CITY OF SOMERVILLE
Transportation Impact Study (TIS) Guidelines
Mobility Division, Mayor's Office of Strategic Planning & Community Development

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1. Overview

The Transportation Impact Study (TIS) is an analysis of existing transportation infrastructure and anticipated transportation impacts from a proposed development project. The Mobility Division of the Office of Strategic Planning & Community Development is the City department responsible for reviewing this study and certifying its accuracy and completeness. These Transportation Impact Study Guidelines represent a set of uniform guidance for project proponents.

2. Study Scope

The scope of the TIS must be approved by the City of Somerville before the start of any study. A scoping request letter with the following information should be submitted to the Director of Mobility. The scoping request letter shall include:

2.1. **Project description and overview,** including project location, site program (land uses and gross floor areas), location of the site access driveway(s) (note which driveways are existing, new, and/or relocated), location of site access walkway(s) and door(s) to the extent known.

2.2. **Previous or Existing Land Uses,** to include floor area, occupancy, use of existing building(s) and counts of entering and exiting vehicles during the am and pm peak hours. If the proposed land use is a commercial use or another use which may generate significant Saturday trips, Saturday afternoon peak period data should be also be included.

2.3. **Vehicle Trip generation,** including any remaining use(s):

2.3.0. Based on ITE *Trip Generation* (latest edition) data. Person trips shall be derived from ITE trips by multiplying by the Average Vehicle Occupancy for the corresponding Census tract from the most current U.S. Census journey-to-work data. Modal splits from the corresponding Census tract shall be applied, unless an alternate is approved by the City. Total vehicle trips shall be calculated as the "drive alone" plus "carpool" percentages, divided by the AVO. Anticipated truck trips shall be added to the vehicle component. The balance of ITE trips shall be allocated as the person-trips among other modes, including transit, bicycle, walking taxi, etc. Trips listed as "other" in Census data shall be proportionally assigned to all other modes. The project trip analysis shall be summarized in a table format, indicating daily and peak hour (entering/exiting/total) trip rates, adjustments, and summarized with project trips by mode.

2.3.1. Any existing trips may be subtracted from new trips to generate a net new vehicle trip total, with Mobility approval. Existing peak hour vehicle trips to/from the site shall be generated based on direct am and pm peak hour counts by a certified traffic counting company. If these are no longer possible due to a discontinued use within the previous year, mode-adjusted ITE trip rates may be used with Mobility approval. Any trips created by a previous use that has been discontinued for over one year may not be discounted from new trips.

2.3.2. For projects including retail (non-ancillary) uses, a pass-by factor of up to 25% can be applied for site traffic associated with these retail uses assigned on the major through street.

2.3.3. Quantify project truck trips by time of day, vehicle type, and routes in a separate table.

2.4. <u>Background Growth Rate,</u> it is important that the assumed background vehicle growth rate aligns with the City's SomerVision mode shift goals. Therefore, the growth rate shall be calculated based on other planned projects. The City recommends a growth rate of 0-0.25% unless there is available data to justify otherwise.

2.5. **<u>Scope approval:</u>** The Mobility department will issue a scope approval email or letter to allow preparation of the TIS which will include the following:

2.5.0. Any necessary changes to trip generation, background growth rate, trip distribution, or mode split assumptions;

2.5.1. Which study area roadway intersections are to be analyzed;

2.5.2. Where daily vehicle, bicycle, and pedestrian counts are to be conducted;

2.5.3. What specific development projects are to be included in the future condition;

2.5.4. Whether analysis may be required that may require advanced traffic analysis software (VISSIM); and

2.5.5. Any other pertinent information about the specific TIS.

3. Components of TIS

The following is a standard list of requirements for any project requiring a TIS. Variations from these guidelines must be approved by Director of the Mobility Division.

3.1. <u>Existing Conditions Inventory</u>

3.1.0. Roadways:

a. Typical number of travel lanes and widths, bicycle accommodations and widths, approximate sidewalk width and condition, and parking regulations. Also include any qualitative information about the pedestrian and bicycle environment along the roadway, e.g. curb cut frequency and width, presence and frequency of street trees, presence of bicycle racks, etc.

b. Sidewalk width shall be measured at a typical point along the sidewalk (i.e. not at bump-outs), and both actual width and effective width (actual width less space allocated for frequent street furniture, blank building faces, trees, parking meters, bicycle racks, etc.) shall be measured along both sides of each study area roadway segment. If sidewalks are in poor condition, i.e. difficult or impassible for persons with disabilities, this too should be noted.

3.1.1. Intersections:

a. Describe operations of all study area intersections, including number and width of approach lanes on each approach, lane assignments, signal phasing, and crosswalk locations, patterns, and widths. At signalized intersections, crosswalk lengths, signal phasing, and pedestrian "WALK" and flashing "DON'T WALK" time shall be documented.

