

ADEQUATE PUBLIC FACILITIES - TRANSPORTATION IMPACTS

April 4, 2021

Executive Summary: A New Approach for City Code Chapters 22.21 and 22.22

An applicant for a proposed development must show that adequate transportation facilities will be in place to serve the proposed development. This Transportation Adequate Public Facilities (TAPF) finding requires forecasting travel demand generated by the proposed development and comparing it to the capacity of existing and programmed transportation networks. This new comprehensive two-tiered approach combines the motor vehicle analysis with other modes of transportation, including pedestrian, bicycle, and transit.

Every project subject to Adequate Public Facilities must complete at least a Tier 1 analysis for four different transportation modes. The following must be evaluated for adequacy:

- Motor Vehicle System Adequacy (MVSA)
- Pedestrian System Adequacy (PSA)
- Bicycle System Adequacy (BSA)
- Transit System Adequacy (TSA)

In the Tier 1 analysis, the standard for all modes is a safety assessment. The question then becomes how to measure “safety”. There is not one well-established metric that has been tested for all modes. However, there are key indicators that can be used across the board. The first is motor vehicle volume. There is a well-known association between volume of traffic and number of accidents. Therefore, any project with more than 50 net new peak hour vehicle trips should be required to do a Tier 2 analysis. Other indicators that can be used to determine MVSA include statistics such as traffic fatalities, serious injury, and other site conditions such as number of travel lanes.

The Annapolis Police Department is able to generate a map of the fatalities and serious injuries over the past three years. We propose using this map, which should be updated annually.

For other modes, “Level of Traffic Stress” (LTS) is a metric that is typically used to assess bicycle facility conditions. However, we propose combining LTS with other traffic safety metrics to determine whether a Tier 2 Assessment is required for a proposed development.

The LTS approach quantifies the amount of stress a user of the transportation network experiences. The methodology assigns a numeric stress level to streets, based on attributes like safety, traffic speed, traffic volume, number of lanes, ease of intersection crossings, accessibility, and other characteristics. Levels of traffic stress for a route combine over segments using weakest link logic. That means that if most of the links on a route have LTS 1 or 2, but one or a few links on a route have LTS 3, the route as a whole has LTS 3.

When a system has a moderate or high level of stress, it may be a sign that additional infrastructure, like separated bike lanes or shared use paths, is needed to make it a place where more users will feel comfortable.

The applicant must mitigate impact to these facilities with improvements or by making a Transportation Mitigation Payment toward area-wide transportation needs. The guidelines that explain the methodology for determining adequacy, specify mitigation for projected traffic generated by proposed development projects, and describe how Transportation Mitigation Payments are determined are found in the “Guidelines for Conducting Transportation Impact Studies.”

All current land uses and anticipated future development in the vicinity of the proposed development area shall be described in detail in the report. The following criteria shall be utilized to determine the minimum study area:

Tier	Applicability	Minimum Study Area Size
Tier 1	All projects subject to APF must conduct a safety assessment	Site access driveways, adjacent signalized and/or major unsignalized intersections within 0.25 miles (minimum)
Tier 2	Safety assessment results, >50 net new peak hour vehicle trips or LTS 3 and higher	Site access driveways, adjacent signalized and/or major unsignalized intersections within 0.5 miles (minimum)

Motor Vehicle System Adequacy (MVSA)

Motor vehicle system adequacy is defined by the number of peak hour net new vehicle trips and with a safety assessment.

For projects that generate more than 50 net new peak hour vehicle trips, a full motor vehicle adequacy analysis is required. For reference, these typically¹ include:

¹ ITE Trip Generation provides data in two forms: the average trip rate, a regression equation. The following steps are recommended for identifying the most correct trip generation estimation:

1. Calculate trips based upon both the average rate and equation. If results are close, the question of which to use is irrelevant. If not, go to 2.
2. Use equation if there are at least 20 well-distributed data points and the “Y” intercept is near zero. If not, go to 3
3. If the correlation coefficient (TV) is 0.75 or higher, use the equation. If not, use the average rate.

Land Use	Critical Peak Hour	Peak Hour Trip Rate	% Entering/ % Exiting	ITE Code	50 Peak Hour
Industrial					
General Light Industrial	PM	0.83 Per 1,000 Sq. ft.	18/82	110	60,975
Institutional					
Church	SUN	11.76 Per 1,000 Sq. ft.	50/50	560	4,000.
Day Care Center	PM	12.46 Per 1,000 Sq. ft.	47/53	565	4,012
School, Elementary	AM	0.45 Per Student	55/45	522	111
Residential					
Apartments, High Rise	PM	0.38 Per Unit	61/39	222	131
Apartments, Low Rise	PM	.058 Per Unit	65/35	221	86
Residential, Multi-Use Retail Mixed	PM	0.62 Per Unit	65/35	270	80
Residential, Single Family	PM	1.01 Per Unit	63/37	210	49
Retail					
Marijuana Dispensary	PM	2 Per 1,000 Sq. ft.	50/50	882	25,000
Nursery (Garden Center)	PM	68.10 Per 1,000 Sq. ft.	50/50	817	734
Office					
Office Building, Single Tenant	AM	4.80 Per 1,000 Sq. ft.	89/11	715	10,000
Services					
Automobile Care Center	PM	3.38 Per 1,000 Sq. ft.	50/50	942	14,792
Automobile Parts Sales and Service Center	PM	4.46 Per 1,000 sq. ft.	42/58	943	11,210
Bank with ATM and Drive-Through	PM	27.41 Per Lane	51/49	912	1
Restaurant, Fast-Food (with Drive-Through)	AM	49.36 Per 1,000 Sq. ft.	51/49	934	1,012
Restaurant, High Turnover	PM	18.49 Per 1,000 Sq. ft.	63/37	932	2,704
Service Station, with Convenience Market (with Car Wash)	PM	13.94 Per Fueling Position	50/50	946	3

