Section 1 - Introduction

1.1. Introduction

Throughout the country, problems on our street system such as midblock accidents and delays to through traffic caused by turning vehicles can be traced to the access provided to abutting property via side streets and driveways. Historically, decisions to allow access were typically made relative to individual properties and not the function and characteristic of the street to which access was allowed. This piece-meal approach to access planning has frequently resulted in an illogical and excessive number of access points that have led to increased congestion and accidents.

“Access management” takes a comprehensive view of property access relative to the function of the streets from which it is provided. The objective of access management is to optimize, or find that right balance, between property access and traffic safety and efficiency, particularly along arterial streets. In other words, access is viewed in the context of the street system instead of just the individual property. Even further, access should be viewed in the context of the ultimate traffic volumes. What might appear acceptable one day may well be perceived differently in a long-term perspective.

Access management is the careful planning and design of driveways, median openings, interchanges, and street connections to a roadway. It also involves the application of median treatments and turning lanes, and the appropriate separation of traffic signals. This is done to maintain the viability of major roadways to safely and efficiently accommodate traffic volumes commensurate with their function. It is the arterial street network that is key to the success of transportation within a community and it represents perhaps the greatest financial infrastructure investment.

Access management requires that all properties have reasonable access to the public roadway system. Existing access will be allowed to continue and some areas, due to existing constraints, may never be fully improved. The objective of this Access Management Code is to avoid further degradation caused by access in already developed areas and to prevent the creation of problems in the future. The net effect of access management along arterial streets is that the supporting networks of collector and local streets, and even inter-parcel connectivity, become more critical to effective circulation and property access.

The ultimate configuration of a street and its function are typically the result of land use planning, transportation planning, and traffic engineering. The concept of access management integrates these activities in order to optimize the safety and performance of the public street network, a significant infrastructure investment vital to the well being of the community.

1.2. Experience

Every community has experienced safety and traffic operational problems associated with too much or poorly planned access to abutting properties. Many have also found it necessary to retrofit solutions to solve these problems. In the course of this experience, it has been discovered that managing access to major roadways has significant positive effects, including reducing accident experience, lessening congestion, enhancing community character, and improving air quality.
Studies to date indicate that an effective access management program can result in significant decreases in accidents and travel delays. Obviously the degree of impact will vary based on the specific circumstances of any street segment, but this experience has provided valuable insight into the factors that have a negative influence on traffic safety and efficiency. Some of these factors include:

- Driveways or side streets in close proximity to major intersections;
- Driveways or side streets spaced too close together;
- Lack of left-turn lanes to store turning vehicles;
- Deceleration of turning traffic in through lanes; and
- Traffic signals too close together.

Sometimes these problems on major streets have unintended and undesirable consequences such as encouraging drivers to find alternate routes on collector and local streets.

Requirements for well-designed road and access systems further the orderly layout and use of land and help improve the design of residential subdivisions and commercial circulation systems. However, the “change” to a system of shared or unified access to property along major roadways often causes concern among property owners or business operators, due to the perception that loss of individual driveway access could adversely impact property values or income.

The appearance of corridors and gateways is also critical to the image of a community and its overall attractiveness to investors. Minimizing the number of curb cuts, consolidating access drives, constructing landscaped medians, and buffering parking lots from adjacent thoroughfares results in a visually pleasing and efficient corridor that, in turn, can help attract new investment. Effective management of roadway corridors also protects property values over time.

1.3. Conflicts and Revisions

While every effort has been made to ensure that this Access Management Code has no conflicts with either the Unified Development Ordinance or the Design and Construction Manual, there may be occasions where discrepancies between these documents arise. Upon such an occasion, the City Engineer (or designee) shall determine the more restrictive provision and it shall apply. This decision can be appealed to the City Council.

Should a discrepancy be identified, city staff will work to modify the affected ordinances in a timely manner.
Section 2 - Glossary

AASHTO - The American Association of State Highway and Transportation Officials.

Access - Any way or means of approach to provide vehicular or pedestrian entrance to a property.

Access Management - Measures to assure the appropriate location, design, and operation of driveways, median openings, interchanges, and street connections to a roadway, as well as the application of median treatments and turning lanes in roadway design, and the appropriate separation of traffic signals for the purpose of maintaining the safety and operational performance of roadways.

Access Management Program - The whole of all actions taken by a governing council, board, or agency to maintain the safety and traffic carrying capacity of its roadways.

