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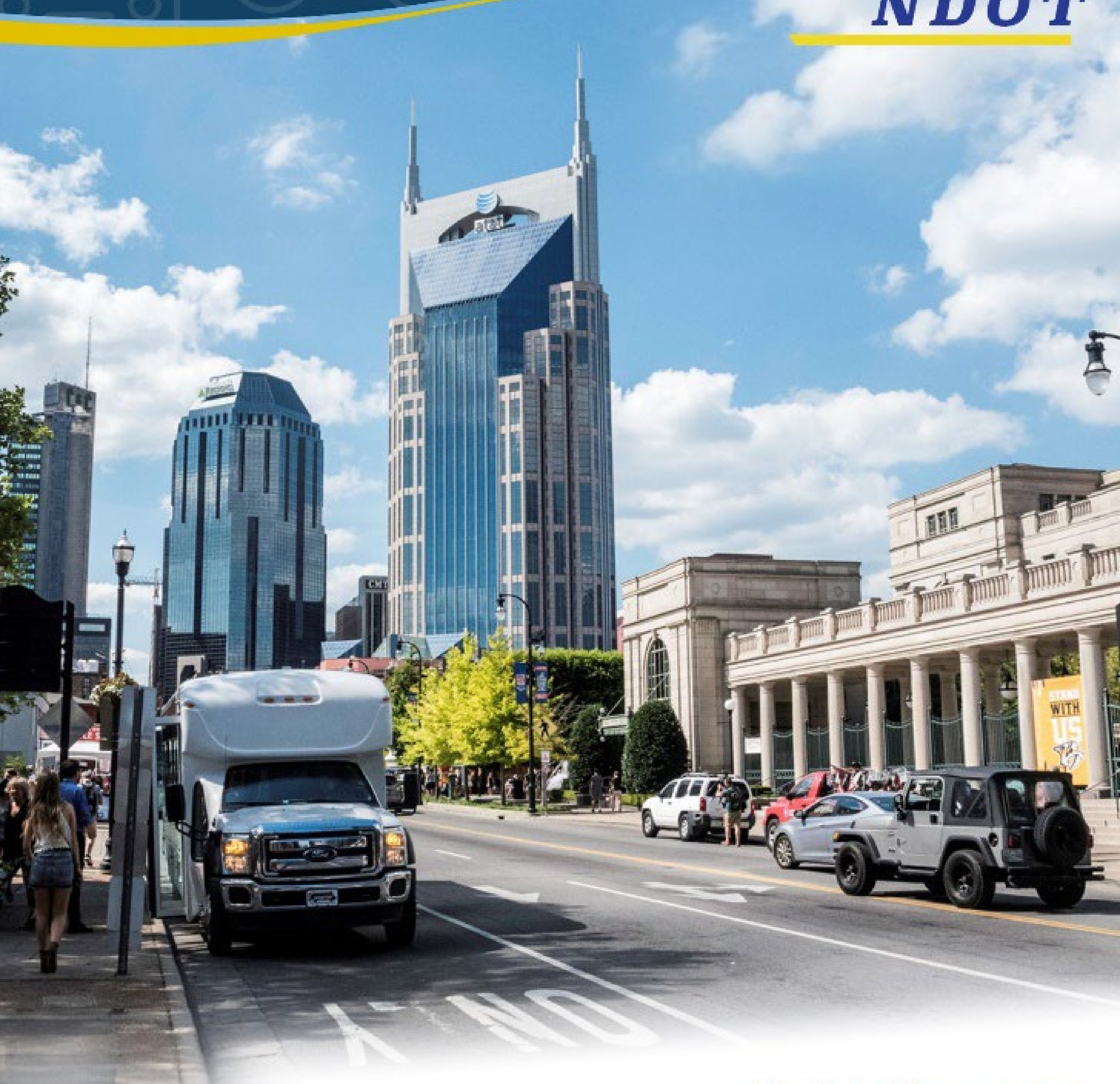

Guidelines on Multimodal Transportation Analysis for Site Development

Metropolitan Government of Nashville and Davidson County

Guidelines on Multimodal Transportation Analysis for Site Development

FINAL DOCUMENT

Guidelines Authorized by Chapter 17.20.140 of the Metro Nashville Code of Ordinances

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Acronyms and Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
BLTS	Bicycle Level of Traffic Stress
DEM	Design and Energy Manual
EPA	United States Environmental Protection Agency
GIS	Geographic Information Systems
HIN	High Injury Network
ITE	Institute of Transportation Engineers
LOS	Level of Service
LPI	Leading Pedestrian Interval
LTS	Level of Traffic Stress
MCSP	Major and Collector Street Plan
Metro	Metropolitan Government of Nashville and Davidson County
MMTA	Multimodal Transportation Analysis
MUTCD	Manual on Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
NDOT	Nashville Department of Transportation and Multimodal Infrastructure
PLTS	Pedestrian Level of Traffic Stress
ROW	Right-of-Way
RRFB	Rectangular Rapid Flashing Beacon
USDOT	United States Department of Transportation
TDM	Travel Demand Management
TDOT	Tennessee Department of Transportation

1 INTRODUCTION

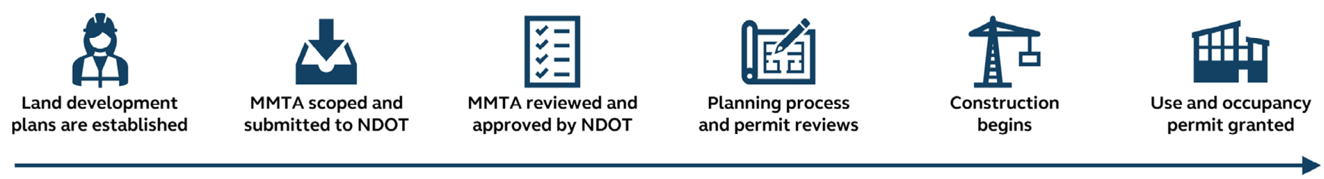
Nashville and Davidson County is a vibrant and dynamic region experiencing rapid growth. The population rise is driven by the emergence of new residential, commercial, and recreational developments that are transforming neighborhoods and attracting millions of new residents, businesses, and visitors every year.

While sustained growth across the county challenges transportation capacity, it also presents opportunities to create a thriving multimodal transportation network built to meet the needs of a modern metropolitan area. To support the evolution of Davidson County's transportation network, the Nashville Department of Transportation and Multimodal Infrastructure (NDOT) requires completion of a Multimodal Transportation Analysis (MMTA) as a condition of new development approval. This document provides guidelines for preparing an MMTA.

1.1 BACKGROUND

The Guidelines on Multimodal Transportation Analysis for Site Development (referred to herein as "MMTA Guidelines") outline and support NDOT by evaluating the impacts of certain land development actions on the Metropolitan Government of Nashville and Davidson County's (Metro's) transportation network. Typical land development actions include new development construction and rezoning requests. This document provides guidance on the preparation of an MMTA for a property or land developer (referred to herein as "Applicant") along with direction to NDOT staff guiding the review process.

Figure 1.1 Typical Land Development Process



The purpose of the MMTA is to identify mitigation measures that address potential adverse impacts to Metro's multimodal transportation network caused by a land development action. These guidelines represent a modernization of the land development impact analysis process, shifting from a focus on vehicular impacts to a holistic approach that addresses all modes of mobility, access, and safety. The construction of new development affects public infrastructure, travel patterns, and operational performance; it is critical that Metro's rapid population growth is supported by resilient and sustainable transportation infrastructure.

NDOT's Vision

A multimodal system for all that offers choice and better connects neighborhoods, residents, and businesses to the places to which they need and want to go in a safe manner.

An MMTA is used to support NDOT's vision, and the vision of each community established through the adoption of the NashvilleNext[1] General Plan, through the systematic analysis of three critical transportation functions: traffic operations, multimodal mobility (including micromobility), and safety. Specifically, a completed MMTA should:

- Provide an overview of the proposed development's size, use, and location.

[1]https://www.nashville.gov/departments/planning/nashvillenext/nashvillenext-plan

- Evaluate the existing state of the transportation network adjacent to and serving the proposed development through a review of traffic operations, multimodal mobility, and safety.
- Analyze impacts the proposed development is expected to have on traffic operations, multimodal mobility, and safety.
- Propose mitigation measures that enhance all modes of mobility in the area serving the development and offset the expected development transportation impacts.

NDOT requires the Applicant to design the site and complete an MMTA consistent with NDOT's approved planning documents including, but not limited to, Vision Zero strategy, the transportation element of the General Plan inclusive of the Major and Collector Street Plan (MCSP), the Design and Engineering Manual (DEM), small area study recommendations, and other agency policies and practices. The information provided herein is intended to explain when an MMTA is necessary, the scope and scale of analysis required, technical methodology, and expected deliverables.

1.2 STUDY TYPES

The Applicant may conduct a Level 1 MMTA or Level 2 MMTA depending on factors such as expected trip generation, development size and intensity, expected land use, and study area characteristics. Both study types will evaluate traffic operations, multimodal mobility, and safety.

Figure 1.2 MMTA Sections

The main difference between study types is the size of the study area. A Level 1 MMTA is generally proposed for developments that are not expected to have a significant impact on the transportation network but are expected to have localized site access impacts. A Level 2 MMTA includes a broader study area for larger developments expected to significantly impact the surrounding transportation network with new vehicular and non-vehicular trips. The recommended scope and thresholds of each study type are outlined in Table 1.1.

Table 1.1 Recommended Study Scopes and Thresholds

Study Type	Recommended Scope *(Including, but not limited to)*	Recommended Thresholds
Level 1	• Public roadways along site frontage, site access points (driveways) to public roadways, public alleys, private driveways, and joint access easements • Multimodal infrastructure and safety of all modes in the vicinity of the development	• 50 to 99 peak hour trips • Proposed development creates a through connection between collector roadways and/or roadways of greater functional classification
Level 2	All criteria included in the Level 1 MMTA Recommended Scope and: • All roadways serving the development, all intersections up to the first collector roadway or the first roadway of higher classification, and intersections and roadways that the Planning Department and NDOT feel are necessary to provide for an adequate review of the proposed project's impacts • Off-site multimodal facilities, proximity to transit, traffic congestion, and roadway geometry	• 75+ units for residential developments • 50,000+ square feet for non-residential developments • 750+ daily trips or 100+ peak hour trips for mixed use developments

"Peak hour trips" include total vehicular and non-vehicular trips generated in the AM and PM peak hours.

The Zoning Code for Metropolitan Nashville and Davidson County[2] (referred to herein as "the Zoning Code") outlines the recommended trip generation and development size thresholds shown in Table 1.1. In most cases, the Applicant should determine the appropriate study type by referring to the recommended thresholds.

If specific development characteristics or external factors make the appropriate study type unclear to the Applicant, NDOT may be consulted before submitting a *Scoping Evaluation Form*. External factors may include specific community concerns about safety, multimodal mobility, and traffic congestion. NDOT will notify the Applicant if a non-traditional study type is required.

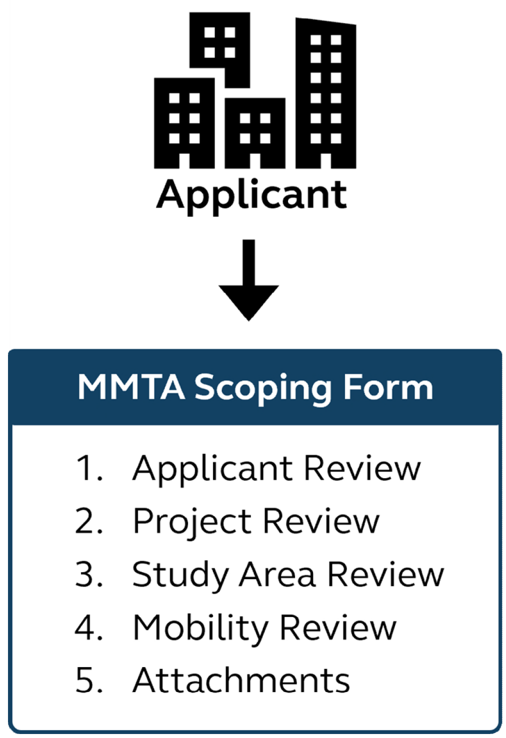
- **Rezoning Analysis:** A rezoning analysis may need to be conducted to analyze the maximum potential trip generation permitted under an existing or requested zoning. The purpose of a rezoning analysis is to analyze the capacity of the existing transportation network to accommodate potential new developments. A rezoning analysis must adhere to the scope of an appropriate study type based on the maximum trip generation permitted under the existing or requested zoning. Completing a rezoning analysis does not preclude the need to complete a more thorough MMTA upon submission of development plans.
- **Regional Study:** A regional study may be required in instances where a proposed development, or group of proposed developments, is expected to cause significant impacts to the transportation network beyond the

[2]https://library.municode.com/tn/metro_government_of_nashville_and_davidson_county/codes/code_of_ordinances?nodeId=CD_TIT17ZO

bounds of a typical study area. Regional studies may be considered if the trips generated by a proposed development(s) are expected to significantly alter the transportation performance of a region within Davidson County. The methodologies of a regional study are typically the same methodologies described in this document applied to a larger geographical area. NDOT will define the scope of a regional study on a case-by-case basis in coordination with the Applicant.

1.3 SCOPING A STUDY

Upon determination that a new development meets the threshold for an MMTA, the Applicant must contact NDOT and submit a *Scoping Evaluation Form* for review. The purpose of the form is to provide NDOT with basic information about a new development, set analysis parameters, and guide the applicant through a preliminary assessment of the transportation network within the study area. **This section of the guideline provides instructions and guidance on how to complete the *Scoping Evaluation Form*.**



Execution of a successful scoping will result in a streamlined and focused analysis. The *Scoping Evaluation Form* should:

- Outline the basic characteristics of the proposed development including size, land use, and expected trip generation.
- Define the study parameters including study area, study intersections, corridors, applicable trip reductions, build year, and growth rate.
- Provide an overview of the transportation network within the study area including the availability of multimodal facilities.

The applicant should also consider the following when completing a *Scoping Evaluation Form*:

- After review and before approval of the *Scoping Evaluation Form*, NDOT may request modifications to certain study parameters. If further discussion is needed, the Applicant may request a meeting.
- All information in the approved *Scoping Evaluation Form* should be applied in the subsequent MMTA. The applicant should notify NDOT if information pertaining to the new development or the study parameters is modified between approval of the *Scoping Evaluation Form* and submittal of a completed MMTA. NDOT may modify analysis requirements upon review of any changes to the development plans.

1.4 STUDY AREA SELECTION

The study area is defined as the area around the proposed development that includes all study intersections, connecting roadways, and multimodal facilities that the Planning Department and NDOT deem necessary for an adequate review of the proposed project's traffic, multimodal, and safety impacts. The study area should be confirmed in the *Scoping Evaluation Form* and based on the recommended scope criteria detailed in Table 1.1.

Analysis of a study intersection may include facilities on intersection roadways up to 200 feet from the midpoint of the study intersection. For example, if a transit stop is 100 feet from the midpoint of a study intersection, it should be subject to the relevant study requirements described in this document. Similarly, multimodal analysis may need to be applied to all intersection approaches. Off-site mitigation measures meant to improve the performance of a study intersection may extend up to 200 feet from the intersection midpoint.

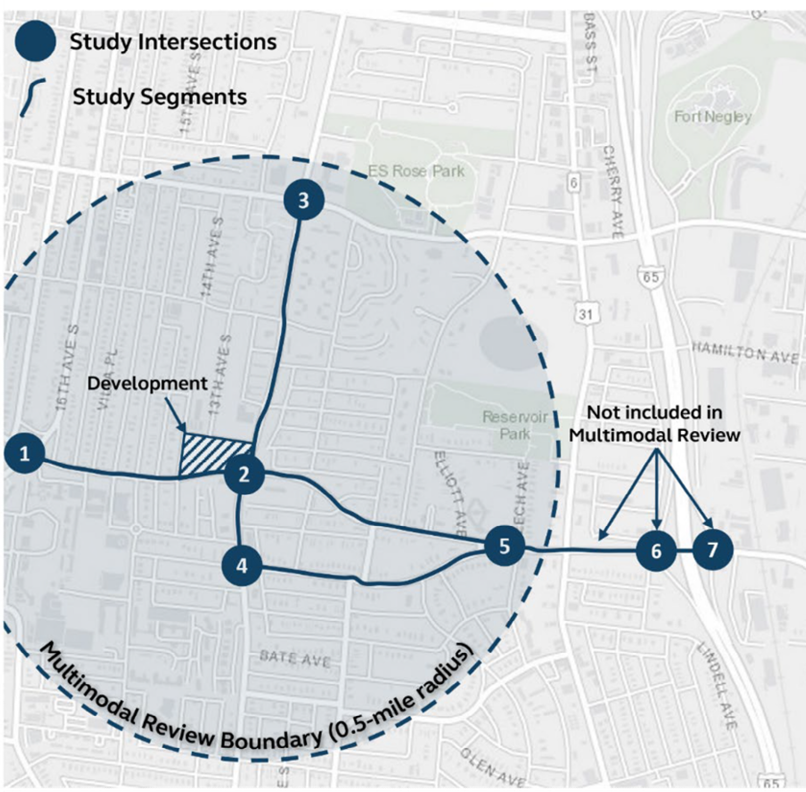
Exclusion of an intersection may be appropriate if the site trips are not expected to make a significant impact on intersection performance or if the intersection is a significant distance away from the proposed development.

Addition of an intersection may be appropriate if the site trips are expected to have a significant impact on intersection performance, if the intersection is located close to the proposed development, or if the intersection is located between two other study intersections.

The applicant is required to conduct a traffic review and safety review for all study segments and study intersections defined in the *Scoping Evaluation Form*. The full extent of the study area indicates the bounds within which vehicle trips generated by the development are expected to impact traffic performance and safety.

Study segments and study intersections located more than 0.5 miles from the development may be excluded from the multimodal review. Impacts from pedestrians, bicyclists, and other non-vehicular trips generated by the development are not expected to be significant at these distances. Unless otherwise directed by NDOT, multimodal review requirements should strictly be applied to study segments, study intersections, and all applicable transportation facilities within a 0.5-mile radius from the development. Off-site improvements intended to improve multimodal mobility should be focused on facilities within the 0.5-mile radius.

Figure 1.3 Example Study Area for Level 2 Study Type



A study area figure should be provided in the *Scoping Evaluation Form* for review by NDOT. The figure should include an aerial map of the entire study area, identify study area intersections, and distinguish the limit of the multimodal review. Deviation from the criteria for study intersection selection should be justified with a detailed explanation in the notes section of Application Information on the *Scoping Evaluation Form.*

NDOT will review the proposed study area and make additions or exclusions as necessary in coordination with the Applicant and before the commencement of an MMTA.

1.5 SUBMITTAL AND REVIEW TIMELINES

The Zoning Code[3] states that NDOT will review and provide comments or approval of a submitted *Scoping Evaluation Form* within 10 business days of submittal. NDOT will review and provide comments or approval of a submitted MMTA within 20 business days of submittal.

An MMTA is a preliminary step in the land development process. A study should be scoped, prepared, and submitted to NDOT for review prior to submitting to the Planning Commission for Specific Plan (SP) applications. If the land development action is under straight zoning, an MMTA should be submitted prior to applying for building permit approval.

Review timelines may be adjusted if delay is caused by resubmittals due to inadequate analysis, missing requirements, discrepancies in scope, or other reasons out of the control of NDOT. An appropriate review timeline should be communicated with the submittal of an updated scope or MMTA. Where NDOT is unable to conduct a sufficient review within the given timelines, NDOT and the Applicant should agree to an appropriate alternative review schedule. To assist NDOT in completing a timely and thorough review of the MMTA, please follow the formatting of the Example MMTA and tables provided in the appendices.

1.6 STUDY APPROVAL

The Zoning Code states that, if an MMTA is required for a submitted planning application, the Planning Department may recommend deferral to the Planning Commission for applications without an approved MMTA. The MMTA will be approved by NDOT and (for applications to the Planning Commission) the Planning Department, with all applicable performance requirements incorporated into any site and building plans.

[3]https://library.municode.com/tn/metro_government_of_nashville_and_davidson_county/codes/code_of_ordinances?nodeId=CD_TIT17ZO.

2 SCOPING AND PREPARING A STUDY

This section details the methodology and procedures an Applicant should use to prepare a *Scoping Evaluation Form* and establish credible data for use in analysis. Appropriate practices for defining trip generation, trip reductions, mode split, trip distribution, traffic growth, and collecting traffic counts are described in this section.

2.1 TRIP GENERATION VOLUMES

> ***Total Trip Generation***
>
> The total vehicular, pedestrian, bicycle, and other multimodal trips generated by a development over a set period, prior to reductions.

Total trip generation is the basis for determining the level of impact that a new development will have on the adjacent transportation network. Accurate trip generation calculations dictate subsequent MMTA analysis and ensure recommendations to mitigate impacts are relevant and effective.

Locally collected data or the latest version of the Institute of Transportation Engineers (ITE) *Trip Generation Manual* should be used, when available, for all trip generation calculations. Data from sources outside of Nashville may be used if local sites are not available and ITE guidance is not available for that land use site. The need to use alternative data sources shall be noted in the scoping form and sources agreed to by NDOT prior to use. The unadjusted daily and peak hour trip generation volumes for the proposed development must be calculated and provided in the *Scoping Evaluation Form* before the commencement of an MMTA. Presentation of trip generation data should follow the templates provided in the *Scoping Evaluation Form*.

When determining trip generation volumes, the Applicant should consider the following:

- **Local Study Methodology:** Calculations in the ITE *Trip Generation Manual* are based on studies from various area types across the country. To provide a better understanding of locally generated trips, actual trip generation from local developments of similar land uses may be used in lieu of ITE *Trip Generation Manual* calculations. Data should be collected at three or more locations for each land use type within the proposed development. All observed locations should be operating at full capacity. NDOT pre-approval of site location, size (e.g., square footage, units), count locations, and data collection dates is required before using this approach. If data collection does not allow for a decisive conclusion, the Applicant will supplement locally collected data with the ITE *Trip Generation Manual* data or collect data at additional sites.
- **Net Trip Generation**: If an existing land use occupies the site in which a proposed development is to be constructed, the net trip generation should be used in the MMTA. This might require the deduction of trips for the existing land use that will be replaced. The Applicant should observe existing development trip generation in the field by taking traffic counts at site access points. If the Applicant is unable to take existing traffic counts, or the existing land use is not at full capacity, trip generation volumes should be calculated based on verifiable and accurate land use information and the ITE *Trip Generation Manual.* Existing trip generation calculations should apply a mode split as outlined in Section 2.4. Presentation of net trip generation should follow the templates provided in the *Scoping Evaluation Form*.
- **ITE Land Use Settings:** The "General Urban/Suburban" land use setting should be applied to all trip generation calculations. Applying the same land use setting to all trip generation calculations allows for a consistent trip generation estimation methodology across all MMTAs submitted to NDOT. When the unadjusted "General Urban/Suburban" trip generation is not expected to accurately reflect the development, the Applicant may

propose trip reductions and/or mode split with sufficient justification in the *Scoping Evaluation Form* (see Sections 2.3 and 2.4). Justification may include traffic counts at sites of a similar size and land use.