3.1.2. Provide figures for:

a. Transit services, including bus and transit stops, shelters, stations, and routes within the study area. If applicable, include private shuttle services, school bus stops, etc.
b. Land use, indicating study area and any relevant land uses, including schools, parks, playgrounds, government buildings, hospitals, etc.

3.2. <u>Existing Conditions Data Collection</u>

3.2.0. Automatic Traffic Recorder (ATR) counts for speed, volume, and vehicle class for a 72-hour period from 12:00:00 am Thursday through 11:59:59 pm Saturday. Count dates shall be approved by the Mobility Division, and should avoid holidays or holiday weekends, school vacations, etc. ATR data shall be seasonally adjusted, in accordance with the nearest MassDOT permanent count station (non-limited access highway) data; if appropriate MassDOT data is not available, MAPC data may be acquired. Full 15-minute increment results must be submitted electronically. An average daily summary in one-hour increments should be included in the report. If counts are not collected during the months of April, May, September, or October, then a second set of counts must be taken during these months as part of mitigation for the project. Locations must receive prior approval by the City of Somerville.

3.2.1. Intersection turning movement counts (TMC's) must be collected at all study area intersections for motor vehicles, bicycle, and pedestrians. TMC's will be collected for one 14-hour weekday count from 6:00 am-8:00 pm. Projects with a retail component must also include a 4-hour Saturday count from 10:00 am – 2:00 pm. Counts should be avoided on municipal or religious holidays or holiday weekends, school vacations, etc. Counts are not valid in inclement weather (heavy rain or snow). If counts are not collected during the months of April, May, September, or October, then a second set of counts must be taken during these months as part of mitigation for the project. Locations must receive prior approval by the City of Somerville.

All TMC's should include:

a. Total cars, trucks, and buses, reported separately by each movement;
b. Pedestrians, by each crossing, each direction, and each side of street;

c. Bicycle turning movements, by street and direction, including bikes on sidewalks (counted separately); and

TMC's should not be taken at the following times where possible. If necessary, they must be approved by Mobility. **Such data shall be seasonally adjusted, as follows (these guidelines are cumulative):**

- When colleges are not in regular session, increase by 3 to 6 percent, depending on proximity to colleges. Adjustment to be approved by Mobility.
- When public schools are not in session, increase by 3 to 5 percent, depending on proximity to public schools. Adjustment to be approved by Mobility.
- During July and August employee summer vacations. Increase by 4 percent.

Raw data collection sheets shall be included in the Appendix. Data shall be submitted electronically to the City in Excel format.

Peak hours shall be determined for the study area as a whole unless otherwise directed by Mobility. Vehicle traffic counts for this peak hour shall be balanced between study area intersections unless discrepancies can be reasonably assigned to intersections and driveways not included in the study area. Peak hours for bicycles and pedestrians shall be determined separately, though volumes do not need to be manually balanced.

TMC's for total vehicles in the am and pm peak hour shall be summarized on separate figures. TMC's for total vehicles in the am and pm shall be summarized on separate figures. TMC's for pedestrians and bicycles shall be shown in separate figures. Vehicle queues for am and pm peak hours shall be summarized in a single figure, if possible, or two separate figures if needed for clarity. The appropriate peak hour for the corresponding mode shall be clearly labeled on each figure.

3.2.2. **Traffic crashes** in the study area, summarized in a table from City of Somerville records provided by Mobility, for the previous 3-year period, summarized by date, crash type, injury, involvement of trucks and/or MBTA buses, involvement of pedestrians and/or bicycles, lighting, surface condition, and weather.

3.2.3. **Public Transit**: Obtain most recent daily, am, and pm boarding and alighting information (include Saturday for residential or retail projects) for light and heavy rail stops/stations within a ½ mile walk of the project site, as well as the closest bus stop for all bus routes within a ½ mile walk of the project site. Describe the amenities and deficiencies, if any, for each such bus stop (bus shelters, benches, insufficient pull-in space, etc.). Also include a summary of transit schedules and headways for each service. Summarize boarding/alighting data and schedule/headway information in separate tables.

3.2.4. **Parking**: For any existing parking to remain with the project, perform a utilization study, including peak accumulation for motor vehicles, carpools, and bicycles. For residential projects, also collect utilization data for resident permit parking spaces within one block of the project site, separated by individual street. Report utilization data in a table.

3.2.5. **Traffic signal timing information** will be provided by the City of Somerville, if available. If such information is unavailable, signal timings shall be collected by the consultant in the field and modeled as accurately as possible.

3.3. **Existing Conditions Transportation Analysis:** Vehicle, pedestrian, bicycle, and transit operations shall be analyzed both qualitatively and quantitatively based on the methodology below.