Service Station, with Convenience Market (without Car Wash)	PM	13.38 Per 1,000 Sq. ft.	13.38	945	3,736
Supermarket	PM	11.85 Per 1,000 Sq. ft.	51/49	850	4,219

A Tier 1 analysis of MVSA shall include both an assessment of the number of net new peak hour vehicle trips as well as an assessment of the site and a description of current transportation and safety issues within 0.25 miles of the site based on the map provided by APD. This can also include other unsafe conditions such as limited sight distance, high speeds, or uneven grades. A field review shall be conducted and include information on existing pavement markings and conditions, existing signage, and vegetation impeding sight distance. A Tier 2 Analysis uses the level of service (LOS) metric from the Highway Capacity Manual (HCM).

A Tier 2 transportation analysis is required for any proposed land use that meets the following criteria:

- The proposed development and/or additions to existing structure is expected to generate 50 net new peak hour vehicle trips or more based upon trip generation rates published in the latest edition of the Trip Generation Manual, published by the Institute of Transportation Engineers (ITE); or
- There are current transportation or safety issues in the project area that have been identified in the Tier 1 analysis including the following conditions:
 - Any traffic fatalities in study area in the past three years
 - Any serious injuries in traffic crashes in the last three years
 - Site condition is 2 thru lanes and daily volume of more than 20,000 AADT
<https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=3f4b959826c34480be3e4740e4ee025f>
 - Site condition is 3 thru lanes per direction

Pedestrian System Adequacy (PSA)

All projects subject to APF must complete a Tier 1 analysis of PSA. Determination of adequacy shall consider the following:

- Pedestrian ways shall be continuous, direct, and convenient with grade separation where necessary.
- Pedestrian ways shall be secure, well lighted, and have good visibility
- Existing sidewalks must be upgraded to current City standards
- Curb ramps must be installed or upgraded to current City standards

Pedestrian system adequacy is defined as providing LTS 2 or less for the pedestrian network within 0.25 miles of the site. If there is a LTS of 3 or higher, a Tier 2 analysis will be required or if the project generates more than 50 net new peak hour vehicle trips.

Bicycle System Adequacy (BSA)

The adequacy standard for bicycle systems is LTS 2 in the area within 0.25 miles from the site. When cyclists travel on roadways, they encounter varying levels of stress from traffic. A quiet residential street with a 25-mile-per-hour speed limit is considered a very low-stress environment

for cyclists. But Forest Drive, with a 40-mile-per-hour speed limit represents a high-stress environment for cyclists who must share the roadway with traffic. If there is a LTS of 3 or higher, a Tier 2 analysis will be required or if the project generates more than 50 net new peak hour vehicle trips.

Transit System Adequacy (TSA)

The adequacy standard for transit riders is LTS for Transit of 2 or lower. This measurement includes the capacity of bus transit service in the vicinity of the site and transit utilization rates. If there is a LTS of 3 or higher, a Tier 2 analysis will be required or if the project generates more than 50 net new peak hour vehicle trips.

Conclusion

Using safety metrics, net new peak hour vehicle trips, and level of traffic stress will allow for a more comprehensive review of all modes and gauge the impact of the new development on existing infrastructure.

This new approach to adequate public facilities addresses the transportation system as a whole. It allows for a compressive approach that considers safety first. More details can be found in the attached “Guidelines for Conduction Transportation Impact Studies”

GUIDELINES FOR CONDUCTING TRANSPORTATION IMPACT STUDIES
Annapolis, Maryland
April 4, 2021

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INTRODUCTION

The purpose of this document is to establish uniform two-tiered guidelines for evaluating transportation impacts as part of the development review process for new development that is subject to Title 22 Adequate Public Facilities (APF) in the City of Annapolis Code.

Every project must complete at least a Tier 1 analysis for four different transportation modes.

The following must be evaluated for adequacy:

- Motor Vehicle System Adequacy (MVSA)
- Pedestrian System Adequacy (PSA)
- Bicycle System Adequacy (BSA)
- Transit System Adequacy (TSA)

APPLICABILITY

Each project shall evaluate modal adequacy to ensure that there is an approximately equivalent transportation level of service in all areas of the City of Annapolis. For each type of modal analysis that may be required, applicants are encouraged to use state-of-the-practice software tools to conduct transportation adequacy analysis. Depending on the safety analysis, number of net new peak hour vehicle trips generated, and LTS level, a Tier 2 analysis may be required.

The LTS approach quantifies the amount of stress a user of the transportation network experiences. The LTS methodology assigns a numeric stress level to streets, based on attributes like safety, traffic speed, traffic volume, number of lanes, ease of intersection crossings, accessibility, and other characteristics. Levels of traffic stress for a route combine over segments using weakest link logic. That means that if most of the links on a route have LTS 1 or 2, but one or a few links on a route have LTS 3, the route as a whole has LTS 3.

All current land uses and anticipated future development in the vicinity of the proposed development area shall be described in detail in the report. The following criteria shall be utilized to determine the minimum study area:

Tier	Applicability	Minimum Study Area Size
Tier 1	All projects subject to APF	Site access driveways, adjacent signalized and/or major unsignalized intersections within 0.25 miles (minimum)
Tier 2	Safety assessment results, >50 net new peak hour vehicle trips or LTS 3 and higher	Site access driveways, adjacent signalized and/or major unsignalized intersections within 0.5 miles (minimum)

MITIGATION PRIORITIES

Mitigation means the construction and/or funding of facilities and/or improvements to off-site road facilities by the developer. Any mitigation plans shall be developed in consultation with the Director of Planning and Zoning and the Director of Public Works and Transportation, as applicable.