- **Mode Split:** Trip generation should include trips for all modes. Modal split should be determined based on the land use, area type, and development features. Alternative mode reductions will no longer be taken; rather, Applicants will need to consider and/or evaluate the impacts of new trips for each mode.
- **Phased Development:** If a proposed development is expected to be constructed or opened in phases, trip generation calculations should be made independently for each phase. NDOT considers a phase as having a planned construction and/or opening date of greater than one year (12 months).
- **Unique Land Uses:** Where a proposed land use does not readily fit into a category provided by the ITE *Trip Generation Manual*, the applicant should provide NDOT with justification for an alternative trip generation methodology, such as by using a similar ITE land use or conducting trip counts at similar land uses in the field.
- **Occupancy:** All trip generation calculations should be based on 100% occupancy, whether at a specific construction phase or at full build-out.
- **Changes to Trip Generation:** The applicant must notify NDOT if the trip generation used in the MMTA is different from the trip generation approved in the *Scoping Evaluation Form*. NDOT may modify the scope of work if the total adjusted trip generation changes by 10 percent or more. This is applicable for MMTAs which were previously approved but where a greater than 10 percent change in total adjusted trip generation is expected based on-site changes. Examples of instances where a trip generation modification may be appropriate include, but are not limited to, updates to land use, density, trip reduction, mode split, or phasing. The *Scoping Evaluation Form* should be revised to reflect changes in trip generation before NDOT's approval of a completed MMTA.
- **Alternative Peak Hours:** Alternative peak hours, such as midday, special event, school dismissals, or weekend, may be required if applicable to the development land use or location. Alternative peak hours should be included in the *Scoping Evaluation Form* for review by NDOT.

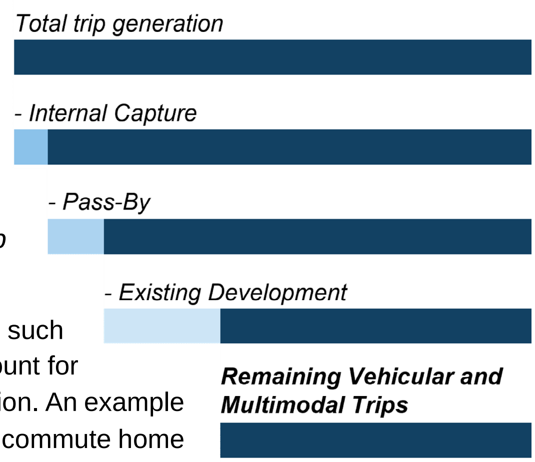
2.2 TRIP REDUCTIONS

Once total trip generation is calculated for a development, trip reductions may be applied to account for the expected proportion of trips that do not directly impact the transportation network.

The proposed trip reductions must be applied to each land use independently in the *Scoping Evaluation Form* before commencement of an MMTA. Presentation of the proposed trip reductions should follow the templates provided in the *Scoping Evaluation Form*, and calculations should be documented.

Permissible trip reductions may fall into the three categories listed below in the order in which they should be applied:

- **Internal Capture** trip reductions are applied to account for the proportion of trips generated by a mixed-use development that begin and end within the site. An example of this could be a multifamily residential building with a retail coffee shop on the ground floor, where a resident may leave their home to go to the coffee shop but does not leave the site. Internal capture reductions should be determined using guidance from the ITE *Trip Generation Manual*.

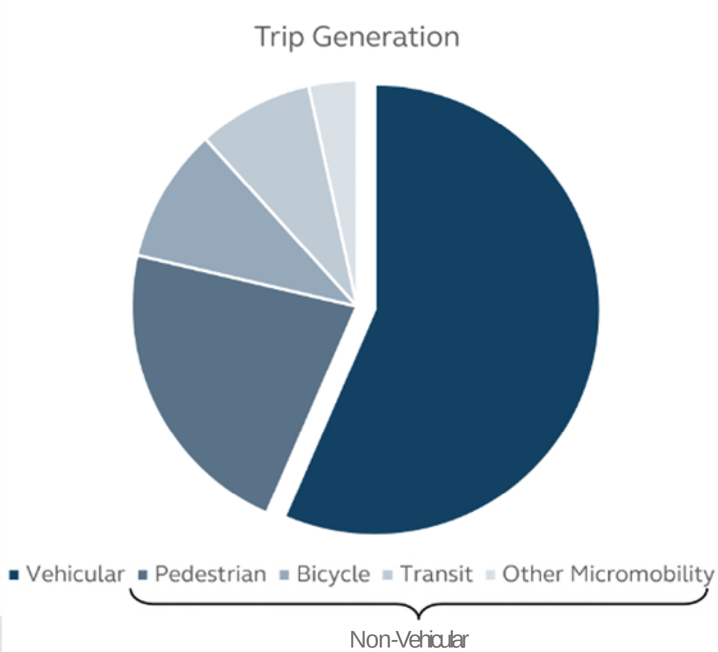


- **Pass-by** trip reductions are applied to commercial developments such as gas stations, fast-food restaurants, and grocery stores to account for trips diverted to the site before continuing to their primary destination. An example of this could be a gas station that attracts a driver on their regular commute home from work. Pass-by reductions are narrowly applied to specific commercial land uses on heavily traveled roads. Calculations should be based on ITE *Trip Generation Manual* guidance.
- **Existing Development** trip reductions are applied to account for any trips being generated by an existing development at the proposed project site. These reductions are accounted for when calculating the “net” trip generation for a new development. Before calculating net trip generation, the mode split of the existing development should be recorded. Once the mode split of the existing development and the proposed development are both known, net vehicular and net multimodal trips should be calculated to ensure consistent analysis throughout the MMTA. If locally collected data were used for trip generation calculations, a comparison between field collected data and development-specific mode split assumptions should be provided.

NDOT must be consulted if changes in trip reductions result in changes to the overall trip generation volume approved by NDOT in the *Scoping Evaluation Form*.

2.3 MODE SPLIT

After trip reductions are applied, the remaining trips consist of vehicular and non-vehicular trips. Non-vehicular trips may include people entering or exiting the site by walking, bicycling, transit, or other micromobility choices, such as E-scooters. Determining the “mode split” of the trips generated by a development requires the differentiation of vehicular and non-vehicular trips. Mode split depends on several factors, such as land use, demographics, available mobility options, location, and area context, and may be impacted by season or time of day.



Before reviewing traffic and multimodal operations, the Applicant must document the percentage of total trips that are expected to be non-vehicular. Proposed developments in areas with a high population density and built out multimodal networks, such as the downtown core, are expected to exhibit a higher percentage of non-vehicular trips. Other relevant considerations when determining an appropriate mode split include:

- Proximity to existing and/or planned pedestrian, bicycle, and transit facilities;
- Proximity to other trip-generating and complementary land uses;
- Low parking supply (on site and off site);
- On-site multimodal facilities; and
- Approved planning study or policy encouraging multimodal mobility in the study area.

Mode split predictions should be supported by results of similar studies, field data, other data sources, or other documented engineering judgement. Mode split and the subsequent analysis replace the previous practice of alternative mode reductions.

2.4 TRIP DISTRIBUTION

The trip distribution of traffic through the study area should be provided as part of the MMTA traffic review for all study scenarios: existing, future no-build, future build, and future build with mitigations (see Chapter 6). Trip distribution of development traffic should follow the trip distribution trends observed in the traffic counts taken at study intersections. The Applicant should also consider the following when determining appropriate trip distribution:

- Existing traffic patterns and tendencies in the study area including AM and PM peak hour directional trends;
- Expected traffic patterns and tendencies of the proposed development's land uses;
- Proposed site access locations; and
- Logical assignment of trips to project access points (i.e., generally trips should be routed to take the shortest and most direct path).

Professional engineering judgement should ultimately be used when determining the trip distribution with documentation of any assumptions.

Trip distribution should be illustrated in an MMTA with trip distribution maps. Maps should be a plan view representation of the study area including all study intersections and accesses, distinct trip distributions for each peak hour, and distinguishable exiting and entering trips.

2.5 TRAFFIC GROWTH

To accurately project future volumes at the proposed development's build-out year, an annual background traffic growth rate must be applied to existing volumes based on historical traffic growth in the study area and anticipated future growth in the area. Background traffic growth is the increase in traffic volumes of the surrounding roadway network that happens without the proposed development. This growth is mainly due to population and employment increases.

One challenge with growth rate calculations is that growth rates often vary between modes. For example, the construction of infrastructure for a specific mode will likely lead to an accelerated adoption of that mode across the transportation network, leading to a higher growth rate. Approval of the traffic growth rate is at the discretion of NDOT.

2.5.1 VEHICULAR GROWTH RATES

For vehicular growth rates, the Tennessee Department of Transportation's (TDOT) Annual Average Daily Traffic (AADT) maps, shown on the right, provide 24-hour, bi-directional traffic volumes at stations throughout Davidson County. To determine an appropriate growth rate, the Applicant should use the historical count data from TDOT stations near the projected development. Any resource used to determine the background growth rate other than TDOT's AADT maps should be vetted and approved by NDOT.

The proposed background traffic growth rate and documentation of calculations should be provided in the *Scoping Evaluation Form* for review by NDOT. NDOT should be consulted if there is a change to the traffic growth rate after approval of the *Scoping Evaluation Form*.

Other items to consider when determining an appropriate background traffic growth rate include:

- Abnormal jumps in year-over-year traffic volumes at a particular location, including variances due to COVID-19 or similar large-scale disruptions to the average condition; and
- Large background developments expected to have significant impacts on traffic growth in the study area as determined through scoping discussions.

NDOT expects background growth rates to be calculated by extrapolating historical data. The Applicant should take the number of years until the expected build year and use the length of that period to determine a historical average growth rate (e.g., if it is currently 2023, and the expected build year is 2027, the Applicant should use AADT data from 2018 to 2022, or the most recent 4 years of available data). It is acceptable to use a recently approved MMTA for an area in the vicinity of the proposed development as a reference point for background growth rates; however, background growth rates should be independently defensible and justified in the *Scoping Evaluation Form*.

The Applicant should use professional judgement when determining the background growth rate and provide NDOT with justification for any additional assumptions.

2.6 BACKGROUND DEVELOPMENTS

In some cases, there may be other proposed developments within or near the study area that are expected to impact the study area but are not yet occupied at the time of the study. The Applicant should provide a list of potential background developments in the *Scoping Evaluation Form* after a thorough search of relevant resources. Appropriate background developments include any approved or proposed developments within the study area in which site-generated traffic will impact the operations or safety of the selected study intersections beyond what is reasonably accounted for in background traffic growth.

Information about proposed developments is available on the Metro Nashville website. The following resources can help determine if background developments should be included:

- Specific Plan Viewer[4]
- Development Tracker[5]

To account for discrepancies or missing information, NDOT will consult with the Applicant if there are additional background developments that should be included.

If an MMTA has been submitted by a background development, NDOT will make the relevant trip generation and trip distribution information available to the Applicant for use in the traffic review. The Applicant should directly apply background development trips as they are presented to the appropriate intersections in the study area. The Applicant should apply these trips in addition to the applied growth rate described in Section 2.6.

If no MMTA is available for a background development, it may be appropriate to account for the additional trips with a higher background growth rate. The Applicant should consult with NDOT to determine the most suitable course of action.

NDOT will review the proposed list of background developments in the *Scoping Evaluation Form* and make additions or exclusions as necessary in consultation with the Applicant.

2.7 TRAFFIC COUNT COLLECTION

The Applicant is responsible for collecting traffic counts at all study intersections and other locations agreed upon in the *Scoping Evaluation Form*. Counts used for traffic analysis should be collected no more than 2 years before the time at which the *Scoping Evaluation Form* is approved. Counts that are more than 2 years old are invalid.

Counts should be collected, at a minimum, between the hours of 7:00-9:00 AM and 4:00-6:00 PM on days when Davidson County schools are in session. When directed by NDOT, the Applicant should also collect counts during any irregular peak hours, such as midday, weekend, or late night. Irregular peak hours may be caused by specific land uses such as sporting or concert venues.

Raw traffic count data should be broken into 15-minute increments and documented in the appendix of an MMTA in PDF format.

The Applicant should consult NDOT if there are any circumstances that may require a non-traditional traffic count methodology. Other items for consideration include:

- If traffic counts are greater than 1 year old at the time of the *Scoping Evaluation Form* approval, the background growth rate should be applied to create the Existing Conditions scenario.
- Previously collected traffic counts are considered invalid if the road network has experienced a change such as increased or decreased capacity, a new signal, added transit services, significant land development, or as determined by NDOT.
- Traffic counts should include vehicles (light and heavy), bicycles, and pedestrians.
- Traffic counts should not be collected when traffic volumes are significantly impacted by external conditions such as severe weather, holidays, summer, or major city events.

[4] https://maps.nashville.gov/SPSearch/
[5] https://maps.nashville.gov/DevelopmentTracker/

3 TRAFFIC REVIEW

The purpose of the traffic review is to evaluate existing and expected traffic operations in the study area and recommend improvements that will mitigate adverse impacts to the transportation network created by a new development. Safe and efficient vehicular operations are an important part of the county-wide transportation network. An MMTA provides a localized opportunity to identify areas with inadequate vehicular performance and determine effective solutions to improve conditions.

3.1 OVERVIEW

This section details the methodology and procedures an Applicant should use to conduct a traffic review that meets the expectations and requirements of NDOT.

As the population continues to grow, safety, mobility, and traffic congestion remain as significant issues for people who live and work within Davidson County. An MMTA presents a key opportunity to create a transportation network that can facilitate the efficient movement of all modes without compromising the safety and wellbeing of others, particularly vulnerable road users. Specifically, the traffic review section should:

- Evaluate existing traffic performance at study intersections.
- Project future traffic performance at study intersections.
- Determine the level of impact a new development will have on the future transportation network.
- Recommend improvements to mitigate the deterioration of traffic performance caused by the new development.

3.1.1 APPLICABILITY

A traffic review is a requirement of any Level 2 MMTA, if parking is provided. If no parking is provided, and documentation has been approved in a *Scoping Evaluation Form*, the Applicant may skip the requirements of the Traffic Review.

If the Applicant is conducting a Level 1 MMTA and parking is provided, a traffic review should be conducted on roads and intersections along property frontage, as approved in the *Scoping Evaluation Form*.

Any deviation from the MMTA traffic review requirements must be approved by NDOT before commencement of an MMTA.

3.2 TRAFFIC CAPACITY ANALYSIS

The purpose of conducting a traffic capacity analysis is to quantify the impact that the proposed development will likely have on the surrounding road network by measuring intersection delay.

The Applicant should use the latest version of Synchro or a similar software based on Highway Capacity Manual methodology for intersection Level of Service (LOS) calculations at all signalized and unsignalized intersections (see Section 3.3 for information on roundabouts). Default flow rate and other Synchro settings should be used. Any deviation from default Synchro settings should be documented in the MMTA.

Overall intersection delays and approach delays should be presented for signalized and all-way-stop-controlled intersections. For two-way-stop-controlled intersections, the Applicant should present delay for each side street and mainline left-turn delays. For all-way-stop-controlled intersections, the Applicant should present the delay for each approach. A complete set of Synchro reports for each intersection and turning movement should be provided in the MMTA appendix. The four traffic capacity analysis scenarios are described in Table 3.1.

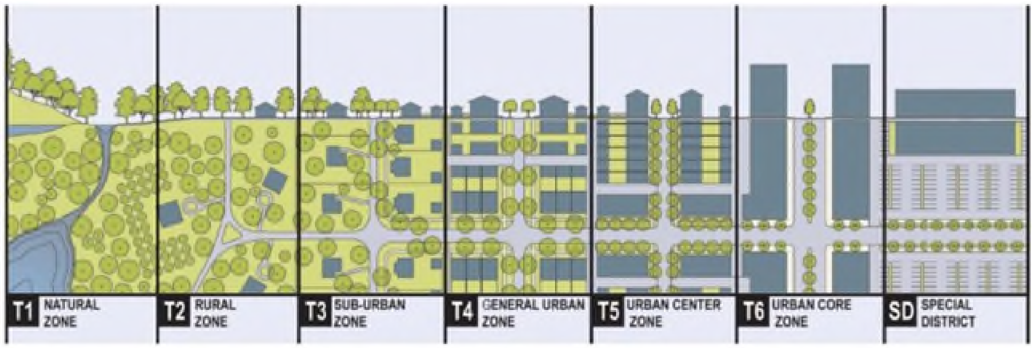
Table 3.1 Traffic Capacity Analysis Scenarios

Scenario	Description
Existing Conditions	The traffic operations at study intersections based on the recorded traffic counts
Future No-Build	Projected operations of the study intersection in the expected build-out year (or interim year[s] in the case of phased developments) if the proposed development is never built. This scenario is derived from the existing conditions by applying the approved background growth rate and known background development trips up to the build-out year of the proposed development
Future Build	Projected operations of the study intersections in the expected build-out and/or interim year(s) including trips from the proposed development. Expected impact of the proposed development on intersection delay can be quantified by measuring the difference between this scenario and the future no-build conditions scenario
Future Build with Mitigations	Projected operations of the study intersections in the expected build-out and/or interim year(s) including trips from the proposed development and feasible mitigation measures recommended by the Applicant. Mitigation measures may include the addition or removal of lanes and signalization or other intersection control modifications. The purpose of this scenario is to measure the impact recommended mitigation measures are expected to have on vehicular delay

The Applicant should also consider the following when conducting the traffic capacity analysis:

- **Phases:** If a development is phased, the sequence and timing of a development should be incorporated into the MMTA. An overall MMTA may be required with additional analysis for individual phases of construction. Completing an MMTA for one phase of a development does not preclude the need to complete additional analysis upon the submission of development plans or requests for the issuance of permits for construction.
- **Acceptable LOS:** One of the main goals of an MMTA traffic review is identifying and mitigating the increase in traffic delay that can be specifically attributed to the development. In general, LOS A, LOS B, LOS C, and LOS D are viewed as acceptable levels of delay at most intersections. In dense urban areas, such as those classified as Transect 6 (see below), peak hour LOS E or LOS F may be acceptable. Efficient vehicular operations in dense urban areas, especially during AM and PM peak hours, may not be feasible due to prohibitive costs, diminishing impact, or lack of available right-of-way (ROW). In these cases, more emphasis should be placed on improvements that address safety and multimodal mobility.

Figure 3.1 Transect Categories



- **Peak Hours:** For most developments, capacity analysis of existing and future scenarios should include modeling of the AM and PM peak hours at study intersections. Additional peak hours, such as midday, special event, or weekend, may be required if applicable to the development land use or location.
- **Signal Timing Modifications:** Existing signal timing sheets should be obtained from NDOT upon request. The Applicant should indicate which signal timing sheets are needed in the *Scoping Evaluation Form.* Any recommendations to modify existing signal timings in the "future conditions with mitigations" scenario should include the proposed signal timing plan in the report appendix and be supported with appropriate justification in the capacity analysis section.
- **Queuing analysis:** A queuing analysis evaluates the lengths of vehicle queues at congested intersections or other traffic control points. It helps identify excessive backups and potential safety issues. A modeled queuing analysis should be included as part of a standard MMTA traffic capacity analysis. Typically, 95th percentile queueing should be reported and included in Synchro reports in the appendix. Relevant issues related to excessive queuing include queues that extend beyond turn lane storage, through lane queues that block access to turn bays, and queues that extend through upstream intersections. Any of the situations identified above should be documented in the MMTA traffic review.

3.3 SUPPLEMENTARY ANALYSES

Additional analyses may be required based on observed conditions in the study area and coordination with NDOT. Analyses that may be appropriate include:

- **Speed Study:** A speed study involves measuring and analyzing the speeds of vehicles on a particular roadway segment to assess whether existing roadway characteristics, such as speed limits and roadway design, are appropriate. Speed studies should be conducted on road segments where there are concerns about excessive speeds or safety issues demonstrated by historical crash data. Concerns about excessive speeds are typically raised by community members, council members, and Metro staff, but may also be identified by the Applicant during analysis. Results of a speed study should be included in the traffic review section and should be factored into the Applicant's recommended mitigation measures.
- **Sight Distance Analysis:** A sight distance analysis evaluates the visibility of drivers along roadways or at intersections, specifically analyzing the drivers' ability to see other road users. A sight distance analysis should be conducted when new roadways, intersections, or accesses are being designed or when obstructions, vertical or horizontal curves, or other roadway elements impact the visibility of a driver. Sight distance calculations should be performed based on American Association of State Highway and Transportation Officials (AASHTO) *Green Book* methodology.

- **Roundabouts:** Roundabouts are intersection control types that have the potential to calm traffic, reduce ROW impacts, and improve safety. Roundabouts should be considered for any new intersections proposed by developments. Roundabouts should be analyzed using the latest Sidra software. Overall roundabout delays and individual approach delays should be presented in the MMTA traffic review section. The Applicant should use default Sidra settings, and any deviation from default settings should be documented in the MMTA.
- **Signal Warrant Analysis:** A signal warrant analysis is used to determine if a traffic signal is warranted at a particular intersection. This type of analysis should be completed for situations in which volume changes, approach configurations, or changes to turning movements impact the performance of an unsignalized study intersection. Additionally, a signal warrant analysis should be considered for situations in which crash patterns indicate that a signal warrant might be met or would otherwise improve safety. A signal warrant analysis should follow the most recent edition of the Manual on Uniform Traffic Control Devices (MUTCD) methodology.
- **Turn Lane Warrant Analysis:** A turn lane warrant analysis evaluates the need for dedicated turn lanes at intersections. The need for turn lanes is based on several factors including roadway speed, turning volumes, and opposing traffic volumes. Turn lane warrants should follow the TDOT *Highway System Access Manual* requirements with additional consideration to the tradeoff between the vehicular safety and capacity benefits of turn lanes and the impacts to bicyclists and pedestrians.

3.4 SITE DESIGN

The proposed development should be designed to minimize adverse impacts to the traffic operations of the adjacent road network. When designing the site, the Applicant should consider the following design strategies:

- Minimize the number of access points to public roadways.
- Maximize the spacing between access points and between access points and intersections.
- Minimize queueing for ingress and egress movements.
- Maximize access for walking, bicycling, and transit use.
- Accommodate site operations such as pick-up and drop-off, valet, trash, and loading to prevent the impediment of vehicular, bicycle, pedestrian, or other traffic.

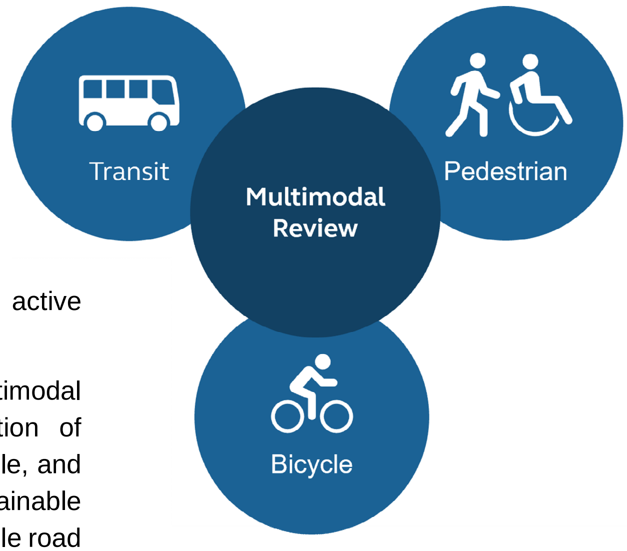
Site design and all public design modifications must comply with all requirements set forth by the Metro Nashville Code of Ordinances and, where applicable, TDOT's *Highway System Access Manual*.

4 MULTIMODAL REVIEW

This section details the methodology and procedures an Applicant should use to conduct a multimodal analysis that meets the expectations and requirements of NDOT.