3.3.0. **Vehicle analysis** shall be conducted for each study area intersection for the weekday am and pm peak hours, and for the Saturday midday peak hour for projects with a retail component. Analysis shall include TMC's, capacity analysis, and queue analysis. Signalized and stop-controlled intersections shall be analyzed using Highway Capacity Manual (HCM) methodology, including software such as Synchro or similar. Roundabout analysis shall be conducted using software such as SIDRA or similar. In some cases, the City of Somerville may ask that in-depth analysis using software such as VISSIM be used for complex intersections or intersection clusters; in this case, Mobility will notify the proponent of this need when scoping the project and prior to data collection**. Items to consider when performing traffic analysis include:**

a. *Existing Conditions models shall be calibrated* with observed conditions in the field. Observed conditions such as average delay, queue length, and capacity of the intersection should, within reason, match the conditions output by the traffic analysis. Factors such as saturated flow rate, parking maneuvers, pedestrian and bicycle conflicts, bus maneuvers, and area type may be adjusted based on engineering judgement in order to calibrate the existing conditions model.

b. *Peak Hour Factor* shall be determined on an approach-by-approach basis (not a movement-by-movement basis) unless a particular movement has a dedicated lane and, for a known reason, produces more variable traffic than the other movements along its approach.

c. *Capacity analysis summary tables* (CASTs) shall be provided for each peak hour analyzed and shall include LOS letter grade, average delay, volume-to-capacity ratio (V/C), and $50^{th}/95^{th}$ percentile queue lengths (95^{th} percentile only for unsignalized intersections). HCM 2000 methodology shall be used unless otherwise directed by Mobility. CASTs shall include overall intersection LOS letter grade, delay, and V/C. All intersections and lane groups that are over 1.00 V/C shall receive an LOS letter grade of F regardless of the average delay reported.

3.3.1. **Bicycle analysis** shall be conducted along each study area roadway segment and intersection using Bicycle Level of Traffic Stress (BLTS) methodology. This methodology can be found in Appendix A of this document. Each roadway segment and each direction of travel shall be analyzed; if conditions change within a segment, e.g. at an intersection approach, the highest-stress portion of that segment shall represent the entire segment. This data shall be summarized in a color-coded figure and explained in tabular and/or text format. If intersection treatments are present at any of the study intersections, this may not be reflected in LTS analysis; however, these treatments shall be described in text format.

3.3.2. **Pedestrian/ADA analysis** shall be provided for each roadway in the study area. The most logical walking route(s) between the project site and the closest MBTA subway/light rail station(s) serving different transit lines within a ½-mile radius of the site shall also be included in this analysis; as well as the most logical walking route(s) between the project site and the closest bus stop of each bus route within a ¼-mile radius of the site. Sidewalk segments and unsignalized intersection crossings shall be analyzed using the Pedestrian Level of Traffic Stress (PLTS) tool, which can be found in Appendix B of this document.

In addition to sidewalk analysis, pedestrian delay analysis shall be conducted at all signalized intersections in the study area. In tabular form, the crosswalk location, length, and available crossing time shall be compared to the "WALK" time and flashing "DON'T WALK" time required by the MUTCD, based on a walking speed of 3.5 fps (feet per second). An assumed walking speed of 3.0 feet per second should be used (and may be required by the Director of Mobility) in locations where seniors or persons with disabilities are common. Maximum pedestrian delay shall also be provided for each crosswalk, and analysis should note whether a crosswalk has exclusive, concurrent, or protected pedestrian phasing.

3.3.3. **Transit analysis** shall be included for all projects located within 0.5 miles of an MBTA bus or rapid transit station. For each available service within 0.5 miles of the site, the walking travel time and distance to the closest station, average wait time for each service, and conditions of the stop or station shall be described. If available, on-time performance and average occupancy of each route at the stop or station closest to the project site should also be provided.

3.4. **<u>Future Transportation Analysis:</u>** Future vehicle, pedestrian, bicycle, and transit operations shall be analyzed for the following conditions, unless alternative analysis conditions are approved by the Director of Mobility:

- **Build conditions:** Existing conditions plus project generated traffic, without any future off-site infrastructure changes. The purpose of this method is to assess the impacts of projects on a roadway network that operates similarly to the existing conditions, before factoring in potential future traffic growth.

- **Build conditions with mitigation (if mitigation impacting this analysis is proposed):** Build condition with assumptions for off-site transportation infrastructure changes only, including traffic signal operation changes.
- **Design year Build conditions (with mitigation if proposed):** Build condition traffic, with assumptions for offsite transportation infrastructure changes, plus background development projects and growth rate applied for the approved design year.

3.4.0. **Vehicle analysis shall be repeated for each condition.** Analyses for two peak hours (and the Saturday midday peak for retail projects) shall be performed, to include TMC's, capacity analysis and queue analysis. All future year analysis shall be compared to existing conditions in a table, and summarized in text. If subsequent analysis or analyses are conducted, all analyses shall be compared to one another in a table.