In circumstances where mitigation would have a negative impact on the characteristics (historical, environmental or unique urban) which served as the basis for declaring an intersection (s) constrained, mitigation needed to pass the test for adequate road facilities on a constrained road facility shall increase the capacity on the constrained facility to the fullest extent possible without negatively impacting the characteristic(s) which caused the road facility to be constrained.

If the roadway and/or intersection being considered for mitigation is owned by another jurisdiction such as State Highway Administration or Anne Arundel County, the operating agency will be the deciding agent in this procedure. These jurisdictions should also be involved in the scoping process for the study. The City of Annapolis will offer a finding that the operating agency concurs with the mitigating improvement(s) being proposed by the applicant.

Mitigation measures may include any roadway and/or intersection capacity improvements except grade separation of the roadways and ramps within the intersection or improvements to through lanes of intermediate arterials and higher classified roads. Under certain circumstances, mitigation measures may include Transportation Demand Management (TDM) strategies to reduce vehicle trips.

If vehicle trip reductions are being assumed because of transit services, the following shall be documented: location of bus routes, accessibility to bus stops, frequency of service and hours of operation.

If vehicle trip reductions are being assumed because of these bicycle and pedestrian facilities, the following must be provided: pedestrian/bikeway facilities that connect or are proposed to connect the proposed development to adjacent trip-generation uses. Proximity to these adjacent uses should be within a 10-minute walk or bike ride.

Mitigation techniques in order of priority, may include, but are not limited to the following:

1) Intersections Improvements

- Add appurtenances for adequate bicycle, pedestrian, and transit facilities, including but not limited to crosswalks, signals, and non-auto curb cuts.
- Fix all Americans with Disabilities Act (ADA) noncompliance issues within a .05 radius of the boundaries, including, but not limited to, curb ramps and sidewalks.
- Improve safety at crossings with curb extensions, raised crossing islands, traffic signals, roadway narrowing, enhanced overhead lighting, or traffic-calming measures).
- Fix or install signage to enhance pedestrian and bicycle safety
- If a proposed project is within 0.25 miles from an existing bus line that is underutilized (characterized by level or declining ridership), the developer can incentivize use of the facility by providing an annual pass to the bus service for residents or occupants of the proposed development.

2) Site Plan/Land Use Techniques

- reduce project size
- modify project phasing, if any
- increase driveway queuing
- revise internal circulation
- revise vehicle/truck access or circulation

3) Roadway Improvements

- construct a by-pass lane
- pave roadway
- realign street
- improve sight distance
- add deceleration/acceleration lanes
- add a traffic signal if warrants/spacing criteria are met
- add a median crossover

4) Operational Improvements

- change signal timing or phasing
- improve signal progression
- off-peak shift changes (demand management)
- time of day lane changes

5) Access Management Techniques

- increase driveway spacing from intersections by relocating driveway(s) or intersection(s)
- reduce number of driveways
- install a median
- develop a service road system
- share access with adjacent land

6) Contribution of a Transportation Mitigation Payment

As a last priority, the mitigation required can be quantified with an estimate from a qualified engineer or transportation professional and paid to the Transportation Mitigation fund with an administrative fee of 5%.

MOTOR VEHICLE SYSTEM ADEQUACY (MVSA)

A Tier 1 analysis of MVSA shall include a safety assessment of the site and a description of current transportation and safety issues within 0.25 miles of the site. This can include high accident frequency, unsafe conditions such as limited sight distance, high speeds, or uneven grades (see map below). A field review shall be conducted and include information on existing pavement markings and conditions, existing signage, and vegetation impeding sight distance.

Annapolis Police Department, 2021

A Tier 2 transportation analysis is required for any proposed land use that meets the following criteria:

- The proposed development and/or additions to existing structure is expected to generate 50 net new peak hour trips or more based upon trip generation rates published in the latest edition of the Trip Generation Manual, published by the Institute of Transportation Engineers (ITE); or
- There are current transportation or safety issues in the project area that have been identified in the Tier 1 analysis including the following conditions:
 - Any traffic fatalities in study area in the past three years
 - Any serious injuries in traffic crashes in the last three years
 - Site condition is 2 thru lanes and daily volume of more than 20,000 AADT (<https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=3f4b959826c34480be3e4740e4ee025f>)
 - Site condition is 3 thru lanes per direction

Prior to beginning a Tier 2 analysis, the Department of Planning and Zoning shall prepare a scoping letter. The Scoping Letter specifies the study area, methodology, waiver(s), level of details required for a particular project and other relevant assumptions. Should a scoping meeting

be requested, the developer or his/her representative(s) shall submit in writing all issues/concerns to be discussed at the meeting to the Department of Planning and Zoning at least two (2) weeks before the meeting.

Level of service shall be done for signalized and unsignalized intersections. The techniques outlined in the latest edition of Highway Capacity Manual shall be used.

Signalized Intersection: Improvements are required if the roadway, the intersection and/or a particular movement are currently operating at a LOS of D or better and will operate below LOS D with the proposed development. Under this condition, the roadway and/or intersection improvements shall bring the level-of-service to at least LOS D. Improvements are also required if the roadway and/or intersection will operate at LOS E or F for the horizon year(s) without the proposed development, and will be even worse with the proposed development. In this case, the proposed mitigation shall aim to maintain the same level of delay and ensure safety.

Unsignalized Intersection: Same as above, however, mitigation can include improving the v/c ratio to a level of 0.85 or below. If v/c ratio is lower than 0.85 and added delay less than 10 seconds, other mitigation may not be required.