4.1 OVERVIEW

The goal of the multimodal review is to support the development of the multimodal transportation network in alignment with the stated goal of Nashville's WalknBike program, which is: "The Nashville bicycle and pedestrian system will be a network of high-quality, comfortable, safe sidewalks and bikeways, connecting people to opportunity. The system, inclusive to users of all ages and abilities, will promote and encourage safety, health, education, and active transportation."



NDOT is committed to building a resilient and modern multimodal transportation network to serve the growing population of Davidson County. Access to connected pedestrian, bicycle, and transit facilitates supports the safe, efficient, and sustainable movement of all people and goods, especially for vulnerable road users. The construction of new development presents an opportunity to further enhance multimodal facilities in support of Nashville's strategic mobility goals.

The multimodal review includes analyses of the pedestrian, bicycle, and transit networks within the study area. Each aspect of the multimodal network will be evaluated for accessibility, connectivity, and compliance with NDOT standards. Additionally, the Applicant will analyze the Level of Traffic Stress (LTS) of the pedestrian and bicycle network in the study area to provide insight into the level of comfort and safety that is felt at specific locations throughout the network. LTS instruction is provided in Section 4.2.2 for bicycles and Section 4.3.3 for pedestrians.

An effective multimodal analysis includes a comprehensive evaluation of existing pedestrian, bicycle, and transit facilities. The results should inform development of practical measures to improve the multimodal network adjacent to and serving a new development. Specifically, an MMTA multimodal review should:

- Evaluate the compliance of the existing multimodal infrastructure using existing NDOT standards and identify instances of non-compliance.
- Evaluate the existing condition of multimodal facilities within the study area and identify deficient or missing infrastructure.
- Evaluate the connectivity of the existing multimodal network within the study area and identify gaps or obstructions to continuous, ADA-compliant multimodal paths of travel.
- Evaluate the Bicycle LTS for segments, approaches, and crossings within the study area.
- Evaluate the Pedestrian LTS for segments and crossings within the study area.

- Ensure the site design appropriately supports development of the multimodal network in the study area and enhances multimodal connectivity.
- Identify opportunities to improve the existing conditions of multimodal facilities that increase connectivity of the multimodal network adjacent to and serving a new development.

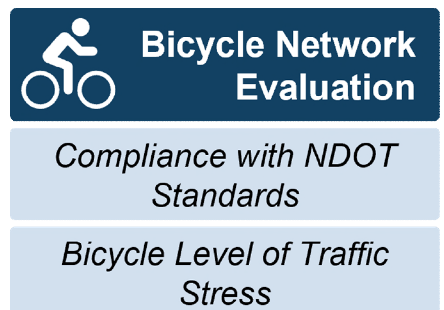
4.1.1 APPLICABILITY

A multimodal review is a requirement of any Level 2 MMTA. If the Applicant is conducting a Level 1 MMTA, a multimodal review should be conducted on roads and intersections along property frontage.

Any deviation from the MMTA multimodal review requirements must be approved by NDOT before commencement of an MMTA.

4.2 BICYCLE NETWORK EVALUATION

The Bicycle Network Evaluation consists of two sections:



- **Compliance with Metro Standards:** When a new development is expected to impact public ROW, it is the joint responsibility of NDOT and the developer to uphold transportation network design standards and maintain a state of good repair for all multimodal facilities. The Applicant should compare the existing street cross section to the cross sections reflected by the MCSP and WalknBike Strategic Plan for Sidewalks and Bikeways (WalknBike), which are both adopted components of the General Plan. Where existing facilities do not match MCSP requirements, the feasibility of aligning facilities with NDOT's transportation network plans should be assessed.
- **Bicycle Level of Traffic Stress Analysis:** Bicycle Level of Traffic Stress (BLTS) methodology is a systematic approach for evaluating the road network with respect to bicyclist comfort and safety. It provides greater insight into the quality of a bicycle facility (i.e., the likelihood of a bicyclist to use specific roadway segments and intersections) based on simple criteria such as bike lane width, posted speed limit, and number of vehicular travel lanes.

Together, these two sections produce a comprehensive review of the bicycle network in the study area.

4.2.1 BICYCLE NETWORK COMPLIANCE WITH METRO STANDARDS

The MCSP is an implementation tool for guiding investment into major streets. It contains guidance on character and function of the street network including the direction of planning, construction, and redevelopment of streets within Davidson County.

The MCSP provides appropriate bicycle facility design along corridors throughout Nashville. The Applicant should use the MCSP to evaluate whether bicycle facilities in the study area comply with MCSP design guidance and are in a state of good repair. Specifically, the Applicant should:

- Present the "Bikeway Buffer" and "Bikeway Width" values provided in the MCSP for all segments within the study area.
- Present the existing bikeway buffer width and bikeway width within the existing study area.
- Identify discrepancies between the MCSP width and existing study area widths.

- Assess the condition of bike facilities in the area and identify instances of excessive deterioration:
  - Excessive deterioration may include pavement condition, pavement markings, excessive debris or litter, lighting and visibility, obstructions and encroachments, and visible damage to the bicycle lane buffer.
- Follow the data presentation guidance provided in Appendix B.

4.2.2 BICYCLE LEVEL OF TRAFFIC STRESS

BLTS is a methodology used to measure the perceived level of discomfort, or "stress," a bicyclist is expected to experience when using a bicycle facility. The approach for this analysis is based on an original methodology developed by the Mineta Transportation Institute[6] and adapted for the MMTA process.

BLTS methodology categorizes a bicyclist's perceived level of stress along segments, approaches to intersections, and at intersections using a "weakest link" method, demonstrating that a road user's perceived comfort level is often governed by the most uncomfortable or unsafe attribute. BLTS uses verifiable roadway characteristics as data inputs, making the methodology well-suited to quickly identify locations in the bicycle network that impose high levels of stress, determine the specific contributing factors, and assist NDOT in implementing a network of high-quality bikeways. Data required to conduct a BLTS analysis include bicycle lane width, buffer width, buffer type, speed limit, number of vehicular travel lanes, and AADT.

The Applicant should use the Level of Traffic Stress flow charts provided in Appendix C to complete a BLTS analysis. The criteria for the four BLTS levels are described in Table 3.1.

[6] https://transweb.sjsu.edu/sites/default/files/1005-low-stress-bicycling-network-connectivity.pdf.

Table 4.1 BLTS Criteria

BLTS Level	Criteria
BLTS 1	Bicycle facility is suitable for all bicyclists including children (around 10 years old) that are trained to safely cross intersections. On segments, traffic speeds are low, there are no more than two total vehicular through lanes, and there is usually adequate buffer space between the bicycle facility and the vehicle lane. When there is a parking lane, there is adequate space to safely use the bicycle facility, and there are not excessive blockages due to parking movements. At crossings, intersections are easily crossed by children and adults.
BLTS 2	Bicycle facility is suitable for most adult bicyclists but demands more attention than might be expected from children. On segments, traffic speeds may be slightly higher than BLTS 1, and there may be additional vehicular through lanes. In most cases, there is adequate buffer between the bicyclist and vehicular traffic. On approaches, bicyclists are given priority when cars cross the bike lane to enter a turning lane. At crossings, intersections are easily crossed by most adults.
BLTS 3	Bicycle facility is suitable for most experienced and observant cyclists. Traffic speeds may be moderate and there may be additional vehicular through lanes; however, traffic stress is markedly lower than riding in mixed traffic at higher speeds. Buffer between bicyclist path of travel and vehicular lane may be smaller, requiring more attention. Intersections are not difficult to cross for most adults.
BLTS 4	Bicycle facility is high stress and suitable only for experienced and skilled cyclists. Traffic speeds are moderate to high and can be on roads with more than six total through lanes. Bicycle facility may be absent, forcing the bicyclist to ride in mixed traffic. Intersections may be difficult to cross due to higher posted speed limits and longer crossing distances.

4.2.2.1 Bicycle Level of Traffic Stress Target Ratings

The target BLTS for segments, approaches, and intersections across Davidson County should be aligned with current bicycle network plans as communicated in the MCSP and WalknBike. All bicycle facilities should be designed for the lowest feasible BLTS under given ROW constraints.

Additional attention should be given to areas that see greater bicycle use, especially by vulnerable road users and children. Where feasible, BLTS 1 standards should be applied to the following areas:

- **School Zones:** The target BLTS within 0.25 mile of all elementary schools, middle schools, high schools, or universities should be BLTS 1.
- **Transit Access:** The target BLTS within 0.25 mile of a transit stop should be BLTS 1.

If planned bicycle facilities shown in the MCSP conflict with the targeted BLTS rating, the planned MCSP facility should take precedent.

4.2.2.2 Bicycle Level of Traffic Stress Rating Adjustments

The Level of Traffic Stress flow charts, provided in Appendix C, allow the Applicant to assign BLTS ratings to all segments, approaches, and intersections in the study area. In some cases, external factors impacting BLTS may not be fully captured by the flow charts. The Applicant should apply the following BLTS Rating Adjustments to more accurately capture the BLTS associated with a specific location:

- **Bicycle Lane Width:** If the bicycle lane is less than 4 feet wide, including curb and gutter, and does not include a buffer, use the BLTS rating table for mixed traffic.
- **Separated Bicycle Facility or Shared Path:** If there is a separated bicycle facility or shared use path that is behind the curb, assign BLTS 1. To qualify, the separated bicycle facility must be at least 6 feet wide, must not be interrupted by excessive curb cuts or vehicular driveways, and must not experience significant pedestrian volumes that prevent the safe use of the facility by a bicyclist. If the facility fails to meet at least one of these conditions, the Applicant should assign at least BLTS 2. The Applicant may assign a higher BLTS depending on the conditions of the separated bicycle facility.
- **Protected Intersections:** If an intersection is protected, per National Association of City Transportation Officials (NACTO) guidance[7] on protected intersections, assign BLTS 1. This takes precedence over any adjacent segment of approach BLTS ratings.
- **Bike Facility Condition:** If the bike lane is in poor condition, such that the riding experience is significantly less comfortable, a BLTS 3 should be assigned. If the poor condition prevents most adult bicyclists from riding the bicycle facility, a BLTS 4 should be assigned. Poor conditions may be caused by pavement cracking, excessive debris or litter, potholes, or other facility deterioration.
- **Frequent Blockages:** If the bicycle lane experiences frequent blockages due to commercial activity, curb cuts, or frequent parking activity, a minimum BLTS 3 should be assigned when the adjacent street has a speed limit of 35 mph or less, and a BLTS 4 should be assigned when the adjacent street has a speed limit of 40 mph or more.
- **Signalized Intersections:** Crossings at signalized intersections are typically assigned the lowest approach BLTS rating (i.e., a signalized intersection with two BLTS 2 approaches and two BLTS 3 approaches is assigned a BLTS 2). However, some signalized intersections may require heightened attention from bicyclists. The Applicant should adjust signalized intersection BLTS ratings if the following criteria are met:
  - Minimum BLTS 2 if a bicyclist must cross six or more vehicular travel lanes at once without a refuge;
  - Minimum BLTS 3 if there are permissive right or left turns.

The Applicant should use engineering judgement when adjusting BLTS ratings and provide sufficient justification in a finalized MMTA.

4.2.2.3 Bicycle Level of Traffic Stress Presentation

The Applicant should follow the guidance on BLTS presentation provided in Appendix D Presentation of BLTS analysis results should include a color-coded aerial map of the study area based on BLTS ratings and a supporting narrative analysis of the results. Supporting narratives should include contributing factors for each BLTS rating and opportunities to improve BLTS with the construction of new infrastructure or modification of existing roadway design.

An example of BLTS analysis can be found in Appendix D.

[7]https://nacto.org/publication/dont-give-up-at-the-intersection/.

4.3 PEDESTRIAN NETWORK EVALUATION

The Pedestrian Network Evaluation consists of three sections:

- **Compliance with NDOT Standards:** Ensuring facilities are safe, usable, and comfortable will further encourage multimodal trips and help deliver Nashville's vision of a resilient transportation network that serves all modes. The Applicant should compare existing sidewalks and sidewalk buffers in the study area to what is called for in the MCSP. Where existing facilities do not meet MCSP requirements, the feasibility of aligning facilities with NDOT's transportation network plans should be assessed.
- **Network Connectivity:** The purpose of evaluating pedestrian connectivity is to identify opportunities that further connect the pedestrian network and provide pedestrians with a continuous and direct path of travel through the study area. The Applicant should identify gaps that prevent the development of a fully connected pedestrian network such as missing or deficient pedestrian intersection infrastructure, unfinished sidewalks, and excessive gaps between pedestrian crossings. Building new multimodal facilities that link or extend the existing network supports NDOT's vision of increasing access to schools, parks, businesses, employment, residences, and other community destinations via multimodal mobility.
- **Pedestrian Level of Traffic Stress Analysis:** Pedestrian Level of Traffic Stress (PLTS) methodology is a systematic approach for evaluating the road network with respect to pedestrian comfort and safety. PLTS goes beyond solely identifying the presence of facilities such as sidewalks by also considering the adjacent roadway characteristics and their impact on pedestrian comfort. Factors such as buffer width, number of vehicular lanes, and posted speed limit provide greater insight into the perceived pedestrian level of comfort.

Together, these three sections produce a comprehensive review of the pedestrian network in the study area.

4.3.1 PEDESTRIAN NETWORK COMPLIANCE WITH METRO STANDARDS

The MCSP provides appropriate pedestrian facility design guidance along corridors throughout Nashville including the locations and dimensions of pedestrian facilities. The Applicant should evaluate whether pedestrian facilities in the study area comply with MCSP design guidance, are in a state of good repair, and are ADA-compliant. Specifically, the Applicant should:

- Present "Planting Strip Width" and "Sidewalk Width" values provided in the MCSP for all segments within the study area.
- Present the actual existing planting strip width and sidewalk width within the existing study area.
- Identify discrepancies between the MCSP widths and existing study area widths.
- Assess the condition of sidewalks in the study area and identify instances of excessive deterioration and/or ADA non-compliance.
    - Excessive deterioration may include pavement or curb ramp condition, excessive debris or litter, poor lighting and visibility, or obstructions and encroachments.
- Follow the data presentation guidance provided in the Appendix B.

4.3.2 PEDESTRIAN LEVEL OF TRAFFIC STRESS

PLTS is a methodology used to measure the perceived level of discomfort, or "stress," a pedestrian is expected to experience when using a pedestrian facility. BLTS and PLTS should be performed at the same time to fully understand multimodal deficiencies within an area.

PLTS methodology categorizes a pedestrian's perceived level of stress at specific locations without intensive data requirements and calculations. Thus, PLTS is well-suited to identify locations in the pedestrian network that are not conducive to a comfortable walking experience and can inform improvement recommendations.

PLTS methodology independently evaluates two different sections of the pedestrian network: segments and crossings. Evaluations are based on accessible and verifiable information about the physical characteristics of each section including: (1) number of vehicular through lanes, (2) posted speed limit, (3) sidewalk width, and (4) buffer width. Criteria for the four PLTS levels is described in Table 4.2.

Table 4.2 PLTS Criteria

PLTS Level	Criteria
PLTS 1	Pedestrian facility is suitable for all users including children (around 10 years or younger), groups of people, elderly people, and those in wheelchairs or other wheeled mobility devices. The facility is a sidewalk or similar shared-use path with an adequate buffer between the pedestrian path and a low-speed/low-volume vehicular facility. There are not excessive curb cuts disrupting the path of travel. Intersections are easily crossed by all adults, trained children, and wheeled mobility devices. All users feel safe and comfortable.
PLTS 2	Pedestrian facility is suitable for most children and all adults. The facility may require more attention, especially from children, than in PLTS 1. In certain cases, some elements of the facility may reduce comfort or usability for wheeled mobility devices. The facility is a sidewalk with varying buffer widths adjacent to a vehicular facility that may experience higher speeds than a PLTS 1 facility. There are not excessive curb cuts disrupting the path of travel. Intersections are easily crossed by adults but may require additional supervision for children.
PLTS 3	Pedestrian facility is suitable for able-bodied adults. An able-bodied adult should feel safe using the facility; however, increased vehicular speeds and lack of buffer requires increased attentiveness. Children should always be supervised by an adult. Some portions of the facility may prevent use by wheeled mobility devices. Intersection may be uncomfortable for some users.
PLTS 4	Pedestrian facility is high stress. Only able-bodied adults with limited alternative route choices would use this facility. Not suitable for children or wheeled mobility devices. Vehicular speeds are moderate to high with narrow or no designated pedestrian facility.

4.3.2.1 Pedestrian Level of Traffic Stress Target Ratings

The target PLTS for segments, approaches, and intersections across Davidson County should be aligned with current bicycle network plans as communicated in the MCSP and WalknBike. All pedestrian facilities should be designed for the lowest feasible PLTS under given ROW constraints.

Additional attention should be given to areas that see greater pedestrian volumes, especially with vulnerable road users and children. Where feasible, BLTS 1 standards should be applied to the following areas:

- **School Zones:** The target PLTS within 0.25 mile of all K-12 schools should be PLTS 1.
- **Elderly Care Facilities:** The target PLTS within 0.25 mile of all elderly care facilities should be PLTS 1.
- **Transit Access:** The target PLTS within 0.25 mile of all transit stops should be PLTS 1.

If planned pedestrian facilities shown in the MCSP conflict with the targeted PLTS rating, the planned MCSP facility should take precedent.

4.3.2.2 Pedestrian Level of Traffic Stress Rating Adjustments

The Level of Traffic Stress flow charts provided in Appendix C allow the Applicant to assign PLTS ratings to all segments, approaches, and intersections in the study area. In some cases, external factors impacting PLTS may not be fully captured by the flow charts. The Applicant should apply the following PLTS Rating Adjustments to more accurately capture the PLTS associated with a specific location:

- **Protected Intersections:** If an intersection is protected per NACTO guidance on protected intersections[8], assign PLTS 1.
- **Facility Condition:** If the sidewalk is in poor condition, such that the walking experience is significantly less comfortable, assign PLTS 3. If the sidewalk or intersection pedestrian facility has deteriorated to an extremely poor condition such that it has become a hazard to users, or prevents wheeled mobility devices, elderly people, or children from using the facility, assign PLTS 4.
- **Frequent Blockages:** If the sidewalk is interrupted by frequent blockages due to commercial activity, curb cuts, or frequent parking activity, a minimum PLTS 3 should be assigned when the adjacent street has a speed limit of 35 mph or less, and an PLTS 4 should be assigned when the adjacent street has a speed limit of 40 mph or more.
- **T-Intersection Segments:** A crossing leg on a T-intersection should not be given a better rating than the segment PLTS of the pedestrian facilities it is connecting.
- **Intersections on Local Streets:** If a crossing of an intersection leg at an unsignalized intersection on a designated local street is missing crosswalks, a minimum PLTS 2 should be assigned to that leg.
- **Signalized Intersections:** Crossings at signalized intersections are typically assigned a PLTS 1. However, some signalized intersections may require heightened attention from pedestrians. The Applicant should adjust signalized intersection PLTS ratings if the following criteria are met:
  - Minimum PLTS 2 if there are permissive right or left turns;
  - Minimum PLTS 3 if a pedestrian must cross six or more vehicular travel lanes at once without a pedestrian refuge; or
  - PLTS 4 if the intersection is missing basic pedestrian infrastructure such as functional pedestrian signals, pedestrian curb ramps, and crosswalks.

The Applicant should use engineering judgement when adjusting PLTS ratings and provide sufficient justification in a finalized MMTA.

4.3.2.3 Pedestrian Level of Traffic Stress Presentation

The Applicant should follow the example on PLTS presentation provided in Appendix D. Presentation of PLTS analysis results should include a color-coded aerial map of the study area based on PLTS ratings and a supporting narrative analysis of the results. Supporting narratives should include contributing factors for each PLTS rating and opportunities to improve PLTS with the construction of new infrastructure or modification of existing roadway design.

An example of PLTS analysis can be found in Appendix D.

[8] https://nacto.org/publication/dont-give-up-at-the-intersection/protected-intersections/

4.4 TRANSIT NETWORK EVALUATION

The Transit Network Evaluation consists of four sections:

- **Stop Type:** Each transit stop type, consisting of distinct amenities and operational features, is primarily driven by the level of ridership to drive cost-effective investment in transit infrastructure. The Applicant should assess each transit stop in the study area to determine if the existing stop type is appropriate.
- **Stop Spacing:** Depending on the location and service frequency along a transit route, transit stops may be spaced at different intervals to optimize ridership. The Applicant should assess transit stop spacing in the study area and identify opportunities for adding, consolidating, or relocating stops.
- **Stop Design:** The *WeGo Transit Design Guidelines*[9] provide specific guidance on appropriate transit stop design for each stop type. The Applicant should evaluate each transit stop for compliance with design guidance and relevant ADA standards.
- **Stop Access:** Access to transit is a fundamental principle of NDOT's multimodal transportation strategy. New development should ensure that transit stops within reasonable walking distance are accessible to pedestrians. An evaluation of transit accessibility includes consideration of the: (1) directness and (2) comfort of a pedestrian path of travel from a development to a transit stop. The Applicant will evaluate both measures and assess the feasibility to improve transit access throughout the study area.

Guidance from the *WeGo Transit Design Guidelines* reflect the most recent version at the time of writing, however the most up-to-date published versions of WeGo guidance should take precedence over the information in this guideline document.

4.4.1 TRANSIT STOP TYPE

WeGo uses three configurations of bus stop: local, rapid, and transit centers. Each stop type is designed to serve a different type of service and ridership. Stops with higher ridership or larger numbers of youth, senior, or disabled passengers may incorporate amenities such as shelters, benches, and bike racks. Stops with lower ridership may simply have a sign indicating the stop location and an accessible landing surface.

A new development that is expected to generate a significant number of multimodal trips should prioritize transit stop upgrades when determining appropriate accommodations and mitigation measures. The Applicant should evaluate local and rapid stop types in the study area to determine if a transit stop upgrade is appropriate.

WeGo publicly shares up-to-date system maps on their website[10] that contain information about the transit service provided at each stop. The applicant should use WeGo's publicly available resources and in-person site visits to verify stop location, service, and facilities.

Descriptions of each stop type are given in Table 4.3 with criteria outlining when the installation of an upgrade is appropriate. If **one or more** criteria for a stop type is met, the installation of the stop type is justified.

[9] https://www.wegotransit.com/assets/1/24/WeGoGuidelines021919.pdf

[10] https://www.wegotransit.com/ride/maps-schedules/bus/

Table 4.3 Transit Stop Type Criteria

Stop Type	Criteria	Picture
Sign	A sign is required at all transit stops Minimum 5 ft by 8 ft ADA landing pad	
Bench	25 or more passengers boarding daily; Long wait times; Higher use by passengers with difficulty walking or standing; Potential increased passenger demand due to changes in land use development; and Proximity to establishments such as hospitals, assisted living facilities, schools, or other facilities that serve a wide range of ages and abilities	
Shelter	One or more of the criteria needed for installing a bench, but consideration must also be given to the following: Frequency of service; Existing land use compatibility; and Availability of space to accommodate infrastructure	

For each transit stop evaluation, the Applicant should follow the data presentation guidance provided in Appendix B.

4.4.2 TRANSIT STOP SPACING

Efficient transit stop spacing maximizes access for pedestrians while maintaining an acceptable travel time along a route. As part of a comprehensive transit review, the Applicant should verify that transit stops within the study area are appropriately spaced in accordance with *WeGo Transit Design Guidelines* and recommend appropriate spacing adjustments or stop consolidations.