3.4.1. **Pedestrian and bicycle analysis shall also be repeated** if roadway conditions are anticipated to change in a future condition, e.g. as part of background infrastructure or project mitigation**.** All future year analysis shall be compared to existing conditions in a table, and summarized in text. If subsequent analysis or analyses are conducted, all analyses shall be compared to one another in a table.

3.4.2. **Project Traffic:** The trip generation material in the approved scope shall be repeated here. Include total trip generation, as well as truck generation in a separate table. Trip generation shall be separated by land use, mode, and entering/exiting/total. Land use codes and specific trip generation rates must be listed.

3.4.3. **Project Trip Distribution** shall be estimated based on U.S. Census Journey to Work data. Locally, trips shall be assigned to the most logical routes. Assigning trips to roadways that are at capacity or approach an intersection with high delay shall be avoided. If trips are assigned to roadways and intersections outside the project study area, this should be explicitly noted in the report. Trip distribution shall be approved by Mobility before Build condition analysis is conducted. Graphics showing trip distribution by percentage entering and exiting for each period, as well as entering and exiting project trips for each period, shall be provided.

3.4.4. **Future Traffic Conditions:** The design year shall be five years in the future or three (3) years after the anticipated completion of the building(s) occupancy, whichever is later, unless otherwise directed by Mobility. For phased projects, multiple design years may be required, in which project occupancy, background traffic, and/or roadway improvement projects may vary.

a. **Background Development Projects** are projects that have been permitted and are projected to send vehicle trips through study area intersections. Trips from these projects shall be added to base year traffic volumes in future conditions analysis . Anticipated projects that do not have vehicle trip distribution data available may be estimated using trip generation methodology, or absorbed into the background growth rate (discussed below) if approved by Mobility.

b. A **Background Growth Rate** shall be applied to base year vehicle traffic volumes. If available, counts from at least two different years at a nearby location may be used to calculate the appropriate growth rate. If data shows zero or negative growth rate, then the growth rate may be omitted. Background growth rates shall be approved by Mobility.

3.4.5. **Future Parking Analysis** of the project site and the project's impact on on-street parking within a one-block radius of the site shall be included in a table or tables. Methodology for determining future parking demand shall be included, and may include factors such mode share; vehicle occupancy rate; shared parking with adjacent sites, etc.

3.4.6. **Future Transit analysis** shall be conducted for the Build (and Build with Mitigation, if results vary) conditions. Analysis of increased transit system use shall be conducted for each affected service in each peak period studied. Analysis shall include project-related transit trips as a percentage of existing ridership, and the impact of project-related transit trips on total capacity of the transit service. If analysis is conducted for a future design year, assume a background transit growth rate of 1% per year unless otherwise directed by the City.

3.5. **Project Mitigation:** This section will discuss all mitigation measures proposed for the project, including those that would not affect vehicular, bicycle, or pedestrian analysis (e.g. streetscape items). All TIS shall include proposed mitigation measures appropriate to the project's size and impact. Improvements to mitigate project-related deterioration in vehicle LOS should be addressed to the extent possible within the existing vehicular footprint of the study area roadways and intersections; however, it is acceptable and encouraged that mitigation for deteriorating vehicle service be accomplished by improvements to the pedestrian, bicycle, and/or transit facilities within or in proximity to the project study area. Improvements to mitigate existing deficiencies identified in the bicycle and pedestrian analysis should be identified, particularly those abutting the development site and along major pedestrian and bicycle routes of access to and from the development site. Mitigation locations shall be shown in a graphic.

The benefits and drawbacks (if any) of each mitigation item shall be discussed; for example, signal retiming may result in a reduction in overall vehicle delay, but may increase delay on one approach. Mitigation items shall be approved by the City prior to preparation of the TIS. Improvements may include, but are not limited to, the following:

- Intersection improvements
  - Geometry or pavement markings
  - Signal controls, equipment, and timing
  - Curb cut locations
- Pedestrian accommodations
  - Crossing improvements
  - Sidewalks or other amenities
- Bicycle accommodations
  - Bicycle facilities (new or upgrades to existing)
  - Bicycle signals
  - Off-street bicycle facilities
  - Public bicycle parking
  - Bike share stations
- Transit service enhancements
  - Station improvements
  - New services
  - Improved routing
  - Monetary payments to MBTA offsetting impact
  - Private transit services (shuttles)
- Adjacent Public/Private Infrastructure Improvements
  - Transit shelters
  - Benches
  - Street furniture
  - Parklets
  - Bicycle repair stations