Queueing at the study intersections may not exceed available storage or impact adjacent intersections. Queue analysis is required for all turn lanes for the purpose of estimating queue lengths that need to be accommodated at intersections. Various methods for queue analysis may be used.

Existing traffic volume should be based on current count information. Average three- to seven-day machine counts should be used to determine daily and peak volumes along roadway segments and peak hour turning movement counts should be used to determine peak intersection volumes if not known. Counts that are one to three years old must be increased by 4% per year. Counts that are older than three years should not be used. Traffic counts shall be conducted when schools are in session.

Other peak periods may be specified in addition to, or in place of, the morning/evening peak periods under the following conditions:

- peak period traffic in the study area occurs at different time of the day (noon time, weekdays)
- unusual peaking characteristics of the proposed development (e.g. theater).

Where appropriate, seasonal factors may be used to adjust actual traffic counts with the approval of the Department of Planning and Zoning.

Level of Service, v/c ratio, and delay must be shown for existing conditions, horizon year level of service without the proposed development, and horizon year level of service with the proposed development.

Where available, local trip generation rates shall be used. If local trip rates cannot be obtained, the recommended source for site trip generation is the Institute of Traffic Engineers (ITE) Trip Generation. The latest ITE trip generation rates shall be used.

Note that for some land uses, ITE Trip Generation does not have any information, or ITE trip rate is based on limited sample size. In such a situation, other sources may be used. These sources must be justified and documented. The preferred sources include:

- state or county data from comparable development
- other published references
- other trip generation studies for similar developments on similar site

Irrespective of the source of trip generation rate, the report shall indicate the sources of trip generation data, including the page number(s), tables, rates/equations used, etc. Any trip generation data used must be reasonable and defensible.

The City will allow the assumption of pass-by trips for certain retail and service uses. The recommended allowable percentages outlined in Table 2 are based on data summarized in ITE publications and other sources. It is important to note that pass-by trips do not affect driveway volumes derived from trip generation rates; it affects only the adjacent street traffic volume. Any other pass-by percentage(s) used and/or any assumption regarding pass-by trips shall be justified and documented. The following chart shows examples of recommended pass-by percentages:

Land Use	Maximum Pass-by %
Service Station	60
Convenience Store	60
Fast Food Restaurant with Drive-through	50
Shopping Center	
Smaller than 100,000 Sq. Ft. GFA	50
Larger than 100,000 Sq. Ft. GFA	25

Trips that will be diverted from other roadways because of the proposed development shall be considered as new trips.

Total trip generation in a multi-use development may be reduced according to the procedures set forth in the latest ITE Trip Generation Handbook. Multi-use development that may qualify for trip generation reduction must have the following characteristics:

- Must have been planned as a single project
- Must be at least 100,000 square feet of gross floor area in size
- Must contain two or more land uses
- Some trips are between on-site land uses
- These trips must travel on internal street system to the development
- A central business district, a shopping center, an office park with retail, and office building with retail, or a hotel with limited retail and restaurant space are not considered multi-use development.

In the ITE Trip Generation, almost all trips are auto-trips since the trip generation data were primarily collected at developments where auto was the primary mode choice. In some cases such as high population density areas, some percentage of trips to and from the proposed development may be made by modes other than auto—on foot, by bicycle or transit. If the assumption is made regarding other mode choices, the report shall indicate the reasonableness of the assumption regarding non-auto trips. Additionally, the report shall document the current travel behavior, availability of transit service and any other relevant data.

Trip distribution analysis is concerned with the flow of traffic between trip origins and destinations within the influence area of the proposed development. Trip distribution analysis provides the spatial dimension to trip generation estimates and thereby permits policy analysis with respect to the planning of the transportation networks.

Any one of the following methods may be used for trip distributions of new trips. The method used and the data source(s) must be documented in the report.

- based on the proximity of trip generators and attractions and on existing travel patterns.
- Any trip distribution model of travel behavior—the gravity models, growth factor models, etc.

PEDESTRIAN SYSTEM ADEQUACY (PSA)

All projects subject to APF must complete a Tier 1 analysis of PSA. Determination of adequacy shall consider the following:

- Pedestrian ways shall be continuous, direct, and convenient with grade separation where necessary.
- Pedestrian ways shall be secure, well lighted, and have good visibility
- Existing sidewalks must be upgraded to current City standards
- Curb ramps must be installed or upgraded to current City standards

Pedestrian system adequacy is defined as providing LTS 2 or less for the pedestrian network within 0.25 miles of the site. If there is a LTS of 3 or higher, a Tier 2 analysis will be required. Any traffic, bicycle, or pedestrian fatalities in study area in the past three years

Pedestrian LTS is measured by the following²:

- LTS 1: The facility is reasonably safe for children 10 years or older and for adults. Pedestrians move freely without altering their speed in response to other pedestrians or to a decrease in the sidewalk width.
- LTS 2: The facility is adequate for users with basic skills and traffic knowledge.
- LTS 3: The facility requires an intermediate skill level and traffic knowledge.
- LTS 4: The facility requires a more advanced skill level and traffic knowledge. All walking speeds are severely restricted and forward progress is made only by “shuffling.”

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<https://www.technicaljournalonline.com/jers/VOL%20II/JERS%20VOL%20II%20ISSUE%20I%20JANUARY%20MARCH%202011/ARTICLE%2016%20JERS%20VOLUME%20II%20ISSUE%20I%20JANUARY-%20MARCH%202011.pdf>. April 4, 2021

- LTS 5: The facility is not suitable for pedestrian travel.