WeGo currently defines appropriate stop distance based on service type (described below):

- **Local:** Moderately spaced stops to connect passengers to frequent service. This stop is designed with neighborhoods as a focus, with routes that may serve less congested areas.
- **Rapid:** Stops are spaced closer together to allow for easier connections to the frequent service that serves this stop. These stops serve dense, mixed-use areas along major corridors in the region.
- **Express:** Intended to serve a purpose on the regional level, with distant service areas focused on park & rides.
- **Circulator:** Serve downtown and popular destinations with convenient stop locations placed close by along routes.

Per the *WeGo Transit Design Guidelines*, recommended stop spacing is 0.25 mile for local service stops and 0.33 mile for rapid service stops. While these are recommended, unique conditions may warrant exceptions. Stops may need to be closer together to better serve highly used facilities or densely populated areas, while stops may need to be further apart to serve sparsely developed areas or account for unsafe roadside conditions.

For each transit stop, the Applicant should follow the data presentation guidance provided in Appendix B. Other items to consider when evaluating transit stop spacing include:

Land Use Type and Population Density: Stops should be located near areas of higher population density or activity. This typically means that stops may be spaced closer together in the downtown core and further apart in less dense areas. Future development and changes in land use should be considered when planning for optimal stop spacing along a route.

Route Interconnectivity: Stops should be strategically placed at transfer points where passengers can access connecting transit routes to other areas of Davidson County. Stop consolidation should be considered where stops are spaced close together to promote network connectivity.

4.4.3 TRANSIT STOP DESIGN AND ADA COMPLIANCE

WeGo Transit Design Guidelines provide detailed design criteria and ADA requirements for different stop types. The Applicant should reference the criteria listed in the *WeGo Transit Design Guidelines* when evaluating whether transit stops in the study area comply with relevant standards. For each transit stop, the Applicant should follow the data presentation guidance provided in the Appendix B.

4.4.4 TRANSIT STOP ACCESS

Access to transit stops is an important part of encouraging broader adoption. The Applicant should assess the path of travel a pedestrian may take from the new development to each transit stop in the study area. Specifically, the applicant should:

- Determine the most reasonable path of travel for a pedestrian walking from the new development to each transit stop in the study area.
- Use PLTS ratings to determine the average level of traffic stress a pedestrian is expected to experience while walking to each transit stop in the study area.
- Evaluate the accessibility of each transit stop through consideration of (1) major factors dictating the level of traffic stress along the path of travel, (2) alternative routes the pedestrian might take, and (3) potential infrastructure upgrades that would improve transit stop access.

To comprehensively evaluate transit stop access, the Applicant may need to apply PLTS methods to roadway segments and intersections that were not included in the multimodal review. All road facilities within a 0.5-mile radius from the development may be included in the transit stop access analysis. If a transit stop inside a 0.5-mile radius from the development cannot be reasonably accessed without using a roadway outside of the radius, the Applicant should indicate this in the MMTA.

To evaluate pedestrian safety and comfort between the new development and a transit stop, the Applicant should:

- Measure the distance from the main entrance of the development to each transit stop if a pedestrian were to take the most reasonable path of travel, considering available pedestrian facilities, safety, comfort, and directness. The Applicant may use desktop aerial imaging software to locate and measure the path.
- For each path of travel between the development and transit stops within the study area, calculate the average PLTS of the route using the formula below. PLTS analysis should be conducted only for the side of the segments and intersection crossings the pedestrian is expected to be using (see PLTS flow charts for segments and unsignalized intersections, note 4).

Equation 1: Average PLTS

$$\frac{(1 * L_1) + (2 * L_2) + (3 * L_3) + (4 * L_4)}{L}$$

Where:

L_1 $Cumulative\ length\ of\ path\ rated\ PLTS\ 1$

L_2 $Cumulative\ length\ of\ path\ rated\ PLTS\ 2$

L_3 $Cumulative\ length\ of\ path\ rated\ PLTS\ 3$

L_4 $Cumulative\ length\ of\ path\ rated\ PLTS\ 4$

L $Total\ length\ of\ the\ path$

- Upon calculation of the path of travel distance and average PLTS, the Applicant should provide a supporting narrative to describe the existing pedestrian accessibility of each transit stop and recommend potential infrastructure upgrades that can improve access. Recommendations should improve the safety, comfort, and/or directness of the path of travel through the installation of pedestrian infrastructure.
- Follow the data presentation guidance provided in Appendix B. In addition to calculating average PLTS, the Applicant should also document the distance a pedestrian is expected to spend walking on a segment rated PLTS 4 and the number of crossings along the path of travel rated PLTS 4.

A sample transit stop access analysis is provided in Appendix E.

5 SAFETY

The purpose of an MMTA safety review is to identify potential safety issues in the study area so that appropriate solutions can be implemented to ensure a safe transportation environment for all road users.

5.1 OVERVIEW

This section details the appropriate steps an Applicant should take to conduct a safety review that meets the expectations and requirements of NDOT.

NDOT is committed to reaching zero roadway deaths by 2050 through Metro Nashville's Vision Zero program, an initiative to eliminate all traffic fatalities and severe injuries while increasing safe, healthy, and equitable mobility for all. At the core of Vision Zero is a data-driven approach to safety that prioritizes infrastructure and behavior change. An MMTA safety review can drive the Vision Zero agenda by enabling local developments to build safer transportation environments throughout Davidson County.

From the perspective of a developer, a safety review will help to ensure that access to a new development is not prevented by an unsafe roadway environment. From the perspective of Metro Nashville, a safety review will help achieve targeted Vision Zero safety benchmarks. Specifically, an MMTA safety review should accomplish the following:

- Conceptualize existing and proposed ingress and egress plans including conflict points.
- Evaluate historical crash data and identify trends.
- Identify and mitigate potential safety issues in the study area.

5.2 SITE ACCESS EVALUATION

The safety of road users can be compromised if new access points proposed by a development are not appropriately designed, especially if they introduce new conflict points to the transportation network. A conflict point is a point at which two road users can potentially collide with each other at road intersections or site accesses.

Conflict points involving vehicles and vulnerable road users (such as pedestrians or bicycles) should be minimized, as they can result in the most severe injuries. While eliminating all new conflict points is often not an option when introducing a new development, it is important to scrutinize all new ingress and egress movements at the site to ensure the safety of all road users. NACTO publications offer guidance on conflict evaluation at site accesses and designs that mitigate conflicts for all modes.

All conflict points identified by the site access evaluation may be categorized into one of the following three conflict point types:

- **Crossing Conflict:** A crossing conflict point occurs when two paths of travel intersect at a perpendicular angle. Crossing conflict points are a major conflict because they can result in severe injuries. Poor sight distance and high travel speed can increase the risk of a crossing conflict.
- **Merging Conflict:** A merging conflict point occurs when one path of travel converges with a travel lane. This occurs when road users turn onto a road and must merge with traffic. The travel speed of the merged road can increase the risk associated with a merging conflict.

- **Diverging Conflict:** A diverging conflict point occurs when a road user exits a path of travel to enter an adjacent lane or make a turning movement. A diverging road user will often slow down, increasing the risk of rear-end collisions at diverging conflict points.

As part of a comprehensive evaluation of the site access, the Applicant should identify potential high-risk conflict points between road users at all proposed site accesses. Conflict points may be high-risk due to multiple factors, including but not limited to:

- Moderate to high posted speed limits (35 mph and above);
- Left turns into heavily congested roadways;
- Long crossing distances (2 or more crossing lanes);
- Limited visibility or site distance;
- Conflict points between vehicles and vulnerable road users such as pedestrians or bicycles; and
- Transit operations occurring in the direct vicinity.

For each high-risk conflict point identified by the Applicant, the Applicant should describe the conflict point type, contributing factors, and recommended strategies to reduce or eliminate the risk associated with the conflict point. Mitigation strategies to reduce conflict point risk may include:

- Additional signage;
- Additional pedestrian scale lighting;
- Roadway geometry modification;
- Access relocation; and
- Vehicular movement restriction.

The Applicant should design site accesses to reduce all conflict points, especially those that are high-risk. Major contributing factors to high-risk conflict points should be identified, and strategies to mitigate risk should be recommended. The Applicant may refer to Appendix B for site access evaluation data presentation guidance.

5.3 HISTORICAL CRASH EVALUATION

As modern data management tools have become ubiquitous across the transportation industry, both high-level and granular safety data are more widely available for public review and use. An evaluation of crashes in the study area can uncover trends that ultimately lead to informed safety improvements. NDOT's Vision Zero program and the AASHTOWare Safety Data Warehouse[11] both provide excellent resources for analyzing safety trends in the study area. Applicants should use these resources to identify safety trends, conduct a crash analysis at study intersections, and inform the strategic deployment of improvements where the greatest benefit to road user safety can be realized.

[11] https://www.aashtoware.org/products/safety/safety-overview/

5.3.1 NDOT HIGH INJURY NETWORK

Metro Nashville's Vision Zero Data Dashboard is a database of interactive maps that present transportation safety trends across Davidson County. Data provided includes the High Injury Network (HIN)[12], vulnerable areas, crashes by travel mode, crashes by severity, crash factors, and hit-and-runs.

The HIN is an interactive map that uses historical data to characterize Davidson County roads by their level of safety. Roads on the HIN have historically seen the highest numbers of people who have died or been injured in a traffic crash, whether driving, walking, bicycling, or riding a motorcycle. The Applicant should leverage the HIN to document areas in the study area that pose the greatest threat to the safety of road users. Specifically, the Applicant should:

- Identify which roads in the study area are on the HIN, including any mode-specific categorizations (Pedestrian/Motorist/Bicyclist).
- Consider HIN characterization of roads when evaluating historical crashes in the study area, selecting mitigation measures, and analyzing MMTA results.

5.3.2 CRASH HISTORY

Upon approval of a *Scoping Evaluation Form*, NDOT will provide the applicant with historical crash data within the study area. This data will be pulled from the AASHTOWare Safety platform. AASHTOWare Safety is a Software as a Service (SaaS) platform specifically designed to meet the needs of state and local transportation agencies in traffic safety management. The integrated Safety Data Warehouse that the AASHTOWare program is built on ingests, cleans, and houses spatial crash data that enables users to conduct comprehensive safety analysis.

NDOT will send the Applicant an Excel file that includes safety data up to five years old. In cases where there is not five years of available data, NDOT will send what is available. For each crash, the dataset includes information on the date, time, location, type of crash, crash severity, contributing actions, vehicle direction, weather conditions, and whether the crash involved pedestrians or other non-motorized vehicles.

The Applicant should leverage the AASTHOWare dataset provided by NDOT to evaluate historical crashes in the study area and identify contributing factors. To conduct an effective safety evaluation, the Applicant should follow the steps below.

- **Clean the Data:** In order to import the dataset to a geospatial visualization software, it is important to clean the received dataset into a format that is easier to work with. If the Applicant is using ArcGIS Pro for data visualization, the dataset should be formatted as a table in Excel, at a minimum. Additionally, the Applicant should modify the column titles to make the fields more recognizable.
- **Visualize the Data:** Import the data to a geospatial data visualization tool, such as ArcGIS Pro. This will enable the Applicant to easily locate the crash locations and identify hotspots that should be addressed.
- **Summarize Crash Severity:** For each year of data collection, evaluate crash severity by summing the total number of crashes and the number of fatal, serious injury, minor injury, possible injury, and property damage only crashes according to the AASHTOWare dataset. The "Type of Crash" field contains this information. See Appendix B for data presentation guidance.
- **Summarize Crash Type:** For each year of data collection, record the crash location and crash type. For crash location, differentiate between crashes that occurred at an intersection or along a roadway. The "Crash

[12]https://experience.arcgis.com/experience/74363e0dbb3e43138bc7d451a90817ef/page/High-Injury-Network/?views=High-Injury-Network

Location" field contains this information. For crash type, sum the number of head-on, rear-end, angle, and sideswipe crashes. For crashes involving only one vehicle, sum up the total number of crashes that involved a pedestrian, other non-motorist, or were property damage only. The "Vehicle Most Harmful Event" and "Manner of First Collision" fields contain this information. See Appendix B for data presentation guidance.

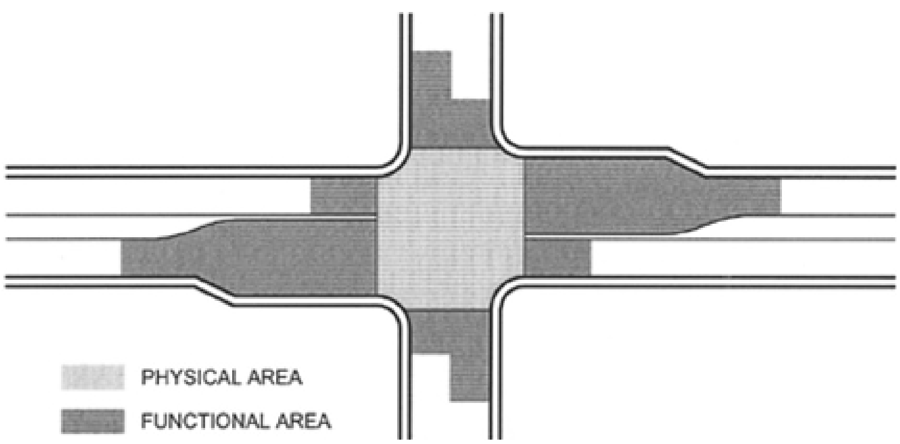
- **Summarize High-Risk Crashes:** Using the AASHTOWare dataset, provide a summary of crashes that resulted in fatalities, suspected serious injuries, and crashes that involved pedestrians or other non-motorists. It is important to identify instances where a high-risk or severe crash has occurred, diagnose the contributing factors, and implement a solution to mitigate similar outcomes in the future. See Appendix B for data presentation guidance.

5.3.3 INTERSECTION CRASH ANALYSIS

The Applicant should conduct an intersection crash analysis to determine the relative crash risk at each intersection and inform the deployment of improvements that increase safety. To conduct an effective analysis, the Applicant should follow the steps below:

- **Record the Number Intersection Crashes:** Use a mapping tool to visualize the study area crashes that can be attributable to each study area intersection based on proximity. Crashes that occur within the "functional area" of an intersection should be attributed to that intersection. The "functional area" includes the intersection up to the point at which a turn lane tapers. Rear-end collisions that are caused by intersection queuing should also be attributed to an intersection. The Applicant may use the "Crash Location" dataset field for reference but should note that it is not always correct and should be verified with coordinates.

Figure 5.1 Intersection Functional Area



- **Calculate Peak Hour Entering Volumes:** Compare the existing AM and PM peak hour traffic counts that were used for the Traffic Review. For each study intersection, sum the total entering volume during each peak hour and determine which volume is greater. The peak hour with the greatest entering volume should be used for this intersection crash analysis.

- **Determine an Appropriate K-Factor:** Using TDOT's Traffic Count Database System, select the nearest count station(s) to the proposed development. In the "AADT" tab under "Station Data" use the K% from the most recent year to determine an appropriate K-factor for use in analysis. The K-factor is the 30th highest hourly volume (known as DHV-30) of the year as a percentage of AADT. Due to the absence of DHV-30 data, the selected K-factor will be applied to the highest peak hour entering volumes. In some cases, this may result in conservative crash rate estimates.

- **Estimate Daily Entering Volumes:** Using the greatest peak hour entering volume and K-factor, estimate the daily entering volume for each study intersection using the following formula:

Equation 2: Daily Entering Volume

$$Daily\ Entering\ Volume \quad \frac{Peak\ Hour\ Entering\ Volume}{K}$$

Where K is the K-factor, as a decimal.

- **Estimate Total Entering Volumes for the Data Collection Period:** Once the daily entering volume for each study intersection is estimated, the Applicant should extrapolate that over the course of the data collection period. For the purposes of this analysis, the data collection period is the number of weeks between the first recorded crash and the last recorded crash in the AASHTOWare dataset provided by NDOT.
- **Calculate Intersection Crash Rates:** For each intersection, calculate the crash rate in the units of crashes per million entering vehicles using the following formulas:

Equation 3: Intersection Crash Rate

$$R \quad \frac{C * 1{,}000{,}000}{V}$$

Where R is the intersection crash rate, C is the number of reported crashes over the data collection period, and V is the total entering volume for the data collection period. Summarize the data in a table – see Appendix B.

- Provide a narrative analysis of potential trends in the crash data, such as similar type, location, contributing factors, or study intersection with relatively high intersection crash rates. The narrative analysis should also include recommendations of potential strategies to improve safety within the study area.

5.3.4 TRAFFIC CONSIDERATIONS

Using the analysis completed in the Traffic Review and Safety Review sections of the MMTA, the Applicant should consider several questions to identify the underlying causes of crashes within the study area including:

- Are there geometric elements of a segment or intersection that impact safety?
- Does poor intersection performance negatively impact safety in the study area?
- Does vehicle speed contribute to traffic crashes in the study area?
- Does vehicle queuing negatively impact safety in the study area or impact site ingress and egress movements?
- What improvements can be implemented to reduce expected crash frequency and severity?

The Applicant should provide a summary of how the traffic facilities and operations in the study area impact safety.

5.3.5 MULTIMODAL CONSIDERATIONS

Multimodal safety should be thoroughly analyzed, as pedestrians and bicyclists are most at risk of severe injuries on the road network, and crash data involving vulnerable road users is often underreported. Using the analysis completed in the Multimodal Review and the Safety Review sections of the MMTA and field observations, the Applicant should consider several items to identify the underlying causes of crashes within the study area including:

- Are there conflict points involving vehicles and pedestrians or bicyclists?
- Do segments or intersections with high BLTS or PLTS ratings negatively impact the overall safety of the study area?
- Is the pedestrian path of travel from the development to multimodal facilities in the study area safe?
- Does the proposed site design accommodate safe mobility for vulnerable road users?

The Applicant should provide a summary of how multimodal safety is impacted within the study area.

6 MITIGATION

The traffic, multimodal, and safety reviews are designed to produce insights that can inform the selection of effective mitigation measures that address transportation deficiencies, mitigate development impact, and enhance the transportation network for the community. All new developments are expected to be positive additions to the area and uphold a transportation network that is safe, efficient, and serves all members of the community. This important step in the MMTA process demonstrates to NDOT that the Applicant is prepared to support community access to safe transportation in the study area.

6.1 OVERVIEW

After a thorough evaluation of traffic, multimodal mobility, and safety within the study area, the Applicant should provide a list of improvements to comprehensively address the outcomes of the MMTA, and a list of mitigation measures to mitigate the impacts of the new development. All recommendations will fall in three categories:

- Off-Site Infrastructure: These are recommendations necessary to address off-site safety, capacity, and operational deficiencies within the study area. Off-site infrastructure improvements should consider the impacts to all modes.
- Internal Site Characteristics: The safety and efficiency of internal site operations are important for internal user experience and the travelling public. Revisions to the site plan, parking plan, or internal transportation network might be required to prevent on-site queues from encroaching onto the public right-of-way or to provide more direct access to public multimodal facilities.
- Transportation Demand Management (TDM) Strategies: In addition to physical mitigations, TDM strategies can also help reduce the volumes of new vehicular trips. These strategies include facilities to encourage the use of sustainable modes, incentive programs for public transit usage, and education on the benefits of flexible work schedules.

The Applicant should evaluate the results of the MMTA and consider the needs of the study area when selecting appropriate improvements and mitigation measures.

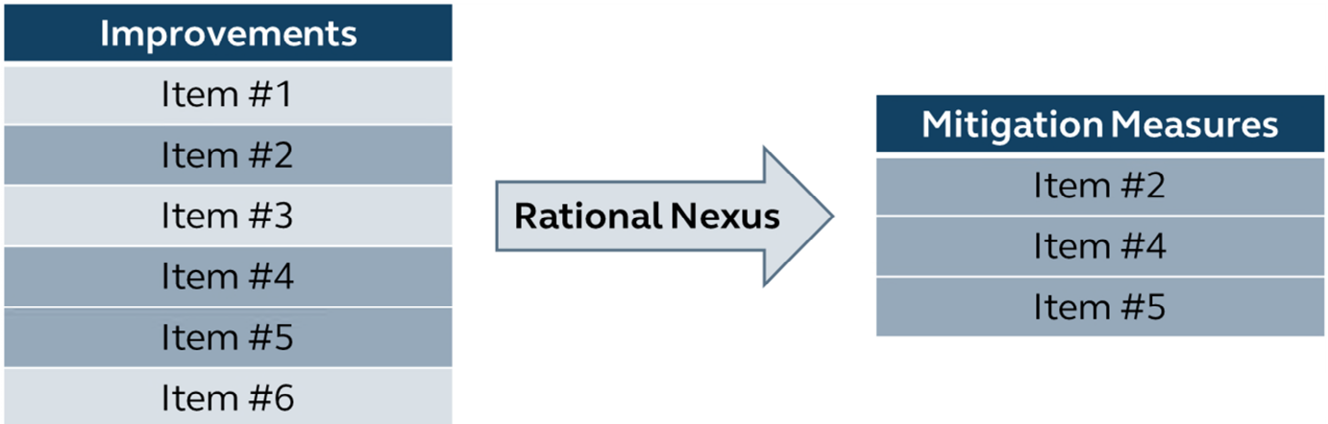
6.2 MITIGATION MEASURES AND RATIONAL NEXUS

The Applicant should provide a comprehensive list of improvements that address the transportation issues, deficiencies, and general themes of the MMTA. Inclusion of items in this list does not indicate responsibility. Rather, it is an opportunity for the Applicant to provide NDOT with a selection of strategies to improve transportation operations in the study area.

From this list of potential improvements, the Applicant should provide a specific list of mitigation measures. The selected mitigation measures represent commitments made by the developer to partially or fully implement and/or fund improvements. The remaining items from the list of improvements will be collected by NDOT and considered for future implementation.

A critical aspect of this selection process involves establishing a rational nexus between the mitigation measure and the proposed development. The term “rational nexus” signifies a clear and logical connection, or justification for the development taking responsibility for a specific mitigation measure. For example, if a new development is expected to generate a significant number of pedestrian trips at an intersection without adequate pedestrian infrastructure, a logical mitigation measure might involve constructing enhanced crossing infrastructure to improve safety and pedestrian mobility.

Figure 6.1 Connecting Improvements and Mitigation Measures with a Rational Nexus



This process will ensure that the selected mitigation measures are purposeful, logically connected to the development's impact, and contribute to the improvement of the transportation network in a manner that benefits both the community and the development.