3.6. **Transportation Demand Management** This section will discuss measures that the project will take to reduce its impact on the transportation network. Generally, these measures will help to discourage the use of private automobile to access or egress the site, and encourage walking, bicycling, and use of transit. Such measures may include:

- Parking spaces reserved for car share (e.g. Zipcar)
- Electric vehicle (EV) charging stations
- Hubway station(s)
- Subsidized MBTA passes for employees/residents
- Subsidized Hubway membership for employees/residents
- Posting of MBTA schedules and routing information
- MBTA fare kiosks on-site
- Showers/lockers for employee use
- Guaranteed emergency/bad weather ride home

Appendix A: Bicycle Level of Traffic Stress Methodology

Bicycle Level of Traffic Stress (BLTS) is based on methodology set forth by Mekuria, Furth, and Nixon in Mineta Transportation Institute (MTI) Report 11-19. The goal of BLTS is to identify gaps in the low-stress bicycling network and prioritize improvements to allow low-stress bicycle travel throughout a city or region. BLTS uses readily available data that can be collected in the field or on a recent, high-quality aerial. BLTS acknowledges that different facilities are appropriate on different streets and that not all bicycle lanes are created equal.

BLTS analysis for the City of Somerville shall apply as required in Section 3.3.1. of the Somerville TIS standards. BLTS for any segment or intersection crossing is calculated by considering all applicable tables and applying the lowest-score (highest numerical value) to the segment/crossing in question. For example, a segment that scored LTS 1 one table and LTS 4 on another table would automatically be classified as LTS 4. BLTS results are best shown graphically, though BLTS for street crossings may be best conveyed in a table.

BLTS Along Street Segments

BLTS can be determined along a segment by comparing the size of the bike lane (or bike lane plus parking lane) to the street width, prevailing speed, and the general amount of time a bike lane tends to be blocked. High BLTS as along segments can be mitigated by reducing the number of vehicle travel lanes along the street to one lane in each direction, adding width or a buffer to the bike lane, reducing the speed along the roadway in question, or reducing the likelihood that a bike lane is blocked.

BLTS analysis for segments are as follows:

Table 1A. Criteria for Bike Lanes Alongside a Parking Lane

	LTS ≥ 1	LTS ≥ 2	LTS ≥ 3	LTS 4
Street Width (through lanes per direction)	1	(no effect)	2 or more	(no effect)
Sum of bike lane and parking lane width (incudes marked buffer and paved gutter)	15 feet or more	14 or 14.5 feet[a]	13.5 feet or less	(no effect)
Speed limit or prevailing speed	25mph or less	30 mph	35 mph	40 mph or more
Bike lane blockage	Rare	(no effect)	Frequent	(no effect)

Note: (no effect) = factor does not trigger an increase to this level of traffic stress
a: if speed limit < 25mph or street type is residential, than any width is acceptable for LTS 2.

Table 1B. Criteria for Bike Lanes Not Alongside a Parking Lane

	LTS ≥ 1	LTS ≥ 2	LTS ≥ 3	LTS 4
Street Width (through lanes per direction)	1	(no effect	2 or more	(no effect)
Bike lane width (includes marked buffer and paved gutter)	6 feet or more	5.5 feet or less	(no effect)	(no effect)
Speed limit or prevailing speed	25mph or less	30 mph	35 mph	40 mph or more
Bike lane blockage	Rare	(no effect)	Frequent	(no effect)

Note: (no effect) = factor does not trigger an increase to this level of traffic stress

Table 2. Criteria for BLTS in Mixed Traffic

Speed Limit/ Street Width	2-3 Lanes	4-5 Lanes	6+ Lanes
< 25 mph	LTS 1 or 2[a]	LTS 3	LTS 4
25-30 mph	LTS 2 or 3[a]	LTS 4	LTS 4
> 30 mph	LTS 4	LTS 4	LTS 4

a: Use lower value for streets without marked centerlines or classified as residential and with fewer than 3 travel lanes; use higher value otherwise.

BLTS along physically separated bicycle lanes is LTS 1 by default, between intersections. Physically separated facilities isolate users from typical traffic stress. This also applies to any standalone path, shared use path, etc. Sharing space with pedestrians does not increase BLTS; the added delay and level of awareness that comes with sharing a space with pedestrians or other, nonmotorized road users is different from the real safety concerns that come with riding next to or mixed with vehicle traffic. However, if a physically separated facility is interrupted by frequent commercial driveway crossings, or if the facility commonly ramps down to street level to accommodate driveways, the City or the transportation professional preparing this TIS may opt to assign a higher BLTS to a segment.