If there is a LTS of 3 or higher, or the site that generates at least 50 total peak-hour vehicle trips, Tier 2 analysis must be performed. This analysis should expand the field analysis to a 0.5 mile radius. Additional factors to consider for Tier 2 are as follows³:

- Pedestrian delay: Pedestrian delay is one of the most important factors influencing pedestrian level of service at signalized intersection. Pedestrian delay was total time the pedestrian waited while crossing the crosswalk. It mainly depends on pedestrian crossing behavior and traffic conditions. The delay caused by waiting at the crosswalk, while crossing the road and due to conflicts with the vehicles
- Corner area: The corner area is the total area of the corner of road. It is divided into holding area and circulation area. Holding area is sufficient enough to provide space for pedestrian waiting at the corner. Circulation area is space required for the movement of pedestrian.
- Pedestrian flow: It is the total number of pedestrian crossing the given crosswalk divided by the analysis period
- Vehicle flow rate: The total number of vehicles crossing a given crosswalk during the analysis period
- Mid-segment 85th percentile speed: The 85th percentile speed is the speed of the vehicle which is exceeded by only 15% of vehicles. The speed measured at a distance from intersection that it should not be influenced by intersection.
- Left turn on red vehicle flow rate: The number of vehicles taking left turn on red phase during the analysis period.
- Left turn vehicle flow rate: The number of vehicles turning to left of the crosswalk during the analysis period.
- Crosswalk length: The length of road from outside edge to the other edge that is it is measured from curb to curb.
- Width of crosswalk: The width of the crosswalk is the width provided for the pedestrian to cross the crosswalk that is the width of the crosswalk.
- Cycle length: The time interval between successive red phases of signal on a given specific road. It mainly depends on the vehicular flow rate

BICYCLE SYSTEM ADEQUACY (BSA)

The adequacy standard for bicycle systems is LTS 2 in the area within 0.25 miles from the site. When cyclists travel on roadways, they encounter varying levels of stress from traffic. A quiet residential street with a 25-mile-per-hour speed limit is considered a very low-stress environment for cyclists. But Forest Drive, with a 40-mile-per-hour speed limit represents a high-stress environment for cyclists who must share the roadway with traffic.

LTS for bicycles range from 1 to 4 as follow⁴:

³ <https://core.ac.uk/download/pdf/80147723.pdf>. April 4, 2021

⁴ <http://www.northeastern.edu/peter.furth/research/level-of-traffic-stress/>. April 4, 2021

- LTS 1: Strong separation from all except low speed, low volume traffic. Simple crossings. Suitable for children.
- LTS 2: Except in low speed / low volume traffic situations, cyclists have their own place to ride that keeps them from having to interact with traffic except at formal crossings. Physical separation from higher speed and multilane traffic. Crossings that are easy for an adult to negotiate. A level of traffic stress that most adults can tolerate, particularly those sometimes classified as “interested but concerned.”
- LTS 3: Involves interaction with moderate speed or multilane traffic, or close proximity to higher speed traffic. A level of traffic stress acceptable to those classified as “enthused and confident.”
- LTS 4: Involves interaction with higher speed traffic or close proximity to high speed traffic. A level of stress acceptable only to those classified as “strong and fearless.”

The Maryland Department of Transportation is finalizing a Bike LTS map for the region (<https://maryland.maps.arcgis.com/home/webmap/viewer.html?webmap=efaaf8540d394b09b01b3765a91e123b> Accessed 19 March 2021). This preliminary map can be used as a guide to establish LTS in Annapolis. This is an Open Streets based map provided by the Accessibility Observatory at the University of Minnesota and is updated every two years.

If there is a LTS of 3 or higher, or the site that generates at least 50 net new peak-hour vehicle trips, a Tier 2 analysis must be performed. This analysis should expand the field analysis to a 0.5 mile radius. Additional factors to consider for Tier 2 are as follows⁵:

- Facilities for cyclists should be part of a network that connects uses. The context of the road for a bicycle facility is a key element that should be considered in the design. The type and level of accommodation must be appropriate for the characteristics of the surrounding conditions. A “one-size-fits-all” approach may result in an underutilized facility or a facility that does not improve cycling safety, and, in some instances, may degrade cyclist safety. There are several factors that should be considered in all contexts to provide safe accommodations for cyclists.
- Directness—The cycling network should be direct between key destinations, considering both distance and time. On a corridor level, it is important to understand the “desire lines” of cyclists accessing key destinations. While directness typically refers to the shortest path to access destinations, it is influenced by travel time factors (e.g., the speed of a route) that may be influenced by the number of stops, grade, and other factors. Frequent stops and steep, uphill sections along a corridor can be a significant burden to cyclists operating under their own power.
- Continuity and Connectivity—The cycling network should be continuous (i.e., without gaps or abrupt changes) and provide convenient linkages to destinations. Often, it is the transition between different land uses and environments where the nature of cycling accommodations changes. For example, a separated facility along public property may become a bicycle lane or an undesignated area where cyclists ride with traffic. Continuity may also relate to any aspect of a facility, such as available riding space or quality.
- Comfort—Cyclist comfort level and perceived risk should be considered, as they may influence route choice and riding behaviors. When presented with facilities on high-

⁵ <https://core.ac.uk/download/pdf/80147723.pdf>. April 4, 2021

speed, high-volume roadways, some cyclists may be more comfortable when dedicated space is provided to create separation from motorized traffic. A lack of adequate riding space or a concern for personal safety will often influence route selection and other riding behaviors, including cyclist use of sidewalks⁶.

