analysis as tables (**Pub. 282, App. A, Step 9**)
- (4) Include left turn signal phasing analysis if required by Pub 149 (**Pub. 149, Ch. 3.1**)
- (5) Include queue analyses if required by Pub 46 (**Pub. 46, Ch. 10.2**)
- (6) Include turn lane warrants/length analysis if required by Pub 46 (**Pub. 46, Ch. 11.16**)
- (7) Include signal warrant if applicable (**Pub. 282, App. A, Step 10**)
- (8) Include weaving analysis if applicable (**Pub. 282, App. A, Att. C**)

## Section 9 – Mitigation Identification and Recommendations

### C N S

- (1) Provide mitigation analysis and description of proposed mitigation (**Pub. 282, App. A, Att. C**).
- (2) Provide concept plans of full mitigation at 1:50 scale. (**Pub. 282, App. A, Step 9**).
- (3) Provide cost estimate (**Pub. 282, App. A, Att. C**)
- (4) Provide Alternative Transportation Plan (ATP) as separate document (if applicable) (**Pub. 282, App. A, Step 11**)
- (5) Provide Design (LOS) Waiver as a separate document (if applicable) (**Pub. 282, Ch. 2.6**)

## Section 10 – Conclusions

### C N S

- (1) Summarize study findings and recommendations (**Pub. 282, App. A, Att. C**)

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## Section 11 – Appendices

### C N S

- (1) Include Intersection Control Evaluation (**Design Manual Part 1X, Appendix AI**)
- (2) Include scoping meeting application and any correspondence with the Department (**Pub. 282, App. A, Att. C**)
- (3) Include Proposed Site Plan (**Pub. 282, App. A, Att. C**)
- (4) Include Cost Estimate (**Pub. 282, App. A, Att. C**)
- (5) Include Turning Movement and 24-Hour Volume Counts (**Pub. 282, App. A, Att. C**)
- (6) Include existing signal plan(s) and permit plan(s) if applicable (**Pub. 282, App. A, Step 3**)
- (7) Include roadway data in form of field sketches if applicable (**Pub. 282, App. A, Att. C**)
- (8) Include background traffic growth (**Pub. 282, App. A, Step 4**)
- (9) Include trip distribution figures, supporting assumptions and calculations, and engineering justification (**Pub. 282, App. A, Step 7**)
- (10) Include volume spreadsheet indicating baseline traffic growth volumes and generated traffic (**Pub. 282, App. A, Att. C**)
- (11) Include capacity and queue analysis worksheets or analysis reports for all analysis scenarios (**Pub. 282, App. A, Att. C**)
- (12) Include pedestrian/bicycle checklist located in Design Manual Part 1X, Appendix S (**Pub. 282, App. A, Step 2**)
- (13) Include crash analysis as a separately bound document (**Pub. 282, App. A, Att. C**)
- (14) Include gap study (**Pub. 282, App. A, Att. C**)
- (15) Include traffic signal warrant analysis (**Pub. 282, App. A, Att. C**)
- (16) Include left turn signal phasing analysis (**Pub. 282, App. A, Att. C**)
- (17) Include turn lane analysis (**Pub. 282, App. A, Att. C**)
- (18) Include approved Alternative Transportation Plan (ATP) if applicable (**Pub. 282, App. A, Att. C**)
- (19) Include Design (LOS) Waiver Request/Approval if applicable (**Pub. 282, App. A, Att. C**)
- (20) Include any additional supporting analysis data as required as part of the approved TIS Scoping Meeting Checklist. List the additional analyses below. (**Pub. 282, App. A, Step 10**)

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**Additional Notes**

For any items marked See Additional notes (i.e., S), provide necessary additional information. For ease of reference, please refer to the applicable comment by its numerical number (For example, 1.2, 3.5, etc.).

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**ATTACHMENT G: CONVENIENCE MARKET WITH GASOLINE PUMPS**

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The following guidance should be followed when completing studies for various sized convenience markets with gasoline pumps:

### Trip Generation

ITE states, "Convenience Market with Gasoline Pumps (Land Use 853), Gasoline/Service Station with Convenience Market (Land Use 945) and Super Convenience Market/Gas Station (Land Use 960) were re-assigned to a single new land use Convenience Store/Gas Station (Land Use 945). Multiple subcategories were added to this land use to allow for multi-variable evaluation with single-variable data plots. Convenience Market with Gasoline Pumps (Land Use 853) and Super Convenience Market/Gas Station (Land Use 960) were removed as land uses."

Existing Facilities: For existing facilities that are being rebuilt or being relocated within the same municipality, traffic counts shall be completed at the existing site driveways and local trip generation rates established for each analysis period. The engineer should then determine whether the local trip generation rates or the ITE rates should be used based on the proposed location, size and adjacent traffic conditions.

Local Trip Generation: Although a proposed development might correspond to the ITE land use code with adequate data points, the applicant may request or the Department may require the use of data collected at comparable sites if there is reason to believe that site trip generation will vary from ITE rates.

### Pass-by Trips

- 1) Weekday A.M. Peak Period and Weekday P.M. Peak Period: Use the pass-by and non-pass-by trip tables in the ITE *Trip Generation Handbook* to determine the appropriate land use pass-by trips.
- 2) Saturday Midday Peak Period: Use ten percent less than the Weekday P.M. Peak Period average pass-by trip percentage provided in the *ITE Trip Generation Handbook* for applicable land use.
- 3) According to ITE's *Transportation Impact Analyses for Site Development*, adjustments should be made to the number of pass-by trips if the results do not appear to be logical or reasonable given the characteristics of the road system and trip distribution. For example, ITE's *Transportation Impact Analyses for Site Development* states that pass-by trips diverted from a thoroughfare should be rechecked if they represent more than 15 percent of the traffic volume on that street.

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## Driveway Design

The study should identify the driveway classification (low volume, medium volume, or high volume), as defined in PA Code Title 67, Chapter 441.1, for each driveway serving the proposed development. If the design standards provided in PA Code Title 67, Chapter 441.9 for the driveway classification cannot be met (i.e., driveway throat length), justification must be provided. Queue analyses should be completed for the driveway egress to justify driveway throat lengths that are less than those shown in the standards. The site should also be designed to ensure that site traffic circulation (e.g., the location of the gasoline pumps and parking spaces) will not negatively impact the driveway operation. For sites being designed to accommodate trucks, the location of on-site trucking facilities and the impact on site circulation and driveway operation should also be considered.

## Access Management

The study should evaluate the need to restrict turning movements at the proposed driveway(s). If a driveway is proposed within the functional area or corner clearance of an intersection as described in TRB's *Access Management Manual*, consideration to restrict turning movements should be analyzed based on but not limited to the site design, the adjacent street lane configurations, traffic volumes, traffic speeds, type of highway being accessed, and alternative access points. Additional restrictions may also be required such as the complete elimination of the proposed access.