BLTS Along Intersection Approaches

BLTS can be used to analyze the level of comfort of a standard bicycle lane as it approaches an intersection. These "pocket bike lanes", which run between a thru lane and a right-turn lane, can be stressful if drivers are not forced to deliberately turn through the bike lane at a slow speed. Right turn lanes in mixed traffic can be similarly stressful. BLTS analysis for *approaches to intersections* are as follows:

Table 3A. Level of Traffic Stress Criteria for Pocket Bike Lanes Approaching Intersections

Configuration	BLTS
Single right-turn lane up to 150 feet long, starting abruptly while the bike lane continues straight, and having an intersection angle and curb radius such that turning speed is ≤ 15 mph.	LTS ≥ 2
Single right-turn lane longer than 150 feet, starting abruptly while the bike lane continues straight, and having an intersection angle and curb radius such that turning speed is ≤ 20 mph.	LTS ≥ 3
> Single right-turn lane in which the bike lane shifts to the left but the intersection and curb radius are such that turning speed is ≤ 15 mph.	LTS ≥ 3
Single right-turn lane with any other configuration; dual right-turn lanes; or right-turn lane along with shared (thru/right) lane.	LTS 4

Table 3B. Level of Traffic Stress Criteria for Mixed Traffic in the Presence of a Right-turn Lane

Configuration	BLTS
Single right-turn lane with length ≤ 75 feet and intersection angle and curb radius limit turning speed to 15 mph.	LTS ≥ 3
Single right-turn lane with length between 75 feet and 150 feet and intersection angle and curb radius limit turning speed to 15 mph.	LTS ≥ 3
All other configurations	LTS 4

BLTS through Unsignalized Street Crossings

BLTS can be used to analyze the level of comfort of unsignalized intersections. Unsignalized crossings of major roadways can be a barrier to cycling, but this can be mitigated by reducing the size of the crossing, providing a median refuge, or reducing the prevailing speed of the street being crossed.

Crossings of major driveways should be considered a street crossing for the purposes of analysis. For the purposes of this analysis, the "speed limit" of driveways should be determined by the speed at which vehicles are able to make turns into a driveway. Typically, driveway crossings will be LTS 1 unless they are wider than 3 total lanes.

BLTS analysis for unsignalized intersection crossings are as follows:

Table 4A. Level of Traffic Stress Criteria for Unsignalized Crossings Without a Median Refuge

Speed Limit of Street Being Crossed	Width of Street Being Crossed		
	2-3 Lanes	4-5 Lanes	6+ Lanes
< 25 mph	LTS 1	LTS 2	LTS 4
25-30 mph	LTS 1	LTS 2	LTS 4
30-35mph	LTS 2	LTS 3	LTS 4
40+ mph	LTS 3	LTS 4	LTS 4

Table 4B. Level of Traffic Stress Criteria for Unsignalized Crossings With a Median Refuge at Least Six Feet Wide

Speed Limit of Street Being Crossed	Width of Street Being Crossed		
	2-3 Lanes	4-5 Lanes	6+ Lanes
< 25 mph	LTS 1	LTS 1	LTS 2
25-30 mph	LTS 1	LTS 2	LTS 3
30-35mph	LTS 2	LTS 3	LTS 4
40+ mph	LTS 3	LTS 4	LTS 4

BLTS does not apply through **Signalized Street Crossings.** These crossings should be evaluated **qualitatively**. Bike boxes, two-stage left-turn boxes, phase-separated right-turn lanes, dedicated bicycle signals, etc. can all improve bicyclists' comfort at signalized intersections.

Appendix B: Pedestrian Level of Traffic Stress Methodology

Pedestrian Level of Traffic Stress (PLTS) is based on methodology set forth by Oregon DOT. The goal of PLTS is to identify gaps in the low-stress pedestrian network and prioritize sidewalk enhancement. PLTS, like BLTS, uses readily available data that can be measured in the field or using recent, high-quality aerial imagery. PLTS acknowledges that, while bare minimum sidewalk widths must be achieved to ensure ADA compliance, the most comfortable sidewalks are physically separated from traffic and located along dense urban fabric.

Note that Oregon DOT's methodology includes a metric for the adjacent land uses along the sidewalk. While this is a valid metric for determining walkability and comfort level while walking, including this criterion is not appropriate for development proposals to analyze in the context of a TIS, as land uses outside of the proposed development site are outside both the City's and the Applicant's ability to mitigate in the short-term. As such, this criterion is not included in this methodology.

PLTS can be analyzed for sidewalk segments and intersection crossings. Sidewalk segment analysis should be presented graphically, while intersection analysis is likely best presented in tabular format. Like BLTS, PLTS is determined by applying the lowest score (highest numerical value) to a sidewalk segment after all metrics have been analyzed; for example, a sidewalk segment with a wide traffic buffer lined with trees would be PLTS 4 if the sidewalk itself was in poor condition or was less than four feet.