TRANSIT SYSTEM ADEQUACY (TSA)

The adequacy standard for transit riders is LTS for Transit of 2 or lower. This measurement includes the capacity of bus transit service in the vicinity of the site and transit utilization rates. For any development subject to APF, determination of adequacy shall consider the following in a Tier 1 analysis⁷:

LTS	Headway (Minutes)	Veh/h	Description
LTS 1	Less than 10	>6	Passengers don't need schedules. Shelters are present and are clean and ADA accessible. Informational signage and trash cans are present.
LTS 2	10-20	3-6	Frequent service. Shelter may be present, a bench is provided. Informational signage and trash cans are present.
LTS 3	21-30	2	Service unattractive to choice riders. No shelter provided, site is muddy and dirty. Informational signage and trash cans are not present.
LTS 4	31-60	1	Service unavailable during hour. No shelter provided, site is muddy, dirty, and unsafe. Informational signage and trash cans are not present.
LTS 5	>60	<1	Service unattractive to all riders. No shelter provided, site is muddy, dirty, and unsafe. Informational signage and trash cans are not present.

For any development generating at least 50 peak-hour transit riders, the applicant or with a LTS of 3 or higher, the applicant must additionally inventory bus routes at stations/stops within 0.5 miles of the site and identify the peak load at that station/stop for each route. The applicant must coordinate with the transit service provider to identify and implement (or fund) improvements that would be needed to address conditions worse than maximum vehicle load of 120%.

Tier 2 analysis should also include the following analysis for transit in the study area⁸:

⁶ Bicycle Road Safety Audit Guidelines and Prompt Lists (May 2012: FHWA-SA-12-018)

⁷ http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_6-e.pdf. April 4, 2021

⁸ http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_6-e.pdf. April 4, 2021

- Total ridership, or ridership by mode or service type
- Passenger trips
- Passenger miles
- Ratio of ridership growth to population growth
- Passengers per capita
- Availability of automatic vehicle location (AVL) systems

CONCLUSION

This goal of this approach to adequate public facilities is addresses the transportation system as a whole. It allows for a compressive approach that considers safety first.

APPENDIX 1: DEFINITIONS

Average day: A Tuesday, Wednesday or Thursday for most uses. The average day may be a Saturday for uses that have higher peak hour traffic volumes on Saturday rather than mid-week.

Average Daily Traffic: The total traffic volume passing a point or segment of a roadway in both directions during an average 24-hour period.

Capacity: On a roadway link, the maximum number of vehicles which can pass a given point during one hour under prevailing roadway and traffic conditions.

Existing Traffic: In a traffic analysis, current traffic in accordance with recent counts on the current road network.

Gap (critical gap): The median time headway (in seconds) between vehicles in a major traffic stream which will permit side-street vehicles at STOP or YIELD controlled approach to cross through or merge with major traffic stream under prevailing traffic and roadway conditions

Level of service: A qualitative measure describing operational conditions within a traffic stream: generally described in terms of such factors as speed and travel time, delay, freedom to maneuver, traffic interruptions, comfort and convenience, and safety

Mode choice: Estimation of the number of trips made by each possible mode such as motor vehicle, bicycle, transit, walking, etc. to make a trip.

Peak hour: The one-hour period of greatest utilization of a transportation facility; weekdays normally have two peaks, one in the morning and one in the afternoon. It represents the most critical period of operation and the highest typical capacity requirements.

Peak Period: A three-hour or more period during which the transportation facility has significantly increase levels of use, includes the peak hour

Peak Hour of Generator: The single hour of highest volume of traffic entering and exiting a site.

Traffic mitigation: Reduction of traffic impacts on intersections and/or roadways to an acceptable level of service through the modification of the site plan, roadway construction improvements or improvements in the existing traffic control devices.

Traffic Impact: The effect of site traffic on the operations and safety of the road network

Transportation Impact Analysis: An engineering study which determines the potential impacts of a proposed traffic generator. A complete transportation impact analysis will include an estimation of future traffic with and without the proposed generator, analysis of traffic impacts and recommended roadway improvements which may be necessary to accommodate the expected traffic.

Traffic generator: a designated land use (commercial, industrial, residential, office, etc.) or a change in land use that generates pedestrian and/or vehicular traffic to and from the site.

Trip: A one-way movement by a person or a vehicle having an origin and a destination

Trip assignment: Determination of site and non-site traffic that will use each access point and route

Trip distribution: Allocation of the site generated trips to all possible routes to and from the site.

Trip generation: The process of estimating the number of vehicle trips originating from or destined for the uses on a land parcel

Volume-to-Capacity Ratio (V/C): A performance measure computed using the ratio of an actual roadway volume to the capacity of a roadway link.

APPENDIX 2:

CURRENT CODE SECTIONS

22.21.010 - Traffic impact analyses.

A. Applicability. Notwithstanding any other provisions of this title, a traffic impact analysis shall be required for:

1. A project must have a traffic impact study if:

a. The proposed development and/or additions to existing structure is expected to generate two hundred fifty daily trips or more based upon trip generation rates published in the latest edition of the Trip Generation Manual, published by the Institute of Transportation Engineers (ITE); or

b. There are current traffic problems or issues in the project area, e.g. high traffic accident frequency; or

c. The proposed entrances and exits from the site are too close to an intersection.

2. Exceptions. There are no exceptions to the criteria above.

B. Procedures for the preparation of traffic impact analyses

1. The traffic impact analysis will be prepared based upon a uniform scope of work and methodology for traffic impact analyses entitled Traffic Impact Analysis for Proposed Development, City of Annapolis, Maryland, maintained by the Department of Planning and Zoning.