6.3 COMMUNITY NEEDS

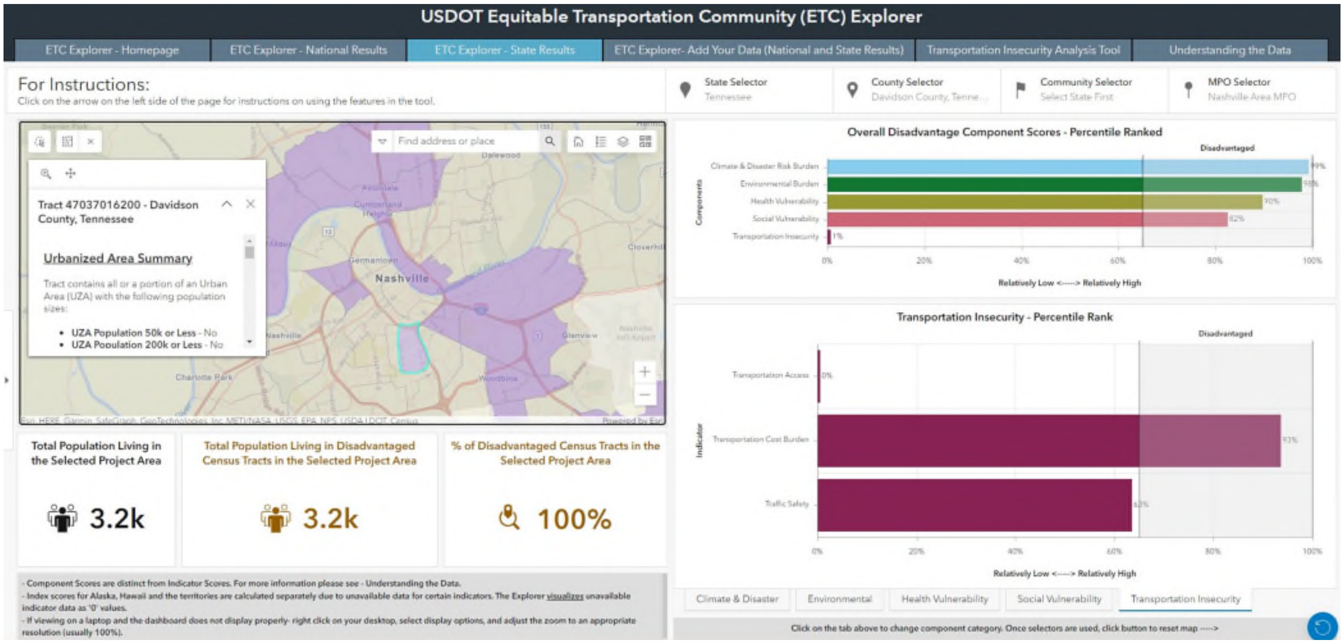
Traditionally, recommendations for roadway improvements have been based on operational performance and cost, often failing to consider the broader implications to road users and community needs. The Applicant should evaluate the expected effectiveness of a potential mitigation measure prior to implementation.

Community needs often dictate the effectiveness of new transportation infrastructure. Different areas throughout Davidson County have different needs, so it is important to consider the characteristics of the population surrounding the development. The Applicant should use a demographic mapping tool, such as the USDOT Equitable Transportation Community (ETC) Explorer[13], to ensure proposed improvements meet the needs of the surrounding community.

The USDOT's ETC Explorer is an interactive web application that uses 2020 census data to explore the cumulative burden communities experience as a result of underinvestment in transportation in the following five components: Transportation Insecurity, Climate and Disaster Risk, Environmental Burden, Health Vulnerability, and Social Vulnerability. The ETC Explorer is a dynamic tool that provides insight into how transportation investments can mitigate or reverse community burdens. Data is published online in a user-friendly interface. Applicants can learn more about the tool on the USDOT website.

[13] https://experience.arcgis.com/experience/0920984aa80a4362b8778d779b090723/page/ETC-Explorer---State-Results/

Figure 6.2 USDOT Equitable Transportation Community Explorer Tool



The Applicant should leverage the following metrics provided by the ETC Explorer tool to evaluate potential mitigation measures:

- Total population living in study area.
- Poverty level
- Median household income
- Housing cost burden
- Points of interest within a 15-minute walk
- Transportation cost burden
- Estimated cost of transportation
- Number of households with no personal vehicle

The characteristics of the population surrounding the proposed development should be considered to ensure that proposed mitigation measures effectively address specific disadvantages due to transportation inequity.

6.4 EVALUATION

Mitigation measures may be targeted at improving traffic operations, multimodal mobility, safety, or a combination, so it is important to evaluate each with respect to their expected outcome.

- **Traffic**: Results of the traffic review may indicate the need for a mitigation measure focused on improving traffic operations in the study area. This may include roadway design modifications, operational improvements, or measures to improve vehicular safety. When evaluating the expected effectiveness of a mitigation measure focused on improving traffic operations, the Applicant should consider the following questions:
    - Does this measure reduce queueing?
    - Does this measure reduce delay?
    - Does this measure improve vehicle safety?
    - Are multimodal mobility and safety uncompromised through the implementation of this measure?

The Applicant should thoroughly assess the expected benefits of a traffic-focused mitigation measure before including it in the MMTA recommendations.

- **Multimodal:** In addition to aligning with NDOT's multimodal project plan, Applicants should consider the impact a mitigation measure will have on multimodal access, connectivity, and safety. The Applicant should consider the following questions when evaluating potential multimodal mitigation measures:
  - Does this measure improve BLTS and/or PLTS along any segment or at any intersection?
  - Does this measure incentivize or encourage multimodal adoption?
  - Does this measure improve the condition of multimodal facilities?
  - Does this measure improve access to transit or other multimodal facilities?

As Nashville's multimodal network expands, measures meant to support this expansion should provide tangible benefit to existing and future multimodal road users.

- **Safety:** In alignment with NDOT priorities, an evaluation of appropriate mitigation measures will also include an assessment of the expected impact on safety and access. Specifically, the Applicant should answer the following for each mitigation measure:
  - Does this measure reduce the number of conflict points?
  - Does this measure provide safer access to transit or other multimodal facilities?
  - Does this measure improve the safety, comfort, visibility, and/or protection of vulnerable road users?

Safety is an unwavering principle of the MMTA process, and all recommended mitigation measures should support road user safety.

6.5 COST

All mitigation measures should be supported by a realistic cost estimate range. If applicable, the applicant should provide an estimated minimum and maximum cost needed to implement or construct new transportation infrastructure at the time of the study. This should be a generalized, planning-level estimate, and does not represent an official agreement between two parties, nor does it protect against future cost fluctuations due to inflation. Recommendations that do not require the implementation or construction of new infrastructure, such as ROW dedication, or where implementation costs are negligible, such as restriping, are not required to include a cost estimate.

6.6 PRIORITIZATION

Mitigation measures should address issues raised in the traffic, multimodal, and safety reviews. Measures recommended by the Applicant should align with NDOT's transportation priorities for the study area and the broader transportation network.

Mitigation measure categories provided in Appendix F are classified by the primary benefit the measure is expected to bring. The categories are: (1) safety, (2) pedestrian mobility, (3) bicycle mobility, (4) transit mobility, and (5) traffic. The order of this list is only to represent each category. Implementation decisions should be made on a case-by-case basis.

Mitigation measures that improve safety should always be prioritized; however, focusing on multimodal or vehicular travel will depend on the results of the MMTA and the specific needs of the study area. It is often the case that a mitigation measure will provide multiple benefits such as providing a safe path of travel for pedestrians and increasing access to transit.

This section provides examples of situations in which mitigation measures targeting a specific benefit should be prioritized. These lists are meant to guide the Applicant towards selecting the most effective strategies to address the most critical transportation needs found through the completion of an MMTA. The Applicant should ultimately use engineering judgement when selecting mitigation measures for a specific development.

Table 6.1 Example Criteria for Selecting Mitigation Measures

Mitigation Target	Criteria
Safety	• Conflict points between vehicles and vulnerable road users at site accesses • Inadequate sight distance • Historical crash trends
Pedestrian Mobility	• Gaps in the pedestrian network directly serving the development • High PLTS (3 or 4) in highly populated area (T4, T5, T6) • Planned pedestrian facilities per MCSP
Bicycle Mobility	• Gaps in the bicycle network directly serving the development • High BLTS (3 or 4) on planned bikeway segment • Planned bicycle facilities per MCSP
Transit Mobility	• Access to the transit stops in the study area is limited due to high PLTS or a lack of adequate pedestrian facilities • Transit stop type, design, or spacing is not appropriate
Traffic	• Streets do not comply with the MCSP • Vehicular queues are creating increased risk of crashes • Intersections experience excessive delays

The mitigation measure process involves identifying, selecting, and committing to specific implementable measures that address anticipated impact of the proposed development and improve safe transportation access for all modes in the study area.

Appendix A

Scoping Evaluation Form

Nashville Department of Transportation and Multimodal Infrastructure

Scoping Evaluation Form for Multimodal Transportation Analysis

Form A

1 Introduction

Submit this form to the Nashville Department of Transportation and Multimodal Infrastructure (NDOT) in advance of commencing a Multimodal Transportation Analysis (MMTA). The purpose of this form is to define MMTA parameters, outline the basic characteristics of a proposed development, and provide an overview of the transportation system in the study area. Along with this form, the Applicant should also submit a (1) site plan, (2) study area map, including labeled study intersections and study segments, (3) growth rate calculations, and (4) phasing plan, if applicable.

Information included in this form at the time of NDOT approval should be applied in the subsequent MMTA. The applicant should notify NDOT if information in this form changes at any point prior to approval of the MMTA.

Recommended MMTA trip generation thresholds are defined in the Guidelines on Multimodal Transportation Analysis for Site Development (referred to herein as the MMTA Guidelines). Before completing this document, recommended thresholds should be reviewed to ensure the completion of an MMTA is appropriate.

For additional guidance on completing this form refer to the MMTA Guidelines.

2 Application Information

Submittal Date	
Codes, Planning Case #, or Building Permit #	
Project Name (address preferred)	
Submission Type	
Council District	
Applicant or Project Developer	
Applicant or Project Developer E-mail	
Applicant or Project Developer Phone #	
MMTA Preparer	
MMTA Preparer E-mail	
MMTA Preparer Phone #	

Notes

3 Project Review

Project Address	
Project Parcel(s)	
Existing Zoning	
Proposed Zoning (if applicable)	
Proposed Parking	

Use table 3.1 to document the expected trip generation (all modes) for any existing development(s) at the project site. **If there is no existing trip generation at the project site, move on to Table 3.3.**

Table 3.1 Existing Trip Generation

Land Use	Size (Square Feet or Dwelling Units)	Peak Hour Trips		Daily Trips
		AM	PM	
Total				

No existing trip generation: ☐

Use additional sheet if necessary. If applicable, alternative peak hours should be shown on an additional sheet.

In Table 3.2, differentiate vehicular and non-vehicular (e.g., pedestrian, bicycle, transit) trips by applying a mode split to the total trip generation volumes calculated in Table 3.1.

Table 3.2 Existing Mode Split

% Vehicle Trips	AM Trips		PM Trips		Daily Trips	
	Vehicular	Non-vehicular	Vehicular	Non-vehicular	Vehicular	Non-vehicular
Total						

No existing trip generation: ☐

Existing Mode Split should be an estimation based on existing land use and surrounding area characteristics.
If applicable, alternative peak hours should be shown on an additional sheet.
For the % Vehicle Trips column, indicate the share of vehicular trips being taken as a percentage. For example, if 85% of the remaining trips are expected to be vehicular, and 15% are expected to be non-vehicular, enter "85%". For the remaining cells, input the number of vehicular and non-vehicular trips for each period based on the defined mode split.

Use Table 3.3 to document the expected trip generation (all modes) for the proposed development.

Table 3.3 Proposed Trip Generation

Land Use	Size (Square Feet or Dwelling Units)	Peak Hour Trips		Daily Trips
		AM	PM	
Total				

Use additional sheet if necessary. If applicable, alternative peak hours should be shown on an additional sheet.

In Table 3.4, apply expected trip reductions to the corresponding trip generation volumes calculated in Table 3.3. Refer to the MMTA Guidelines for additional information on applying trip reductions.

Table 3.4 Proposed Trip Reductions

Trip Reduction Type	Peak Hour Trips				Daily Trips	
	AM		PM			
	Percent	Value	Percent	Value	Percent	Value
Internal Capture						
Pass-By						
Remaining Trips						

Use additional sheet if necessary. If applicable, alternative peak hours should be shown on an additional sheet.
In the "Percent" columns, enter the trip reduction as a percentage of total trip generation for the specified period.
In the "Value" columns, enter the corresponding number of trips associated with the percent reduction for the specified period.
In the "Remaining Trips" row, subtract the total trip reductions for the from the total proposed trip generation of the specified period.

In Table 3.5, differentiate vehicular and non-vehicular trip generation by applying a mode split to the "Remaining Trips" volumes calculated in Table 3.4.

Table 3.5 Proposed Mode Split

% Vehicle Trips	AM Trips		PM Trips		Daily Trips	
	Vehicular	Non-vehicular	Vehicular	Non-vehicular	Vehicular	Non-vehicular
Total						

If applicable, alternative peak hours should be shown on an additional sheet.
For the % Vehicle Trips column, indicate the share of vehicular trips being taken as a percentage. For example, if 85% of the remaining trips are expected to be vehicular, and 15% are expected to be non-vehicular, enter "85%". For the remaining cells, input the number of vehicular and non-vehicular trips for each period based on the defined mode split.

Provide justification for the proposed trip reductions and mode split. Reasons could include, but are not limited to, existing and planned transportation infrastructure, land use, location, and population density.

Narrative summary of proposed trip reductions and mode split

In Table 3.6, calculate the net change in trip generation for the proposed development using values calculated in previous Project Review tables. **If there is no existing trip generation at the project site, skip this step.**

Table 3.6 Net Trip Generation

	AM		PM		Daily	
	Vehicular	**Non-vehicular**	**Vehicular**	**Non-vehicular**	**Vehicular**	**Non-vehicular**
Existing						
Proposed						
Net Change						
Total Net Change						

No existing trip generation: ☐

If applicable, alternative peak hours should be shown on an additional sheet.
In the "Existing" row, enter values calculated in Table 3.2.
In the "Proposed" row, enter values calculated in Table 3.5.
In the "Net Change" row, enter the net difference between existing trip generation and proposed trip generation for each mode.
In the "Total Net Change" row, sum the vehicular net change and non-vehicular net change for the corresponding period to determine the total difference between existing trip generation and proposed trip generation.

4 Study Area Review

Build Year	
Growth Rate	

In Table 4.1, provide a list of background developments that are expected to impact the study area transportation network in the build year. To qualify, a background development must be one that is not occupied at the time of study but is expected to be occupied prior to the approved build year proposed in this section.

Table 4.1 Background Developments

Name	Address	Parcel ID	Available MMTA/TIS

In "Available MMTA/TIS" column, the applicant should indicate, to the best of their knowledge, whether an MMTA has been submitted to NDOT for the associated development with one of three answers: "Yes", "No", or "Unknown".

In Table 4.2, provide a list of study intersections to be analyzed.

Table 4.2 Study Intersections

	Major Street (Functional Classification)	Minor Street (Functional Classification)
1		
2		
3		
4		
5		
6		
7		
8		

The Applicant should populate each cell with the street name, followed by the associated functional classification, per MCSP, in parenthesis.

Table 4.3 Study Segments

	Street Name	Segment Origin	Segment Terminus
1			
2			
3			
4			
5			
6			
7			
8			

Study Segments are defined as roadways between two Study Intersections.
In the "Street Name" column, the Applicant should document the street name of the Study Segment.
In the "Segment Origin" column, the Applicant should document the name of the crossing street where the Study Segment originates, followed by the Study Intersection number in parenthesis, e.g., "Main Street (Int. 3)".
In the "Segment Terminus" column, the Applicant should document the name of the crossing street where the Study Segment terminates, followed by the Study Intersection number in parenthesis, e.g., "Main Street (Int. 3)".

5 Mobility Review

Use the prompts in the tables below to provide a high-level overview of the multimodal facilities in the study area.

Table 5.1 Bicycle Mobility Review

Describe the availability of bicycle infrastructure in the study area.	

Table 5.2 Pedestrian Mobility Review

Describe the availability of pedestrian infrastructure in the study area.	

Table 5.3 Transit Mobility Review

List all transit stops in the study area.	

Upon approval of this Scoping Evaluation Form (Form A), all transit stops in the study area that have been documented in Table 5.3 should be evaluated per guidance provided in the MMTA Guidelines unless otherwise directed by the NDOT Reviewer.

6 NDOT Reviewer Response

Table 6.1 should be completed by the NDOT Reviewer upon review of the Scoping Evaluation Form.

Table 6.1 NDOT Reviewer Response

NDOT Reviewer Name	
NDOT Reviewer E-Mail	
Date	
Response	☐ Approved ☐ Additional Information/Revisions Needed ☐ Denied
Study Type	☐ Level 1 ☐ Level 2
Comments	

☐ **NDOT has reviewed and approved this Scoping Evaluation Form. The Applicant may now commence a Multimodal Transportation Analysis in alignment with the information provided in this form.**

Appendix B

Data Table Examples

The following tables are templates the Applicant may use for presenting analysis results as part of a Multimodal Transportation Analysis (MMTA). While these tables are not a requirement of the MMTA, they are strongly suggested for clarity. If an alternative method for presenting data is used, the same information should be clearly documented.

Traffic Review

Intersection Level of Service

Intersection	Turning Movement	Level of Service (Average Delay in sec/veh)			
		Existing	Background	Future	Future with Mitigations
Intersection A (Unsignalized)	Northbound Approach	A/B/C/D/E/F (sec delay)			
	Eastbound Approach				
	Southbound Approach				
	Westbound Approach				
Intersection B (Signalized)	Overall				

Multimodal Review

Transit Stop Summary (Type, Spacing, Design)

Transit Stop	Type	Upgrade?	Transit Stop Spacing

Transit Access

Segment	Length (ft)	Rating
	Weighted Average Rating	

Transit Access Summary

Transit Stop	Pedestrian Route Distance	Pedestrian Route Average PLTS	Distance on PLTS 4 Facilities	# of Crossings Rated PLTS 4	Is Transit Stop on PLTS 4 Facility?

Safety Review

Site Access Evaluation

Site Access	High-Risk Conflict Point	Mitigation	Feasibility to Implement Mitigation

Crash Severity Summary

Year	Total Crashes	Crash Severity				
		Fatal	Serious Injury	Minor Injury	Possible Injury	Property-Damage Only
Sum						

Crash Location and Type Summary

Year	Total Crashes	Crash Location		Crash Type							
		At an Intersection	Along Roadway	Crash involving two vehicles				Crash involving one vehicle			
				Head On	Rear-End	Angle	Sideswipe	Pedestrian Involved	Other Non-Motorist	Property	Other/ Unknown
Sum											

Intersection Crash Rate Analysis

Intersection	Total Crashes	Peak Hour Entering Volume*	K factor	Daily volume	Total entering volume**	Crashes per million entering vehicles