PLTS along Sidewalk Segments

PLTS is determined along sidewalk segments by comparing sidewalk condition and width to the size and material of the buffer between the sidewalk and moving vehicle traffic. Wider sidewalks and wider buffers, or buffers lined with trees, parked cars, or other vertical barriers provide the highest level of comfort for pedestrians. Mitigation for poor PLTS can be provided by repairing poor sidewalks, widening sidewalks, and/or providing a wider buffer with vertical barriers between the sidewalk and travel lanes. Note that, in order to achieve the highest level of comfort, the *effective* width of the sidewalk (the consistent usable width of the sidewalk, free of obstructions) must be at least six (6) feet.

Note that there is no PLTS metric for sidewalks that share a space with bicyclists, or sidewalks located alongside sidewalk-level bicycle lanes. Sidewalk segments that are PLTS 1 after applying all metrics may be adjusted to PLTS 2 if pedestrians on the sidewalk can expect to conflict with a significant number of bicyclists, such that the effective width available for pedestrians is less than 6 feet.

Table 1: Level of Stress Criteria Based on Sidewalk Width and Condition

Actual/Effective Sidewalk Width (ft)		Sidewalk Condition				
		Good	Fair	Poor	Very Poor	No Sidewalk
Actual	<4	PLTS 4	PLTS 4	PLTS 4	PLTS 4	PLTS 4
	≥4 to <5	PLTS 3	PLTS 3	PLTS 3		
	≥5	PLTS 2	PLTS 2	PLTS 2	PLTS 2	
Effective	≥6	PTLS 1	PLTS 1		PLTS 3	

Table 1B: Level of Stress Criteria Based on Buffer Type

<table>
<tr><th colspan="6">Physical Buffer Type</th></tr>
<tr><th rowspan="2">Buffer Type</th><th colspan="5">Prevailing or Posted Speed</th></tr>
<tr><th>≤20 MPH</th><th>25 MPH</th><th>30 MPH</th><th>35 MPH</th><th>≥40 MPH</th></tr>
<tr><td>No buffer (curb tight)</td><td>PLTS 2</td><td rowspan="2">PLTS 2</td><td>PLTS 3</td><td>PLTS 3</td><td>PLTS 4</td></tr>
<tr><td>Solid surface (e.g. bike lanes)</td><td rowspan="4">PLTS 1</td><td rowspan="2">PLTS 2</td><td rowspan="2">PLTS 2</td><td rowspan="4">PLTS 2</td></tr>
<tr><td>Landscaped</td><td rowspan="3">PLTS 1</td></tr>
<tr><td>Landscaped with trees</td><td rowspan="2">PLTS 1</td><td rowspan="2">PLTS 1</td></tr>
<tr><td>Vertical (e.g. parking)</td></tr>
</table>

Table 1C: Level of Stress Criteria Based on Buffer Width

<table>
<tr><th rowspan="2">Total Number of Travel Lanes (both directions)</th><th colspan="5">Total Buffering Width (ft)</th></tr>
<tr><th>≤5</th><th>≥5 to <10</th><th>≥10 to <15</th><th>≥15 to <25</th><th>≥25</th></tr>
<tr><td>2</td><td>PLTS 2</td><td rowspan="2">PLTS 2</td><td>PLTS 1</td><td rowspan="3">PLTS 1</td><td rowspan="3">PLTS 1</td></tr>
<tr><td>3</td><td>PLTS 3</td><td rowspan="2">PLTS 2</td></tr>
<tr><td>4-5</td><td rowspan="2">PLTS 4</td><td>PLTS 3</td></tr>
<tr><td>6+</td><td>PLTS 4</td><td>PLTS 3</td><td>PLTS 2</td><td>PLTS 2</td></tr>
</table>

PLTS at Unsignalized Crossings

At unsignalized crossings, pedestrians must judge the speed of vehicle traffic, often in multiple lanes and directions. Depending on the prevailing speed and traffic volume of a street crossing, this can be daunting. Median refuges help by reducing the number of lanes that a pedestrian must cross, but also allowing pedestrians to only judge the speed of one direction of traffic at a time. High levels of traffic stress can be mitigated by providing a median refuge, reducing the number of travel lanes to be crossed, and/or reducing the speed and/or volume of traffic.

Level of Stress Criteria Based on Curb Ramps: Crossing locations without ramps shall be PLTS 4. Crossing locations with substandard ramps, including ramps that are too steep, do not provide proper level landing areas, do not provide tactile warning panels, etc. shall be ranked no better than LTS 3.

Pedestrian Crossing Enhancements: This analysis does not account for pedestrian crossing enhancements, such as curb extensions, raised crosswalks, or activated beacons. Crossings one or more of treatments may improve the PLTS score that would otherwise be assigned to a given crossing by 1 point (0.5 points for curb extensions), up to a best possible score of PLTS 1. Multiple treatments do not provide a cumulative improvement to PLTS. For example, a crossing with a PLTS of 4 would improve to PLTS 3.5 if curb extensions were installed, and would improve to PLTS 3 if a ped activated beacon was installed. The application of such adjustments to PLTS is subject to the approval of the Director of Mobility. Engineering judgement should be exercised when applying these adjustments.