2. The traffic impact analysis will be performed under the oversight of the Department of Planning and Zoning as follows:

a. Upon a determination that a development will require a Traffic Impact Analysis, the applicant will be notified of such.

b. The Department of Planning and Zoning will prepare a scope of services for the traffic impact analysis and solicit a cost estimate(s) from a competent consulting firm(s) for the preparation of the analysis.

c. The applicant will remit to the Department of Planning and Zoning sufficient funds for the completion of the analysis plus an administrative fee not to exceed ten percent of the projected cost of the analysis. If the completion of the analysis exceeds the funds applicant remitted to the Department of Planning and Zoning, the Department may withhold approval until full payment is remitted.

d. The Department of Planning and Zoning will contract directly with the consulting firm and oversee the preparation of the traffic impact analysis.

e. All traffic analysis results will be incorporated into any Adequate Public Facilities Ordinance considerations.

3. The Department of Planning and Zoning shall be a party to all communications between the project developer and the consultant performing the Traffic Impact Analysis. Should communication occur, to which the Department of Planning and Zoning is not a party, the consultant may not be utilized again by the City of Annapolis, or the Department may, at its sole discretion, stop the Analysis and reinitiate a Traffic Impact Analysis with an alternative consultant at applicant expense.

Chapter 22.22 - REVIEW CRITERIA AND CERTIFICATION FOR ADEQUATE NON-AUTO TRANSPORTATION FACILITIES

22.22.010 - Responsibility.

The Planning and Zoning Director shall be responsible for review and assessment of a proposed project with regard to the adequacy of non-auto transportation facilities, which review and assessment shall consider recommendations of the Director of Transportation.

22.22.020 - Goal.

The goal of adequate bicycle, pedestrian, and transit facilities is to increase accessibility and to ensure reasonable and assessable alternatives to automobile travel.

22.22.030 - Exemptions.

There are no exemptions under this Chapter for any proposed projects.

22.22.040 - Standards.

A. The standards required to be promulgated pursuant to Section 22.08.010, shall include but not be limited to:

1. Bicycle Facilities. Proposed projects shall be served by adequate bicycle facilities where necessary throughout the site.

2. Pedestrian Facilities. Proposed projects shall be served by sidewalks where necessary throughout the site, which sidewalks shall be constructed to City standards.

3. Transit Facilities. Where a proposed project abuts an existing or planned bus line, the proposed project shall be served by a bus shelter at all existing and planned bus stops on roadways throughout the proposed project.

4. Signalized Intersections. Signalized intersections adjacent to proposed projects shall have the appurtenances necessary for adequate bicycle, pedestrian, and transit facilities, including but not limited to crosswalks, signals, and non-auto curb cuts.

APPENDIX 3:
PROPOSED CODE SECTIONS

Chapter 22.21 - ~~Traffic Impact Analyses~~ REVIEW CRITERIA AND CERTIFICATION FOR
ADEQUATE TRANSPORTATION FACILITIES

22.21.010 - ~~Traffic impact analyses.~~ RESPONSIBILITY

THE DIRECTOR OF PLANNING AND ZONING IN CONSULTATION WITH THE DIRECTORS OF TRANSPORTATION AND PUBLIC WORKS SHALL BE RESPONSIBLE FOR REVIEW AND ASSESSMENT OF A PROPOSED PROJECT WITH REGARD TO THE ADEQUACY OF ADEQUATE TRANSPORTATION FACILITIES.

A.— ~~Applicability. Notwithstanding any other provisions of this title, a traffic impact analysis shall be required for:~~

1.— ~~A project must have a traffic impact study if:~~

a.— ~~The proposed development and/or additions to existing structure is expected to generate two hundred fifty daily trips or more based upon trip generation rates published in the latest edition of the Trip Generation Manual, published by the Institute of Transportation Engineers (ITE); or~~

b.— ~~There are current traffic problems or issues in the project area, e.g. high traffic accident frequency; or~~

c.— ~~The proposed entrances and exits from the site are too close to an intersection.~~

2.— ~~Exceptions. There are no exceptions to the criteria above.~~

B.— ~~Procedures for the preparation of traffic impact analyses~~

1.— ~~The traffic impact analysis will be prepared based upon a uniform scope of work and methodology for traffic impact analyses entitled Traffic Impact Analysis for Proposed Development, City of Annapolis, Maryland, maintained by the Department of Planning and Zoning.~~

2.— ~~The traffic impact analysis will be performed under the oversight of the Department of Planning and Zoning as follows:~~

a.— ~~Upon a determination that a development will require a Traffic Impact Analysis, the applicant will be notified of such.~~

b.— ~~The Department of Planning and Zoning will prepare a scope of services for the traffic impact analysis and solicit a cost estimate(s) from a competent consulting firm(s) for the preparation of the analysis.~~

c.— ~~The applicant will remit to the Department of Planning and Zoning sufficient funds for the completion of the analysis plus an administrative fee not to exceed ten percent of the projected cost of the analysis. If the completion of the analysis exceeds the funds applicant remitted to the Department of Planning and Zoning, the Department may withhold approval until full payment is remitted.~~

d.— ~~The Department of Planning and Zoning will contract directly with the consulting firm and oversee the preparation of the traffic impact analysis.~~

e.— ~~All traffic analysis results will be incorporated into any Adequate Public Facilities Ordinance considerations.~~

3.— ~~The Department of Planning and Zoning shall be a party to all communications between the project developer and the consultant performing the Traffic Impact Analysis. Should communication occur, to which the Department of Planning and Zoning is not a party, the consultant may not be utilized again by the City of Annapolis, or the Department may, at its sole discretion, stop the Analysis and reinitiate a Traffic Impact Analysis with an alternative consultant at applicant expense.~~

22.21.020 - GOAL.