Pedestrian Crash Summary

Date	Location	Type	Severity	Driver Actions	Vehicle Direction(s)	Conditions

Suspected Serious Injury or Fatal Crash Summary

Date	Location	Type	Driver Actions	Vehicle Direction(s)	Conditions

Mitigations

Recommended Improvements

#	Description	Location	Benefit
1			
2			
3			
4			

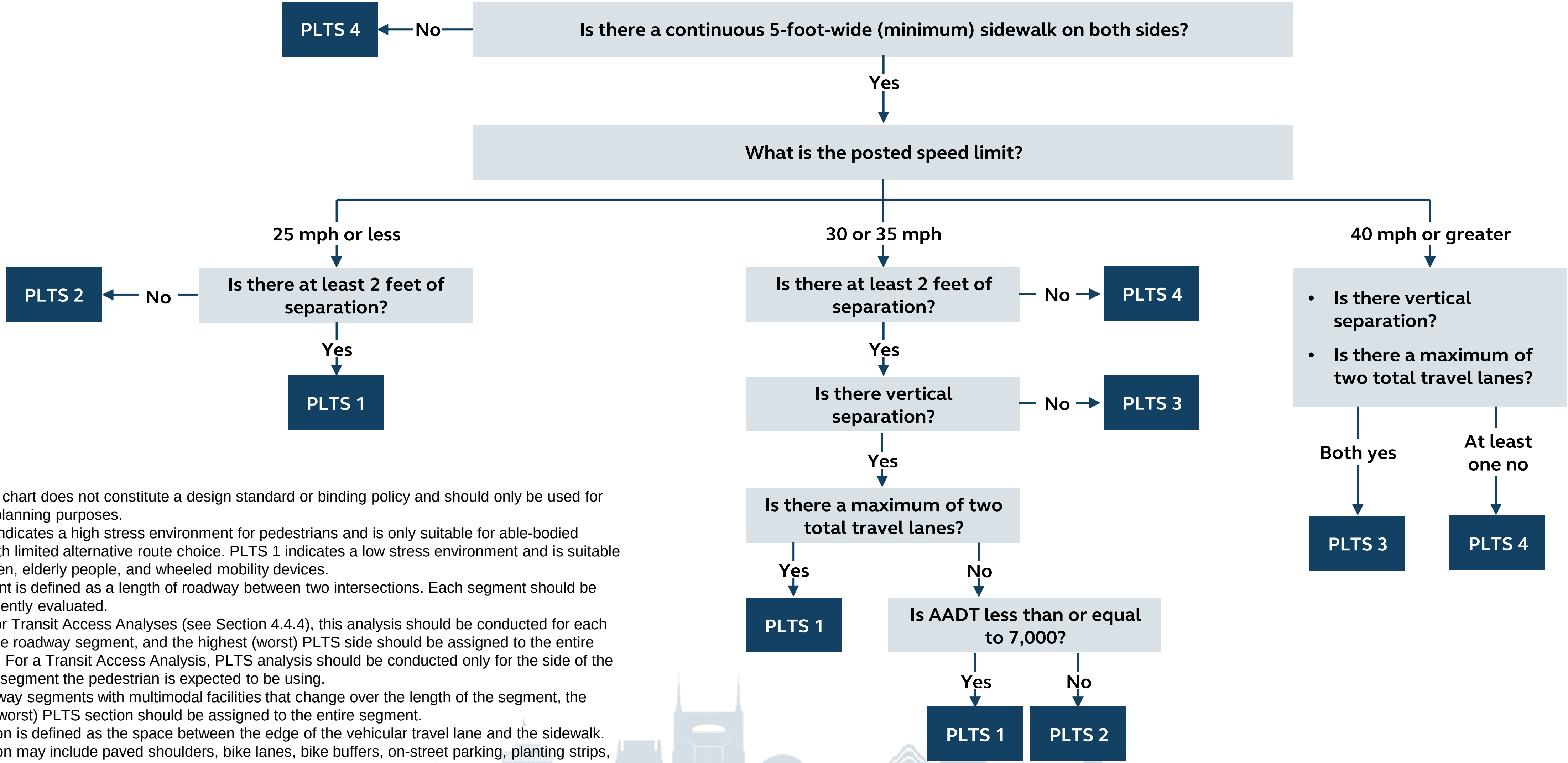
Recommended Mitigation Measures

#	Description	Location	Rational Nexus	Cost	Commitment
1					
2					
3					
4					

Appendix C

Level of Traffic Stress Flow Charts

Pedestrian Level of Traffic Stress: Segments

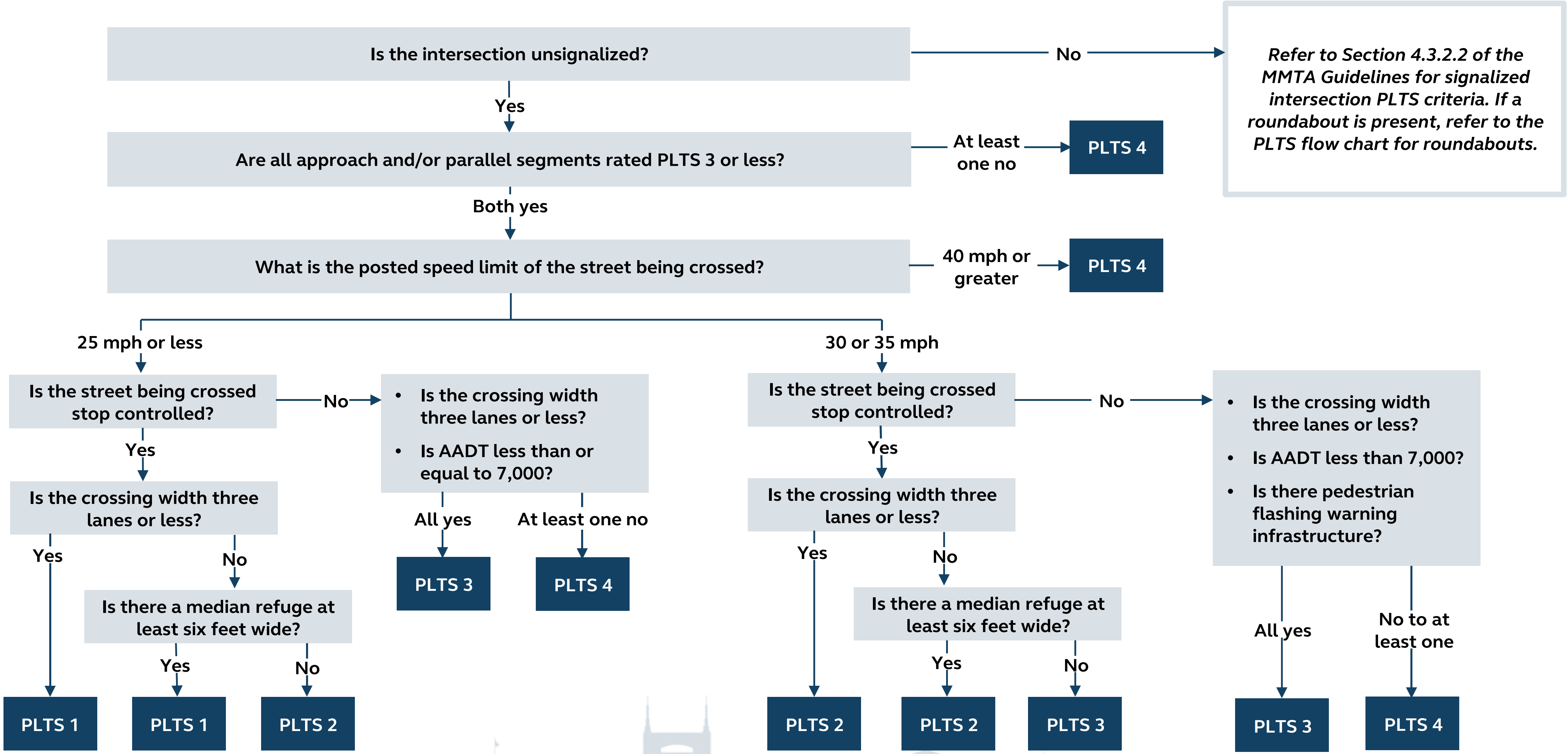


Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. PLTS 4 indicates a high stress environment for pedestrians and is only suitable for able-bodied adults with limited alternative route choice. PLTS 1 indicates a low stress environment and is suitable for children, elderly people, and wheeled mobility devices.
3. A segment is defined as a length of roadway between two intersections. Each segment should be independently evaluated.
4. Except for Transit Access Analyses (see Section 4.4.4), this analysis should be conducted for each side of the roadway segment, and the highest (worst) PLTS side should be assigned to the entire segment. For a Transit Access Analysis, PLTS analysis should be conducted only for the side of the roadway segment the pedestrian is expected to be using.
5. For roadway segments with multimodal facilities that change over the length of the segment, the highest (worst) PLTS section should be assigned to the entire segment.
6. Separation is defined as the space between the edge of the vehicular travel lane and the sidewalk. Separation may include paved shoulders, bike lanes, bike buffers, on-street parking, planting strips, and sidewalk width greater than 6 feet (i.e., a 10-foot sidewalk would add 4 feet of separation). Separation may not include curb and gutter.
7. Vertical separation may include on-street parking, landscaping such as tall shrubs or trees, raised bicycle lane buffers such as delineators, and other tall rigid structures.
8. Travel lanes are defined as vehicular lanes used for through travel along a segment. Travel lanes do not include center turn lanes, shoulders, parking lanes, or intersection approach turn lanes.
9. If AADT data is not available, the higher PLTS rating should be assigned.

NDOT

Pedestrian Level of Traffic Stress: Unsignalized Intersections

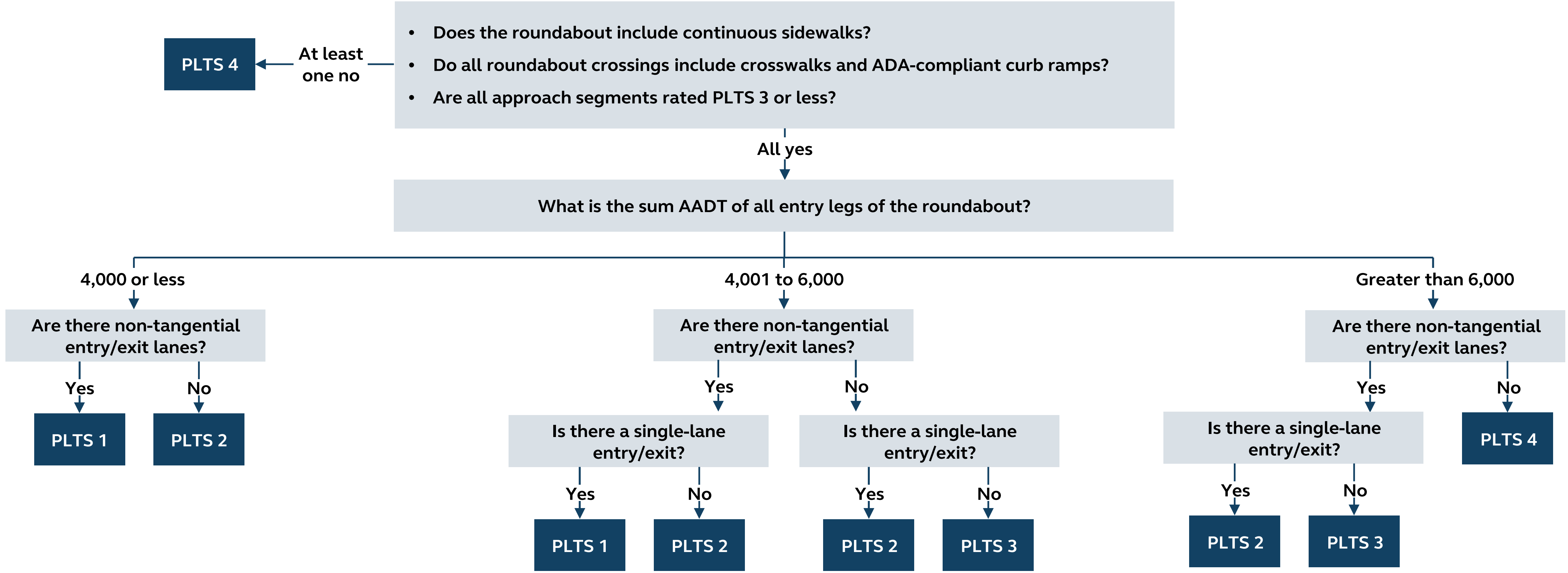


Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. PLTS 4 indicates a high stress environment for pedestrians and is only suitable for able-bodied adults with limited alternative route choice. PLTS 1 indicates a low stress environment and is suitable for children, elderly people, and wheeled mobility devices.
3. Except for Transit Access Analyses (see Section 4.4.4), this analysis should be conducted for each leg of the intersection, and the highest (worst) PLTS leg should be assigned to the entire intersection. For a Transit Access Analysis, PLTS analysis should be conducted only for the leg of the intersection the pedestrian is expected to be crossing.
4. Intersection PLTS ratings provided in this flow chart are minimums. Intersections should not be rated less (better) than the lowest rated PLTS approach.
5. Crossing width includes vehicular travel lanes, center turn lanes, intersection approach turn lanes and all other lanes designated for vehicular travel. Permanent parking lanes are not included in crossing width.
6. Pedestrian flashing warning infrastructure must be functional and push-button activated. Infrastructure may include HAWKs, RFBs, or other flashing pedestrian crossing signs.
7. AADT should be assessed for the leg being crossed. If AADT data is not available, the higher PLTS rating should be assigned.

NDOT

Pedestrian Level of Traffic Stress: Roundabouts

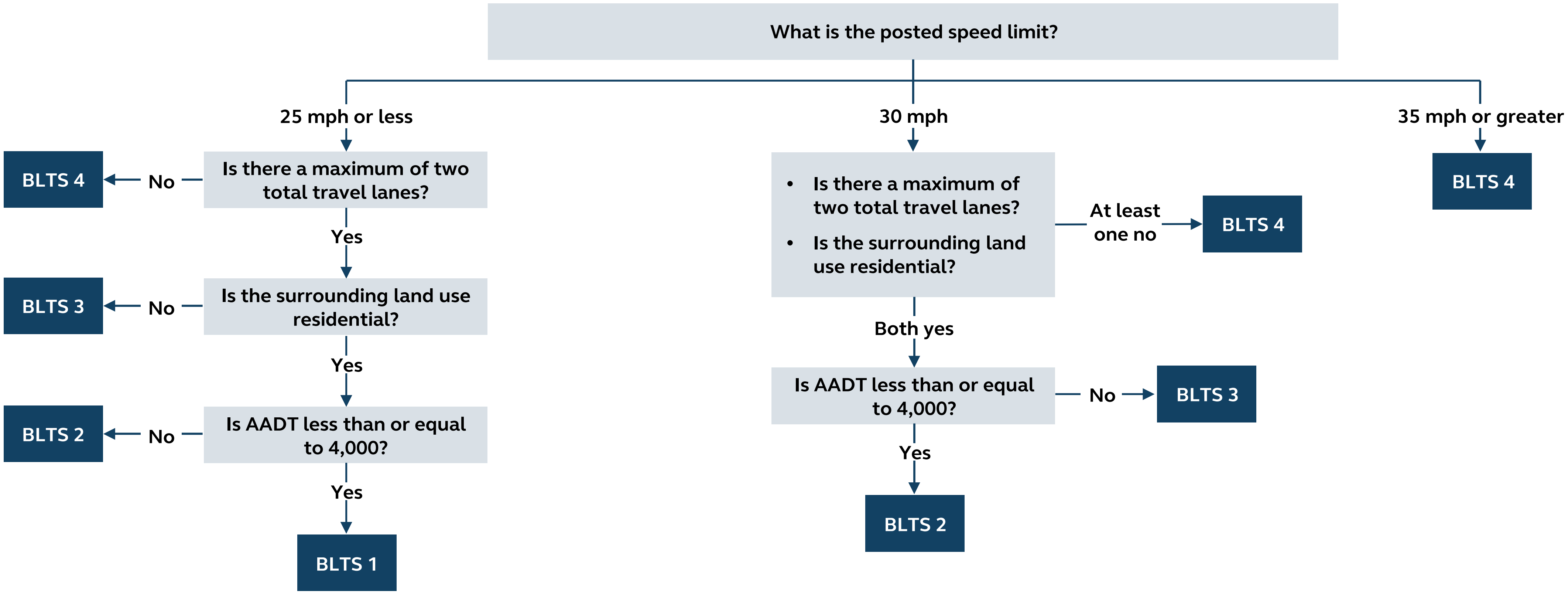


Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. PLTS 4 indicates a high stress environment for pedestrians and is only suitable for able-bodied adults with limited alternative route choice. PLTS 1 indicates a low stress environment and is suitable for children, elderly people, and wheeled mobility devices.
3. This analysis should be conducted for each crossing of the roundabout, and the highest (worst) PLTS crossing should be assigned to the entire roundabout.
4. Roundabout PLTS ratings provided in this flow chart are minimums. Roundabouts should not be rated less (better) than the lowest rated PLTS approach.
5. If sum AADT of all entry legs of the roundabout is unknown or can't be reasonably estimated, assume greater than 6,000.
6. An entry or exit lane is defined as non-tangential if a driver must turn right to enter or exit the roundabout. If a driver can continue straight when entering or exiting a roundabout, the entry or exit lane is tangential. Refer to the MMTA Guidelines Appendix for examples.

NDOT

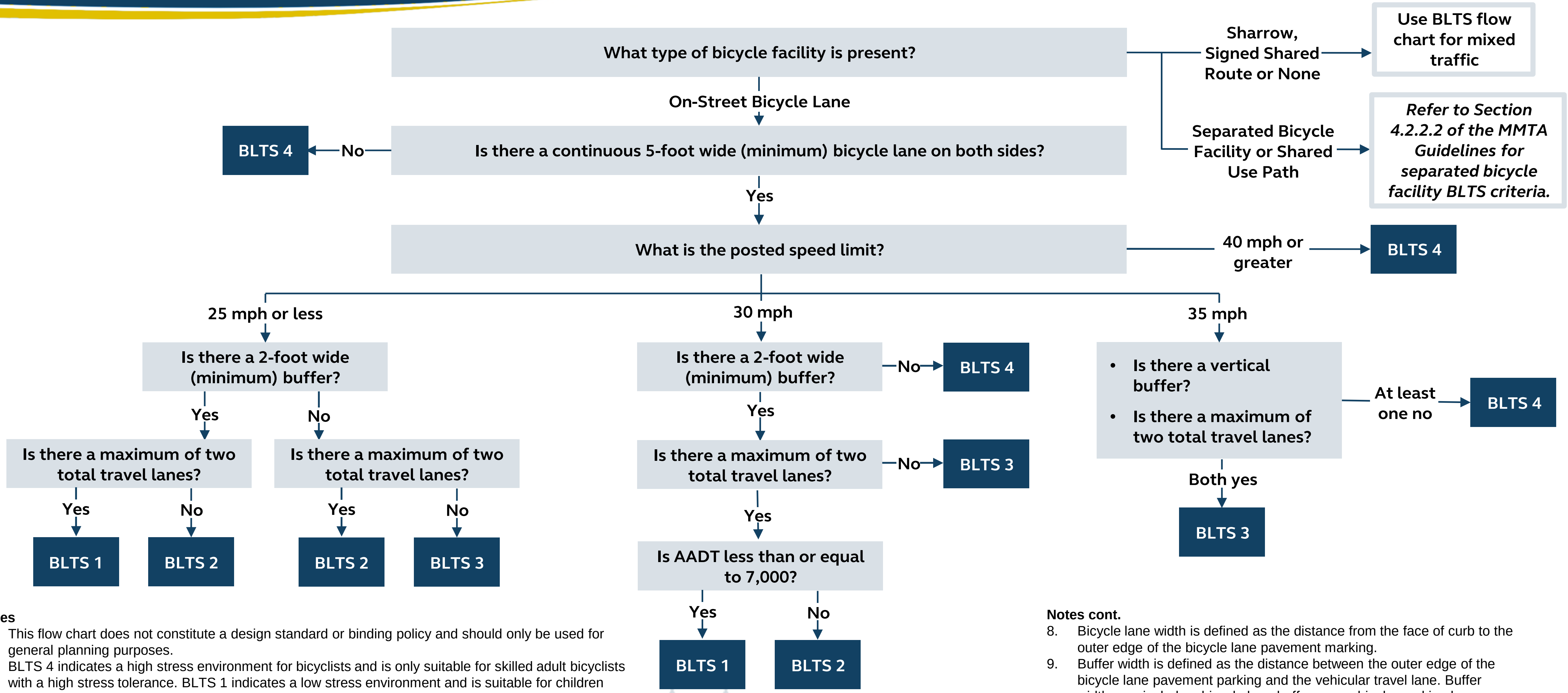
Bicycle Level of Traffic Stress: Mixed Traffic Segment



Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. BLTS 4 indicates a high stress environment for bicyclists and is only suitable for skilled adult bicyclists with a high stress tolerance. BLTS 1 indicates a low stress environment and is suitable for children trained to obey traffic laws.
3. A segment is defined as a length of roadway between two intersections. Each segment should be independently evaluated.
4. This analysis should be conducted for each side of the roadway segment, and the highest (worst) BLTS side should be assigned to the entire segment.
5. For roadway segments with multimodal facilities that change over the length of the segment, the highest (worst) BLTS section should be assigned to the entire segment.
6. Travel lanes are defined as vehicular lanes used for through travel along a segment. Travel lanes do not include center turn lanes, shoulders, parking lanes, or intersection approach turn lanes.
7. If reliable AADT data is not available or can't be reasonably estimated, assume the AADT is higher than the given threshold by default.

Bicycle Level of Traffic Stress: Segments with a Bicycle Facility



Notes

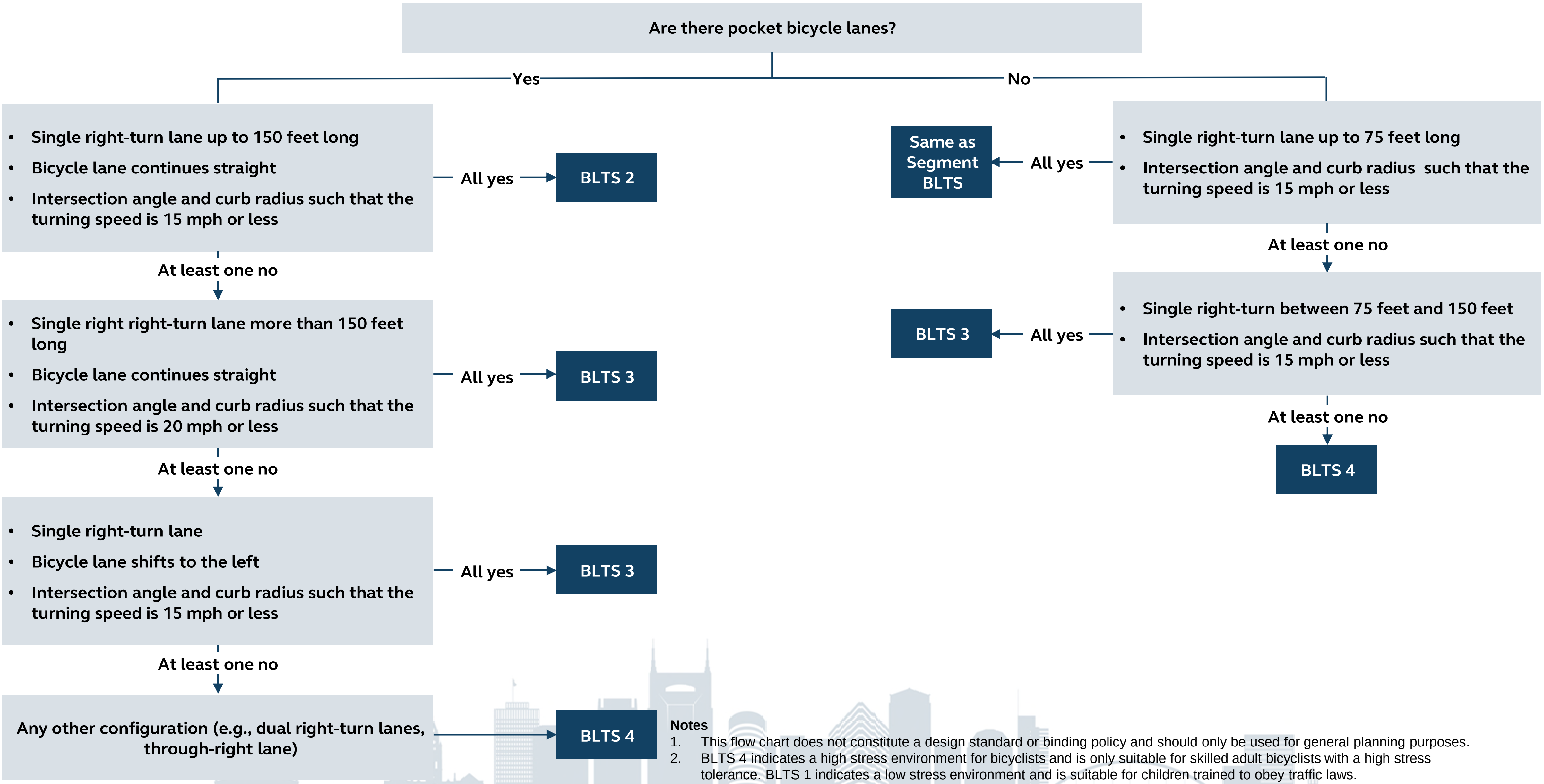
1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. BLTS 4 indicates a high stress environment for bicyclists and is only suitable for skilled adult bicyclists with a high stress tolerance. BLTS 1 indicates a low stress environment and is suitable for children trained to obey traffic laws.
3. A segment is defined as a length of roadway between two intersections. Each segment should be independently evaluated.
4. This analysis should be conducted for each side of the roadway segment, and the highest (worst) BLTS side should be assigned to the entire segment.
5. For roadway segments with multimodal facilities that change over the length of the segment, the highest (worst) BLTS section should be assigned to the entire segment.
6. If there is a separated bicycle lane or shared use path and an on-street bicycle lane, evaluate the segment as having a separated bicycle lane or shared use path.
7. Refer to Section 4.2.2.2 of the MMTA Guidelines for separated bicycle path or shared use path criteria.

Notes cont.

8. Bicycle lane width is defined as the distance from the face of curb to the outer edge of the bicycle lane pavement marking.
9. Buffer width is defined as the distance between the outer edge of the bicycle lane pavement parking and the vehicular travel lane. Buffer width may include a bicycle lane buffer or a vehicular parking lane.
10. Vertical buffer may include raised bicycle lane buffers such as delineators, on-street parking, landscaping such as tall shrubs or trees, and other tall rigid structures between the bicycle lane and the vehicular travel lane.
11. Travel lanes are defined as vehicular lanes used for through travel along a segment. Travel lanes do not include center turn lanes, shoulders, parking lanes, or intersection approach turn lanes.
12. If AADT data is not available, the higher BLTS rating should be assigned.