Table 2A: Level of Traffic Stress at Unsignalized Intersection Crossings of One or Two Lanes[1, 2, 3, 4]

Speed Limit or Prevailing Speed	Width of Street Being Crossed		
	No median refuge		Median Refuge Present
	Total Lanes Crossed		
	1 Lane	2 Lanes	
< 25 mph	LTS 1	LTS 1	LTS 1
25-30 mph	LTS 1	LTS 2	LTS 1
30-35mph	LTS 2	LTS 2	LTS 2
40+ mph	LTS 3	LTS 3	LTS 3

1. For street being crossed.
2. Minimum PLTS 4 when crossing lacks ADA ramps, or PLTS 3 when ramps are non-compliant
3. Use Table 2C or Table 2D for oneway streets, when ADT exceeds 5,000, or total number of lanes exceeds two.
4. Street may be considered a one-lane road when no centerline is striped and when oncoming vehicles commonly yield to each other (yield streets).
5. Refuge should be at least 10 feet for PLTS 1, otherwise use PLTS 2 for refuges 6-10 feet. Narrower refuge islands shall not be considered a refuge island for the purposes of this analysis.

Table 2B: Unsignalized Intersection Crossings Without a Median Refuge[1, 2]

Speed Limit or Prevailing Speed	Total Lanes Being Crossed (both directions)					
	2 Lanes			3 Lanes		
	<5,000 vpd	5,000-9,000 vpd[4]	>9,000 vpd	<8,000 vpd	8,000-12,000 vpd[4]	>12,000 vpd
< 25 mph	PLTS 2	PLTS 2	PLTS 3	PLTS 3	PLTS 3	PLTS 4
25-30 mph	PLTS 2	PLTS 3	PLTS 3	PLTS 3	PLTS 3	PLTS 4
30-35mph	PLTS 3	PLTS 3	PLTS 4	PLTS 3	PLTS 4	PLTS 4
40+ mph	PLTS 3	PLTS 4	PLTS 4	PLTS 4	PLTS 4	PLTS 4

1. For street being crossed.
2. Minimum PLTS 4 when crossing lacks ADA ramps, or PLTS 3 when ramps are non-compliant
3. For one-way streets, use Table 2D. Use PLTS 4 for crossings of four or more lanes.
4. Use these columns when ADT volumes are not available and unable to be confidently estimated.

Table 2C: Unsignalized Intersection Crossings (1 to 2 lanes) With a Median Refuge[1, 2]

Speed Limit or Prevailing Speed	Maximum Through/Turn Lanes Crossed Per Direction			
	1 Lane	2 Lanes		
	Any	< 5,000 vpd	5,000-9,000 vpd[4]	> 9,000 vpd
< 25 mph	PLTS 1[3]	PLTS 1[3]	PLTS 2	PLTS 2
25-30 mph	PLTS 2	PLTS 2	PLTS 2	PLTS 2
30-35mph	PLTS 2	PLTS 2	PLTS 2	PLTS 3
40+ mph	PLTS 3	PLTS 3	PLTS 3	PLTS 4

1. For street being crossed.
2. Minimum PLTS 4 when crossing lacks ADA ramps, or PLTS 3 when ramps are non-compliant
3. Refuge should be at least 10 feet for PLTS 1, otherwise use PLTS 2 for refuges 6-10 feet. Narrower refuge islands shall not be considered a refuge island for the purposes of this analysis.
4. Use this column when ADT volumes are not available and unable to be confidently estimated.

Table 2D: Unsignalized Intersection Crossings (3 or more lanes) With a Median Refuge[1, 2]

Speed Limit or Prevailing Speed	Maximum Through/Turn Lanes Crossed Per Direction			
	1 Lane			4+ lanes
	< 8,000 VPD	8,000-12,000 vpd	> 12,000 vpd	Any
< 25 mph	PLTS 1[3]	PLTS 2	PLTS 3	PLTS 4
25-30 mph	PLTS 2	PLTS 3	PLTS 3	PLTS 3
30-35mph	PLTS 3	PLTS 3	PLTS 4	PLTS 4
40+ mph	PLTS 4	PLTS 4	PLTS 4	PLTS 4

5. For street being crossed.
6. Minimum PLTS 4 when crossing lacks ADA ramps, or PLTS 3 when ramps are non-compliant
7. Refuge should be at least 10 feet for PLTS 1, otherwise use PLTS 2 for refuges 6-10 feet. Narrower refuge islands shall not be considered a refuge island for the purposes of this analysis.

8. Use this column when ADT volumes are not available and unable to be confidently estimated.