THE GOAL OF ADEQUATE TRANSPORTATION FACILITIES IS TO ENSURE THAT ALL MODES OF TRANSPORTATION EXISTING AND PROPOSED WILL BE ADEQUATE TO ADDRESS A PROPOSED DEVELOPMENT. THIS INCLUDES MOTOR VEHICLES, PEDESTRIAN, BICYCLE, AND TRANSIT FACILITIES IMPROVEMENTS THAT INCREASE ACCESSIBILITY AND TO ENSURE REASONABLE AND ACCESSIBLE TRANSPORTATION OPTIONS

22.21.030 - EXEMPTION.

ALL PROPOSED PROJECTS NEED TO INCLUDE A TIER 1 ANALYSIS OF TRANSPORTATION FACILITIES.

22.21.040 - STANDARDS.

- A. ANALYSIS. EVERY PROJECT SUBJECT TO ADEQUATE PUBLIC FACILITIES MUST COMPLETE AT LEAST A TIER 1 ANALYSIS FOR FOUR DIFFERENT TRANSPORTATION MODES. THE FOLLOWING MUST BE EVALUATED FOR ADEQUACY: MOTOR VEHICLE SYSTEM ADEQUACY (MVSA), PEDESTRIAN SYSTEM ADEQUACY (PSA), BICYCLE SYSTEM ADEQUACY (BSA), AND TRANSIT SYSTEM ADEQUACY (TSA).
- B. PROCEDURES FOR THE PREPARATION OF TRANSPORTATION IMPACT ANALYSES. THE TRANSPORTATION IMPACT ANALYSIS WILL BE PREPARED BASED UPON A UNIFORM SCOPE OF WORK AND METHODOLOGY FOR ENTITLED "GUIDELINES FOR CONDUCTING TRANSPORTATION IMPACT STUDIES, CITY OF ANNAPOLIS, MARYLAND", MAINTAINED BY THE DEPARTMENT OF PLANNING AND ZONING. THE TRAFFIC IMPACT ANALYSIS WILL BE PERFORMED UNDER THE OVERSIGHT OF THE DEPARTMENT OF PLANNING AND ZONING AS FOLLOWS: UPON A DETERMINATION THAT A DEVELOPMENT WILL REQUIRE A TRANSPORTATION IMPACT ANALYSIS, THE APPLICANT WILL BE NOTIFIED OF SUCH.
 - 1. THE DEPARTMENT OF PLANNING AND ZONING WILL PREPARE A SCOPE OF SERVICES FOR THE TRAFFIC IMPACT ANALYSIS AND SOLICIT A COST ESTIMATE(S) FROM A COMPETENT CONSULTING FIRM(S) FOR THE PREPARATION OF THE ANALYSIS.
 - 2. THE APPLICANT WILL REMIT TO THE DEPARTMENT OF PLANNING AND ZONING SUFFICIENT FUNDS FOR THE COMPLETION OF THE ANALYSIS PLUS AN ADMINISTRATIVE FEE NOT TO EXCEED TEN PERCENT OF THE PROJECTED COST OF THE ANALYSIS. IF THE COMPLETION OF THE ANALYSIS EXCEEDS THE FUNDS APPLICANT REMITTED TO THE DEPARTMENT OF PLANNING AND ZONING, THE DEPARTMENT MAY WITHHOLD APPROVAL UNTIL FULL PAYMENT IS REMITTED.
 - 3. THE DEPARTMENT OF PLANNING AND ZONING WILL CONTRACT DIRECTLY WITH THE CONSULTING FIRM AND OVERSEE THE PREPARATION OF THE TRANSPORTATION IMPACT ANALYSIS.

4. THE DEPARTMENT OF PLANNING AND ZONING SHALL BE A PARTY TO ALL COMMUNICATIONS BETWEEN THE PROJECT DEVELOPER AND THE CONSULTANT PERFORMING THE TRANSPORTATION IMPACT ANALYSIS. SHOULD COMMUNICATION OCCUR, TO WHICH THE DEPARTMENT OF PLANNING AND ZONING IS NOT A PARTY, THE CONSULTANT MAY NOT BE UTILIZED AGAIN BY THE CITY OF ANNAPOLIS, OR THE DEPARTMENT MAY, AT ITS SOLE DISCRETION, STOP THE ANALYSIS AND REINITIATE A TRANSPORTATION IMPACT ANALYSIS WITH AN ALTERNATIVE CONSULTANT AT APPLICANT EXPENSE.

~~Chapter 22.22 – Review Criteria and Certification for Adequate Non-auto Transportation Facilities~~

~~22.22.010 – Responsibility.~~

~~The Planning and Zoning Director shall be responsible for review and assessment of a proposed project with regard to the adequacy of non-auto transportation facilities, which review and assessment shall consider recommendations of the Director of Transportation.~~

~~22.22.020 – Goal.~~

~~The goal of adequate bicycle, pedestrian, and transit facilities is to increase accessibility and to ensure reasonable and assessable alternatives to automobile travel.~~

~~22.22.030 – Exemptions.~~

~~There are no exemptions under this Chapter for any proposed projects.~~

~~22.22.040 – Standards.~~

~~A. The standards required to be promulgated pursuant to Section 22.08.010, shall include but not be limited to:~~

~~1. Bicycle Facilities. Proposed projects shall be served by adequate bicycle facilities where necessary throughout the site.~~

~~2. Pedestrian Facilities. Proposed projects shall be served by sidewalks where necessary throughout the site, which sidewalks shall be constructed to City standards.~~

~~3. Transit Facilities. Where a proposed project abuts an existing or planned bus line, the proposed project shall be served by a bus shelter at all existing and planned bus stops on roadways throughout the proposed project.~~

~~4. Signalized Intersections. Signalized intersections adjacent to proposed projects shall have the appurtenances necessary for adequate bicycle, pedestrian, and transit facilities, including but not limited to crosswalks, signals, and non-auto curb cuts.~~