NDOT

Bicycle Level of Traffic Stress: Approaches

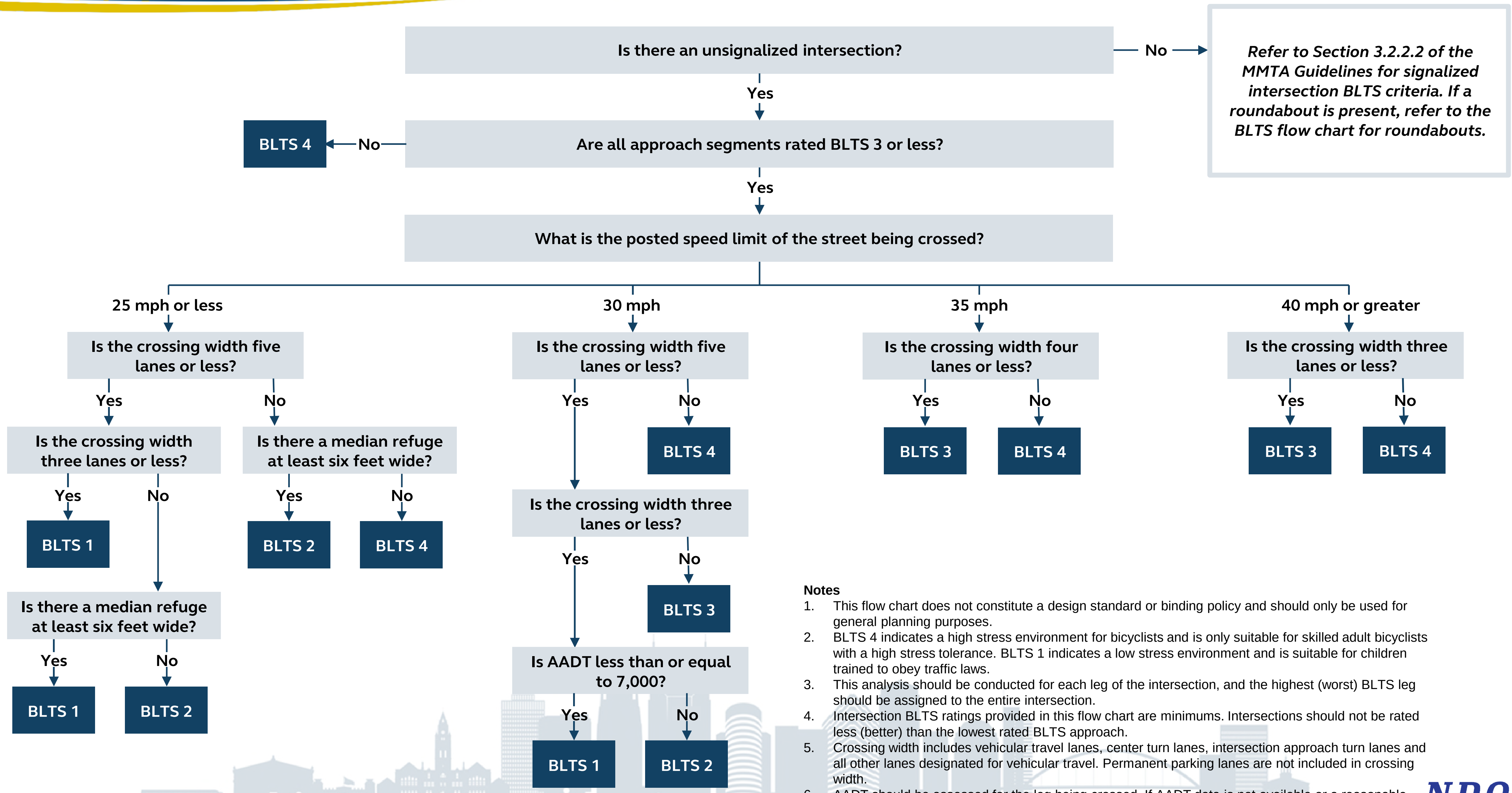


Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. BLTS 4 indicates a high stress environment for bicyclists and is only suitable for skilled adult bicyclists with a high stress tolerance. BLTS 1 indicates a low stress environment and is suitable for children trained to obey traffic laws.
3. Approach BLTS ratings provided in this flow chart are minimums. Approaches should not be rated less (better) than segment BLTS preceding the approach.
4. A pocket bicycle lane is a bicycle lane positioned between a vehicular right-turn lane and a through lane.

NDOT

Bicycle Level of Traffic Stress: Unsignalized Intersections

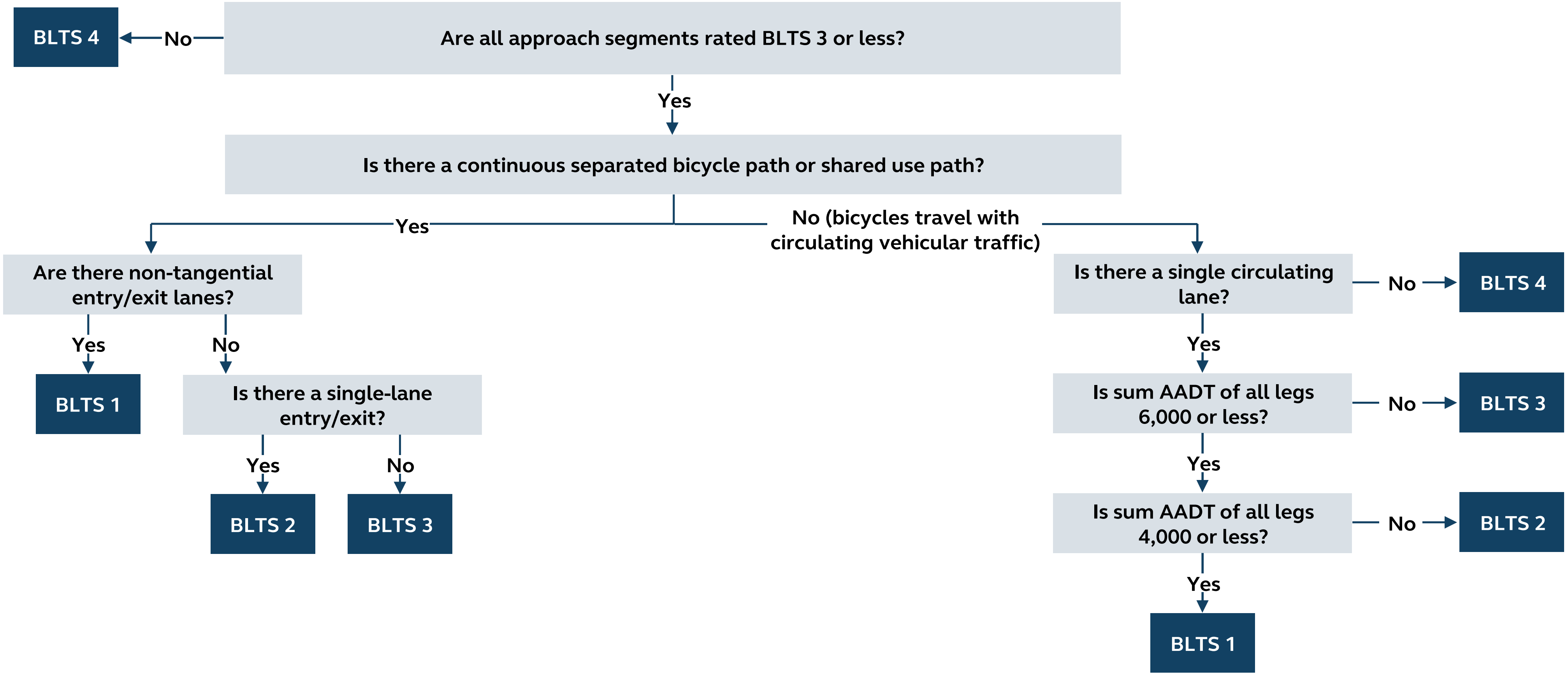


Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. BLTS 4 indicates a high stress environment for bicyclists and is only suitable for skilled adult bicyclists with a high stress tolerance. BLTS 1 indicates a low stress environment and is suitable for children trained to obey traffic laws.
3. This analysis should be conducted for each leg of the intersection, and the highest (worst) BLTS leg should be assigned to the entire intersection.
4. Intersection BLTS ratings provided in this flow chart are minimums. Intersections should not be rated less (better) than the lowest rated BLTS approach.
5. Crossing width includes vehicular travel lanes, center turn lanes, intersection approach turn lanes and all other lanes designated for vehicular travel. Permanent parking lanes are not included in crossing width.
6. AADT should be assessed for the leg being crossed. If AADT data is not available or a reasonable estimation can't be made, the higher BLTS rating should be assigned.

NDOT

Bicycle Level of Traffic Stress: Roundabouts



Notes

1. This flow chart does not constitute a design standard or binding policy and should only be used for general planning purposes.
2. BLTS 4 indicates a high stress environment for bicyclists and is only suitable for skilled adult bicyclists with a high stress tolerance. BLTS 1 indicates a low stress environment and is suitable for children trained to obey traffic laws.
3. This analysis should be conducted for each crossing of the roundabout, and the highest (worst) BLTS crossing should be assigned to the entire roundabout.
4. Roundabout BLTS ratings provided in this flow chart are minimums. Roundabouts should not be rated less (better) than the lowest rated BLTS approach.
5. Refer to Section 4.2.2.2 of the MMTA Guidelines for separated bicycle path or shared use path criteria.
6. An entry or exit lane is defined as non-tangential if a driver must turn right to enter or exit the roundabout. If a driver can continue straight when entering or exiting a roundabout, the entry or exit lane is tangential. Refer to the MMTA Guidelines Appendix for examples.
7. If sum AADT of all entry legs of the roundabout is unknown or can't be reasonably estimated, assume greater than 6,000.

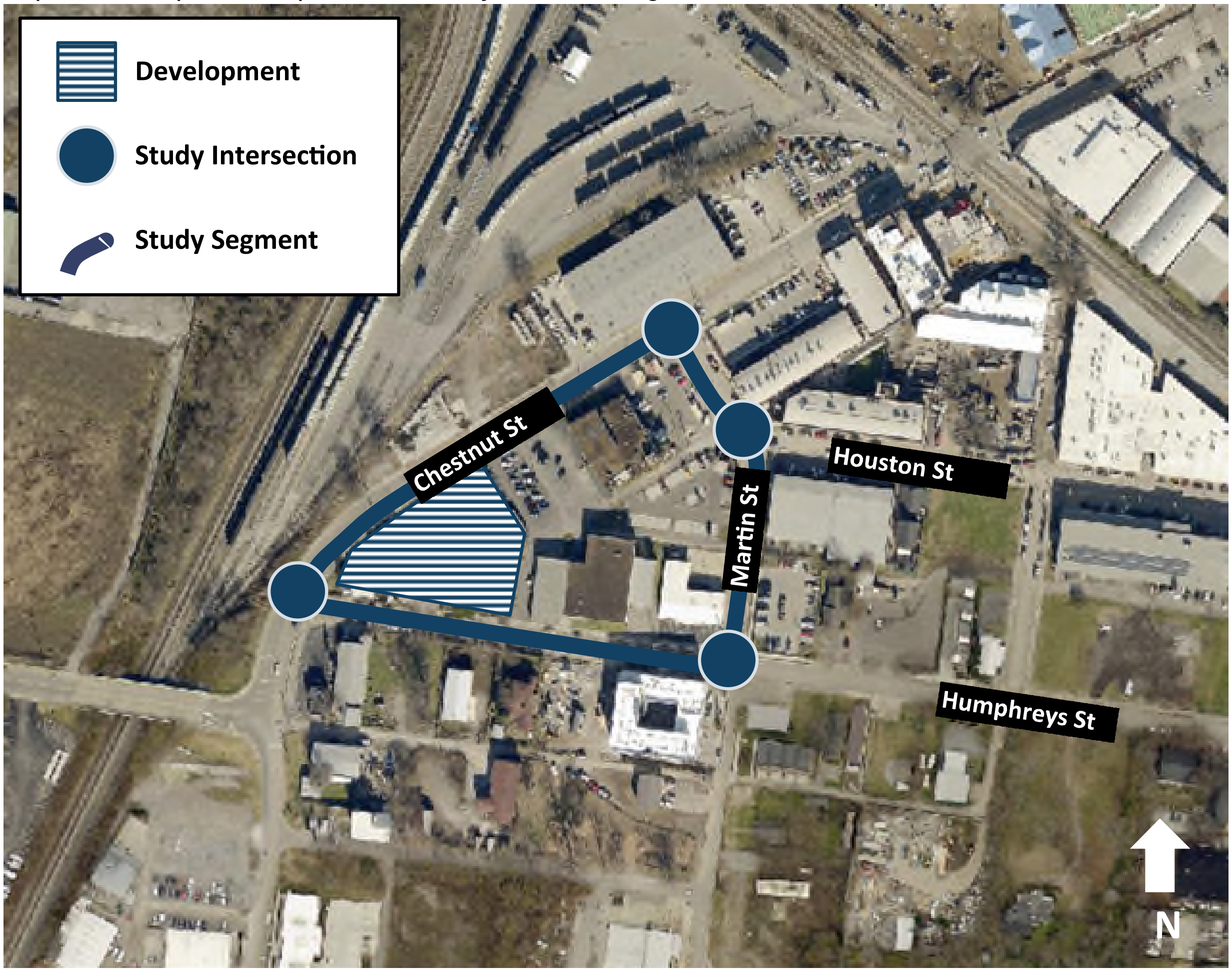
Appendix D

Level of Traffic Stress Analysis Example

The following example illustrates the process and rationale behind a Level of Traffic Stress (LTS) analysis. It should be used for general guidance and is not indicative of an appropriate level of completeness. Study area and narrative analysis have been abbreviated for the purposes of this example. For a complete understanding, the Applicant should reference the LTS flow charts in Appendix C and the LTS guidance throughout Sections 4.2 and 4.3 of the MMTA Guideline.

1. **Establish the Study Area:** The MMTA study area will be defined upon approval of the Scoping Evaluation Form (Form A). The study area for this example consists of four segments and four intersections in the Wedgewood-Houston neighborhood of Nashville. A comprehensive LTS analysis includes an evaluation of all study segments, study intersections, and all approaches to study intersections.

Caption: Example development and study area in Wedgewood-Houston



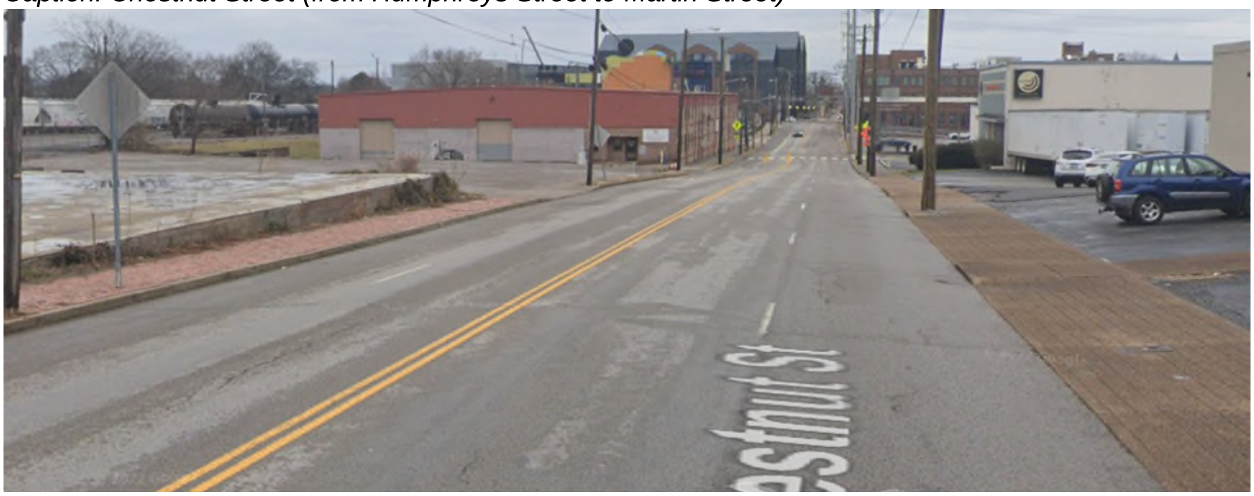
2. **Determine Bicycle and Pedestrian Level of Traffic Stress:** Use the appropriate LTS flow charts, Section 4.2.2, and Section 4.3.2 to determine the LTS for each study segment, approach, and intersection. Per instructions found in the LTS flow charts, the "weakest link" of each facility (i.e., the worst rated side of a segment, portion of a segment, or intersection crossing) was evaluated to determine the appropriate LTS to assign to the entire facility. A comprehensive analysis requires the complete evaluation of each facility, then selection of the worst rated link. For the purposes of this example, characteristics were only documented for the worst rated link. If "N/A" is written in the "Weakest Link" column, all multimodal facilities throughout the segment or intersection resulted in the same LTS rating, or other factors determined the LTS rating.

Segment	Analysis	Weakest Link	Characteristics	Rating
Humphreys Street (from Martin Street to Chestnut Street)	Bicycle	N/A	Mixed traffic; 25 mph posted speed limit; two total travel lanes; nonresidential surrounding land use	BLTS 3
	Pedestrian	N/A	Continuous 5-foot sidewalk; 25 mph posted speed limit; more than 2 feet of separation (on-street parking)	PLTS 1

Caption: Image of Humphreys Street (from Martin Street to Chestnut Street)

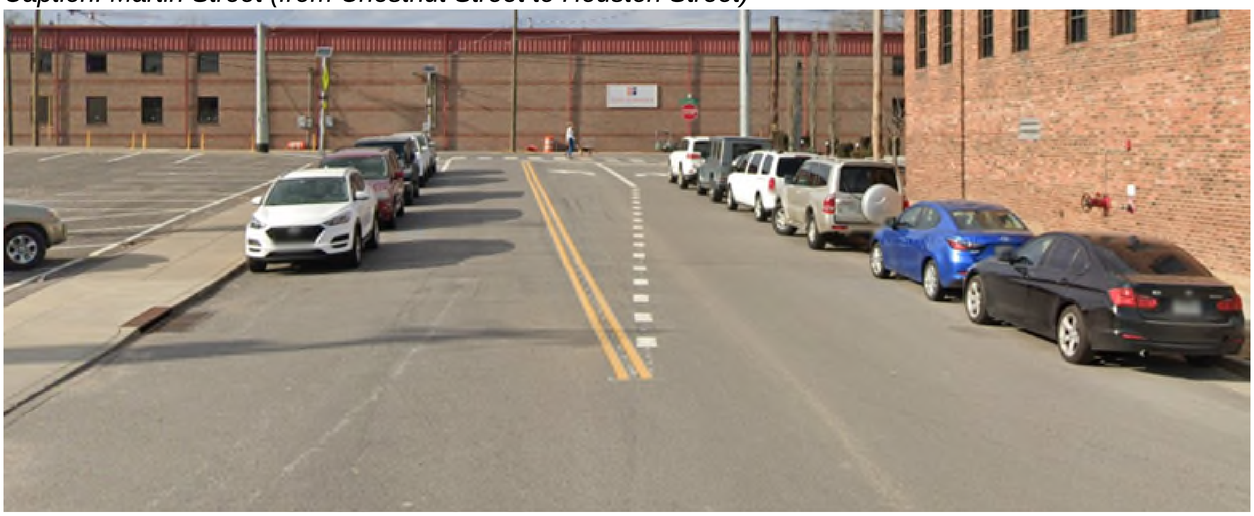
Segment	Analysis	Weakest Link	Characteristics	Rating
Chestnut Street (from Humphreys Street to Martin Street)	Bicycle	N/A	Mixed traffic; 30 mph posted speed limit; 4 total travel lanes	BLTS 4
	Pedestrian	EB side	Continuous 7-foot sidewalk; 30 mph posted speed limit; no separation	PLTS 4

Caption: Chestnut Street (from Humphreys Street to Martin Street)



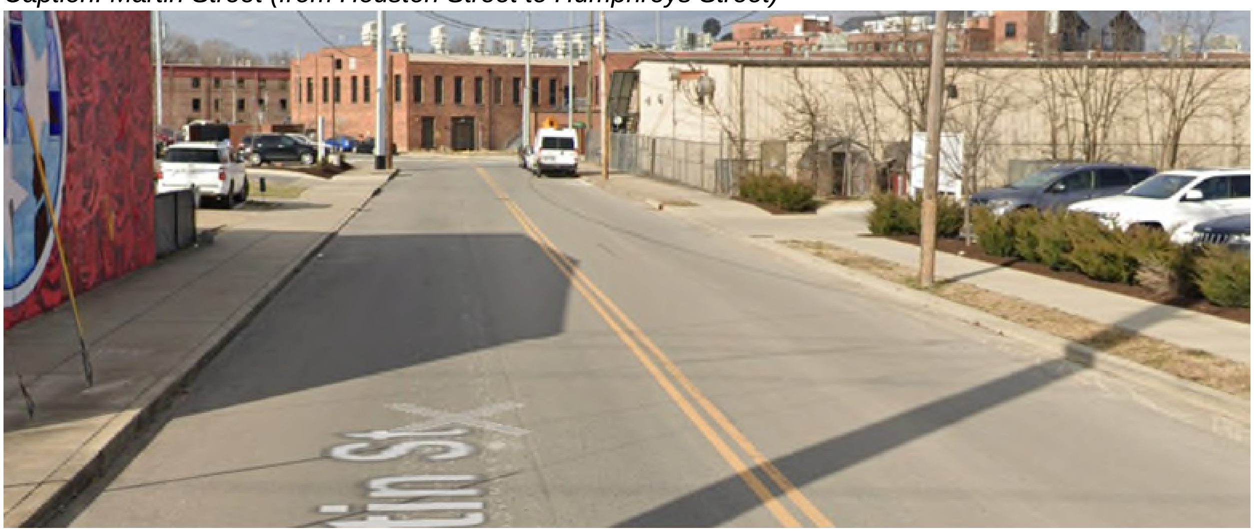
Segment	Analysis	Weakest Link	Characteristics	Rating
Martin Street (from Chestnut Street to Houston Street)	Bicycle	N/A	Mixed traffic; 25 mph posted speed limit; 2 total travel lanes; nonresidential surrounding land use	BLTS 3
	Pedestrian	N/A	Continuous 7-foot sidewalk; 25 mph posted speed limit; more than 2 feet of separation (on-street parking)	PLTS 1

Caption: Martin Street (from Chestnut Street to Houston Street)



Segment	Analysis	Weakest Link	Characteristics	Rating
Martin Street (from Houston Street to Humphreys Street)	Bicycle	N/A	Mixed traffic; 25 mph posted speed limit; 2 travel lanes; nonresidential surrounding land use	BLTS 3
	Pedestrian	N/A	Continuous 8-foot sidewalk; 25 mph posted speed limit; on-street parking	PLTS 1

Caption: Martin Street (from Houston Street to Humphreys Street)



Intersection	Analysis	Weakest Link	Characteristics	Rating
Humphreys Street and Martin Street	Bicycle	N/A	All approach segments BLTS 3 or less; 25 mph posted speed limit; 2-lane crossing width	BLTS 3*
	Pedestrian	N/A	Crosswalks and ADA-compliant curb ramps; all approach segments PLTS 3 or less; 25 mph posted speed limit; stop controlled; 2-lane crossing width	PLTS 1

**BLTS 1 raised to BLTS 3 because best-rated approach segment is BLTS 3*

Caption: Intersection of Humphreys Street and Martin Street

Intersection	Analysis	Weakest Link	Characteristics	Rating
Humphreys Street and Chestnut Street	Bicycle	N/A	One or more approach segment rated BLTS 4	BLTS 4
	Pedestrian	N/A	One or more approach segment rated PLTS 4	PLTS 4

Caption: Intersection of Humphreys Street and Chestnut Street

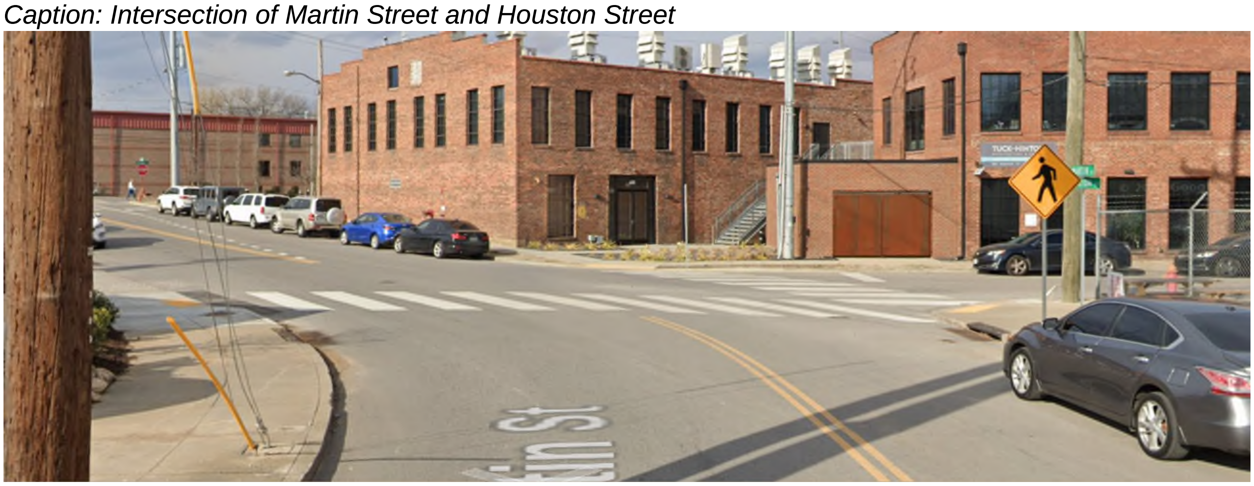
Intersection	Analysis	Weakest Link	Characteristics	Rating
Chestnut Street and Martin Street	Bicycle	N/A	One or more approach segment rated BLTS 4	BLTS 4
	Pedestrian	N/A	One or more approach segment rated PLTS 4	PLTS 4

Caption: Intersection of Chestnut Street and Martin Street

Intersection	Analysis	Weakest Link	Characteristics	Rating
Martin Street and Houston Street	Bicycle	N/A	All approach segments rated BLTS 3 or less; 25 mph posted speed limit; 2-lane crossing width	BLTS 3*
	Pedestrian	NB approach crossing	Crosswalks and ADA compliant curb ramps; all approach segments PLTS 3 or less; 25 mph posted speed limit; not stop controlled; 2-lane crossing width; AADT less than 7,000	PLTS 3

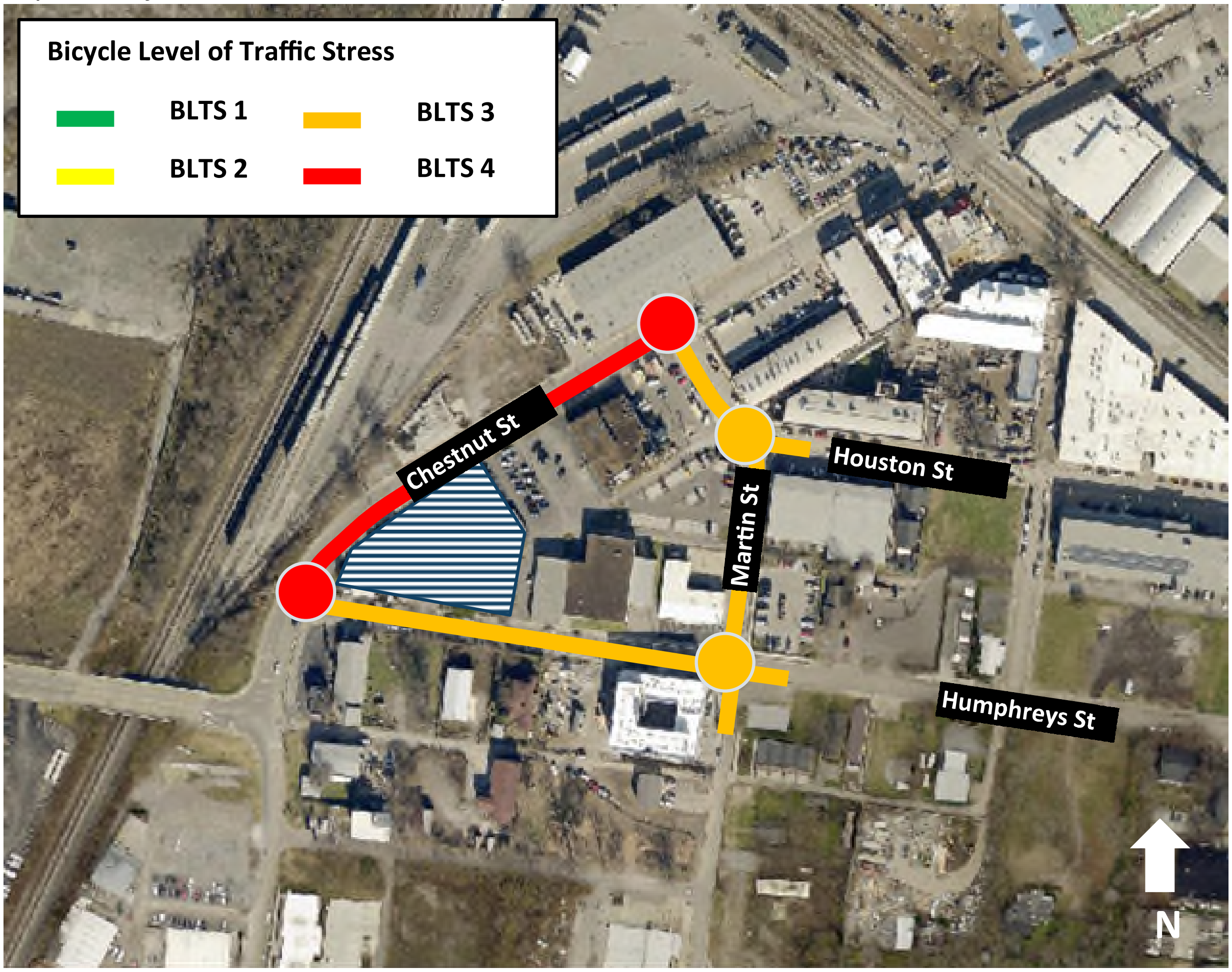
**BLTS 1 raised to BLTS 3 because best-rated approach segment is BLTS 3*

Caption: Intersection of Martin Street and Houston Street

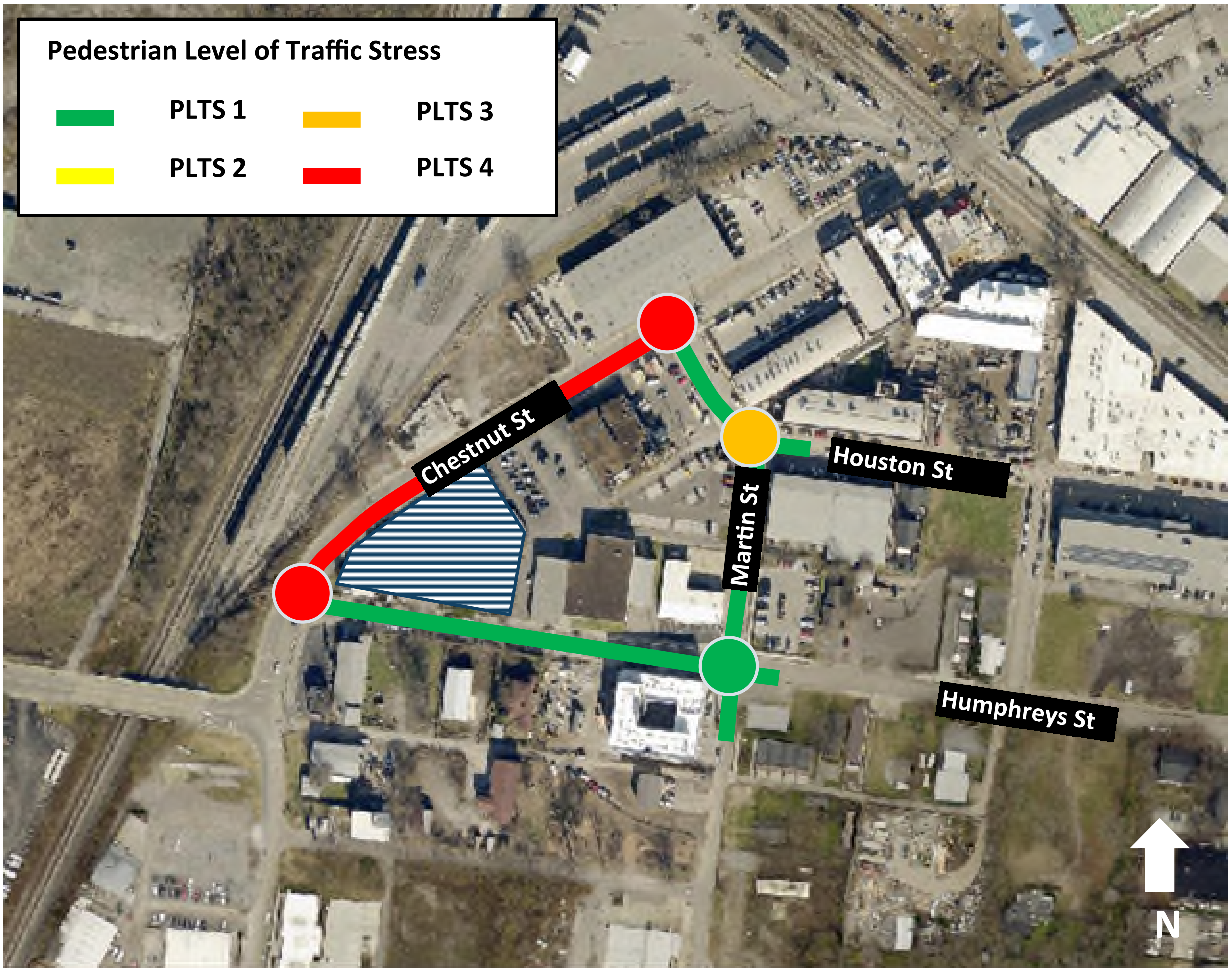


3. **Display BLTS and PLTS Results:** Once LTS rating have been assigned, illustrate the results on an plan view of the study area. Segments, approaches, and intersections should be clearly defined and color coded based on their LTS rating.

Caption: Bicycle Level of Traffic Stress Map



Caption: Pedestrian Level of Traffic Stress Map



4. **Analyze Results with Narrative Analysis:** Supplement LTS documentation and plan view maps with a narrative analysis of results. A narrative analysis may include:
   - A summary of the multimodal infrastructure in the area
   - Common contributing factors behind poor LTS ratings
   - The impact of study area LTS on transit access
   - Multimodal needs of surrounding land uses
   - Multimodal needs of study area demographics
   - The impact of traffic review results on LTS in the study area
   - The impact of safety review results on LTS in the study area
   - Improvements that can be implemented to improve LTS throughout the study area

Appendix E

Transit Access Analysis Example

The following transit access analysis example illustrates the appropriate implementation of Section 4.4.4 in the Multimodal Transportation Analysis (MMTA) Guidelines. This example is based on a hypothetical development and should only be used for general guidance. The study area and analysis have been abbreviated for the purposes of this example. For a complete understanding, the Applicant should reference instructions provided in Section 4 and relevant Pedestrian Level of Traffic Stress (PLTS) flow charts in Appendix C. To conduct a transit access analysis in accordance with MMTA requirements, the Applicant should follow the steps outlined below.

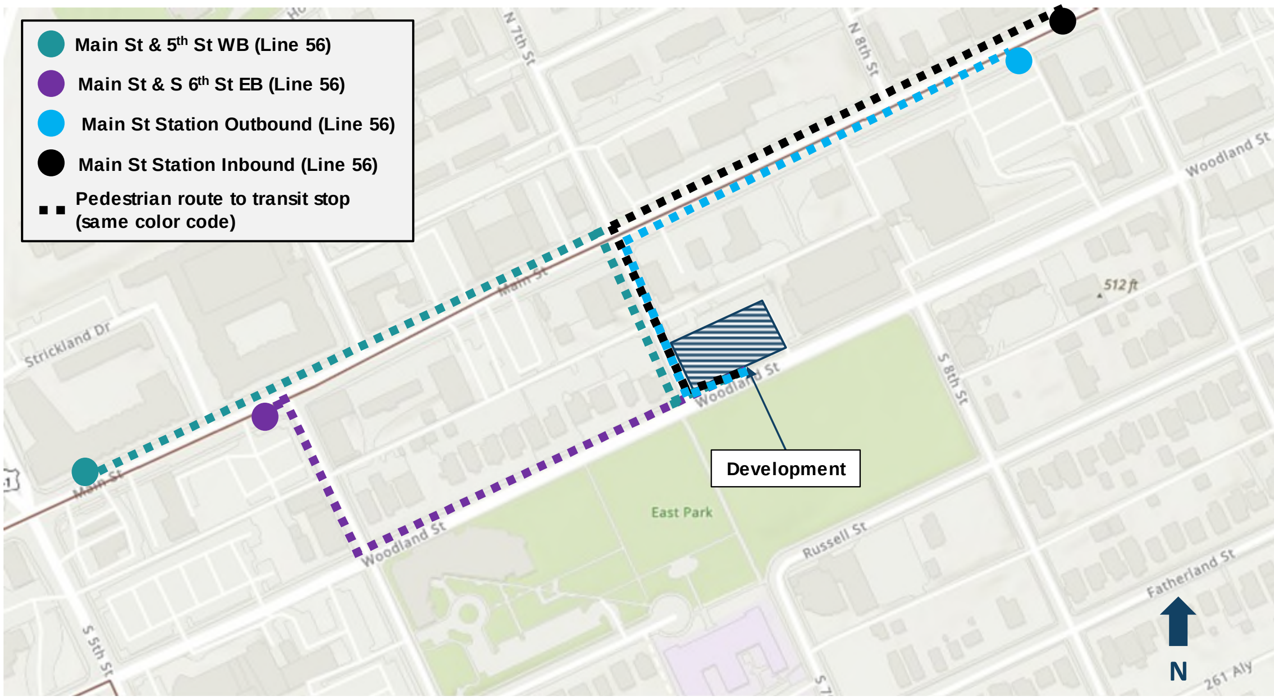
1. **Establish the Transit Stops to be Studied:** Transit stops within the study area that warrant analysis will be determined in the Scoping Evaluation Form (Form A). This example will evaluate four transit stops along Main Street in the East Nashville neighborhood of Nashville shown in the image below.

Caption: Aerial image of transit stops

2. **Measure the Pedestrian Paths of Travel:** The applicant should measure the distance from the main entrance of the development to each transit stop if a pedestrian were to take the most reasonable route, considering available pedestrian facilities, safety, comfort, and directness. The Applicant may use desktop aerial imaging software to identify, measure, and illustrate the path.

Transit Stop	Pedestrian Route Distance
Main St & 5th St WB (Line 56)	1,810 ft
Main St & S 6th St EB (Line 56)	1,330 ft
Main St Station Outbound (Line 56)	1,370 ft
Main St Station Inbound (Line 56)	1,500 ft

Caption: Pedestrian transit routes



3. **Calculate Average PLTS for Each Pedestrian Route:** For each path of travel between the development and transit stops included in the study, calculate the average PLTS of the route.

Transit Stop	Average PLTS
Main St & 5th St WB (Line 56)	2.47
Main St & S 6th St EB (Line 56)	1.66
Main St Station Outbound (Line 56)	3.04
Main St Station Inbound (Line 56)	3.02

4. **Supporting Information and Data Presentation:** Summarize the results of the analysis in table format.

Transit Stop	Route Distance	Average PLTS	Distance on PLTS 4 Facilities	# of Crossings Rated PLTS 4	Is Transit Stop on PLTS 4 Facility? (Y/N)
Main St & 5th St WB (Line 56)	1,810 ft	2.47	692 ft	2	N
Main St & S 6th St EB (Line 56)	1,330 ft	1.66	0 ft	0	N
Main St Station Outbound (Line 56)	1,370 ft	3.04	925 ft	0	Y
Main St Station Inbound (Line 56)	1,500 ft	3.02	1,067 ft	1	Y

5. **Support Narrative Analysis:** Provide a supporting narrative to describe existing pedestrian accessibility of each transit stop, major contributing factors that dictated results, and recommend potential infrastructure upgrades that can improve access. Recommendations should improve the safety, comfort, and/or directness of the path of travel through the installation of pedestrian infrastructure.

Appendix F

Mitigation Measure Examples

To support the Applicant in selecting appropriate mitigation measures, this section provides an extensive list of implementable mitigation measures depending on the specific needs of an area. It is the responsibility of the Applicant to select appropriate and effective mitigation measures. A mitigation measure that is not included in this section may also be recommended if the Applicant deems it a reasonable solution. The CMF Clearinghouse[1], funded by the U.S. Department of Transportation Federal highway Administration and maintained by the University of North Carolina Highway Safety Research Center, offers measurable crash modification factors for several types of safety improvements to provide insight into expected effectiveness.

Off-Site Pedestrian Mobility Mitigation Measure Examples

Mitigation Measure	Description
Median and Pedestrian Refuge Island	Area between opposing lanes of traffic intended to protect pedestrians crossing the road.
Sidewalk Installation	Sidewalk should be installed consistent with the MCSP and NDOT specifications.
Public Streetlights	Streetlights should be installed and designed to a standard approved by NDOT.
ADA Improvements	ADA improvements may include upgrading, replacing, or adding infrastructure at intersections or along segments to best serve pedestrians using the transportation network, including those using wheeled mobility devices.
Wayfinding Features	The use of signage, color, and/ or other design elements to help occupants navigate a space.
Pedestrian Connections	Internal sidewalks that are generally located entirely within or a part of a private development. Often, these pedestrian connections connect two public sidewalks.
Enhanced Crosswalks for Pedestrians at Unsignalized Intersections	Enhanced features such as the FHWA's pedestrian safety countermeasures to improve pedestrian safety at crosswalks
New Crosswalks	New or restriped crosswalks to designate crossing space for pedestrians.

[1] U.S. Department of Transportation. 2023. Crash Modification Factors Clearinghouse. Available at: https://www.cmfclearinghouse.org/

Off-Site Bicycle Mobility Mitigation Measure Examples

Mitigation Measure	Description
Bicycle Lanes	Bicycle lanes should be consistent with the MCSP and designed per NDOT specifications. NDOT may request bike lanes that are not already be identified in existing planning documents.
Bicycle Parking	Public or private facilities that house bicycles.
Active Warning Beacon for Bicycle Route at Unsignalized Intersection	User-actuated amber flashing lights that supplement warning signs at unsignalized intersections or mid-block crossings.

Off-Site Transit Mobility Mitigation Measure Examples

Mitigation Measure	Description
Wayfinding Features	The use of signage, color, and/ or other design elements to help transit users locate stops and learn route information.
Transit Amenities	Amenities provided for transit users, including shelters, benches, and paved waiting areas, trash cans, and digital information boards.
New Transit Stops	Add new transit stops or combine transit stops to improve access or quality of the service
Transit Facilities	Bus Rapid Transit facilities, Bus queue jump lanes, Bus only lanes, and Transit Signal Priority

Other Off-Site Mitigation Measure Examples

Mitigation Measure	Description
Tactical Urbanism Improvements	Temporary change to the built environment intended to enhance local neighborhoods and city gathering places.
Street Trees	Street trees are often installed within the furnishing zone of the sidewalk. Attention should be placed on width of furnishing zone and overhead utilities.
Parklets	Public seating platforms that convert curbside parking spaces into community spaces.
Complete Street Conversions	Developer may be asked to incorporate more than one measure referenced above as part of a comprehensive approach to design an existing roadway to accommodate all users.

Off-Site Traffic Mitigation Measure Examples

Mitigation Measure	Description
Additional Turn Lanes	Addition of an extra lane at an intersection to address excessive queuing and delays.
Signal Timing Optimization	Adjusting the timing and sequencing of traffic signals along a corridor to minimize delays, improve traffic flow, and enhance overall intersection efficiency.
Road Widening	Expansion may be needed for adding extra through lanes or turning lanes to increase capacity and alleviate congestion.
Access Management	May include strategies such as consolidating driveways or relocating driveways to have less impact on traffic flow, and installing infrastructure to limit certain turning movements at accesses.
Roadway Signage and Markings	Design and installation of visible signs and pavement markings to provide the road user with directional guidance, regulate traffic, and enhance safety.

Transportation Demand Management Strategy Examples

TDM Strategy	Description
Subsidized or Free Transit Passes	Transit passes offered at a subsidized rate to all tenants through WeGo's Employer or Residential Pass
Multimodal Wayfinding Signage	Provide signs, maps, and directions to guide travelers to the locations of nearby alternative commute routes such as transit or shuttle routes, bicycle pedestrian paths, as well as major nearby destinations.
Real Time Transportation Information Displays	The developer will provide a physical informational platform, such as kiosks, transit screens, websites, or apps, to increase effectiveness and reach of transit services. Information typically includes transit and shuttle maps, bike maps, locations of car and bike share lots, as well as preferential carpool parking.
Secure Bicycle Parking	Secure, indoor bicycle parking, such as a bike room or bike lockers, adds a level of security for riders who want long-term parking and protection form weather and theft. Secure bike storage should be clearly signed and easily accessible from main entrances. In addition, simple outdoor racks encourage visitors and patrons to use bicycles.
Vanpooling	Passengers will use a non-commercial shared-ride arrangement carrying anywhere from two to ten passengers and is more likely implemented by employers. Often subsidized by employer.

TDM Strategy	Description
Preferential Parking for Carpool/ Vanpool	Reserve the most desirable parking spaces for employees who use a sustainable transport mode such as carpool or vanpool. The parking spaces should be close to the building entrance, covered, or otherwise more appealing.
Robust Teleworking Policy	Employers provide ability for employees to work remotely. Could provide money to employees for work-from-home stations. Developers would provide space for residents to work remotely and high-speed internet.
New Resident/Employee Kits	Provide welcome kits to all new building occupants to educate them about the transportation options available at their new residence or employer site. Minimum kit requirement would include nearby transit route information, WeGo bus tickets (min. of two per resident/employee), bike map, bike parking information for location, and information on other TDM programs offered at the property and by the Nashville Connector.
Education and Outreach	Providing residents with information and incentives, including marketing campaigns, information on transit schedules and routes, and discounts for multimodal travel options, to encourage people to use multimodal travel options. Participation in region-wide commuter-oriented events.
Flexible Work Schedules	Strategies to reduce the need for daily commuting by allowing employees to commute during off-peak hours.

Safety Mitigation Measure Examples

Improvement	Description
Traffic Calming	Traffic calming measures may include signage or physical infrastructure such as speed bumps
Leading Pedestrian Intervals	LPIs reduce vehicle-pedestrian conflicts by allowing pedestrians to establish their presence in the crosswalk before vehicles can turn right or left. Pedestrians may enter the crosswalk at an intersection 3 to 7 seconds before vehicles are given a green indication.
Curb Extensions	Curb extensions may be installed at intersections to increase pedestrian visibility and reduce vehicle turning speeds. They are especially useful when paired with on-street parking or Leading Pedestrian Intervals (LPIs).
Sight Distance Improvement Measures	Modification to improve sight distance may include removing obstructions or adjusting intersection geometry.
Lighting	Adequate lighting ensures all road users are properly visible.
No Right Turn on Red Signs	Drivers must wait for a green signal before making a right turn.
Rectangular Rapid Flashing Beacon (RRFB)	An RRFB is an effective pedestrian crossing traffic controls treatment that aims to improve pedestrian visibility at uncontrolled crosswalks. Usually implemented on lower-speed and lower-volume roadways.

Site Characteristics Mitigation Measure Examples

Improvement	Description
Reservation of Right-of-Way	Provision that preserves a certain area of private property for future improvement of public right-of-way.
Unbundled Parking	Parking that is charged additionally to the cost of renting or owning a property
Reduced or No Parking Supply	Provide the absolute minimum number of required parking spaces required per the zoning ordinance. In locations where code allows, provide no parking to encourage multimodal trips.
Visitor Parking Pricing	All visitor parking is priced to discourage single occupancy vehicle trips.
Internal Showers and Locker Facilities	Shower and locker facilities provided for new non-residential developments that are accessible to users whose primary mode of transportation is bicycling.