Annual Average Daily Traffic (AADT) - The annual average two-way daily traffic volume on a route. AADT represents the total traffic on a road per year, divided by 365.

At Grade - When two or more facilities that meet in the same plane of elevation.

Auxiliary Lane - A lane adjoining a roadway that is used for acceleration, deceleration, or storage of turning vehicles.

Backage Road - A local road that is used to provide alternative access to a road with higher functional classification; backage roads typically run parallel with the main route and provide access at the back of a line of adjacent properties. Also known as “Reverse Frontage Road” or “Parallel Access Road”.

Change in Use - A change in use may include, but is not limited to, structural modifications, remodeling, a change in the type of business conducted, expansion of an existing business, a change in zoning, or a division of property creating new parcels, but does not include modifications in advertising, landscaping, general maintenance or aesthetics that do not affect internal or external traffic flow or safety.

City Engineer - City staff position that is responsible for directing the operation of the Technical Engineering Element of the Engineering Group in the Public Works Department. The Technical Engineering Element encompasses capital improvement management, development review, traffic engineering, and public works inspections.

Commercial - Property developed for the purpose of retail, wholesale, or industrial activities, and which typically generate higher numbers of trips and traffic volumes than residential properties.

Conflict - A traffic-related event that causes evasive action by a driver to avoid a collision.

Conflict Point - Any point where the paths of two through or turning vehicles diverge, merge, or cross and create the potential for conflicts.

Congestion - A condition resulting from more vehicles trying to use a given road during a specific period of time than the road is designed to handle with what are considered acceptable levels of delay or inconvenience.

Connection - Any driveway, street, turnout or other means of providing for the movement of vehicles to or from the public roadway system.
Connection Spacing - The distance between connections, measured from centerline to centerline (center of right-of-way for public streets) along the edge of the traveled way.

Cross Access - A service drive that provides vehicular access between two or more abutting sites so that the driver need not enter the public street system to move between them.

Deceleration Lane - A speed-change lane that enables a vehicle to leave the through traffic lane and decelerate to stop or make a slow-speed turn.

Directional Median Opening - An opening in a raised median that provides for specific traffic movements and physically restricts other movements. For example, a directional median opening may allow only right turns at a particular location.

Design Traffic Volume - The traffic volume which a roadway or driveway was designed to accommodate, and against which its performance is evaluated.

Downstream - The next feature (e.g. a driveway) in the same direction as the traffic flow.

Downtown Core - An area bordered by Chipman Road on the north, Route 291 on the east and U.S. 50 on the south and west.

Driveway - A (typically) private roadway or entrance used to access residential, commercial, or other property from an abutting public roadway.

Driveway Density - The number of driveways divided by the length of a particular roadway.

Driveway Spacing - (see Connection Spacing)

Driveway Width - The width of a driveway measured from one side to the other at the point of tangency.

Easement - A grant of one or more property rights by a property owner. For example, one property owner may allow a neighbor to access public roads across his or her property.

Entering (or Intersection) Sight Distance - The distance of minimum visibility needed for a passenger vehicle to safely enter a roadway and accelerate without unduly slowing through traffic.

Facility - A transportation asset designed to facilitate the movement of traffic, including roadways, intersections, auxiliary lanes, frontage roads, backage roads, bike paths, etc.

FHWA - The Federal Highway Administration of the U.S. Department of Transportation.

Flag Lot - A lot not meeting minimum frontage requirements where access to a public road is provided by a narrow strip of land carrying a private driveway.

Frontage - The length of a property that directly abuts a highway.

Frontage Road - A local road that is used to provide alternative access to property from a road with higher functional classification; frontage roads typically run parallel to the mainline road and provide access at the front of a line of adjacent properties.
**Functional Area** - The area surrounding an interchange or intersection that includes the space needed for drivers to make decisions, accelerate, decelerate, weave, maneuver, and queue for turns and stop situations.

**Functional Classification System** - A system used to categorize the design and operational standards of roadways according to their purpose in moving vehicles; higher functional classification implies higher traffic capacity and speeds, and typically longer traveling distances.

**Functional Integrity** - Incorporating appropriate access management standards and controls that allow a roadway to maintain its classified purpose.

**Geometric Design Standards** - The acceptable physical measurements that allow a facility to maintain functional integrity.

**Grade Separated** - Two or more facilities that intersect in separate planes of elevation.

**Highway Capacity** - The maximum number of vehicles a highway can handle during a particular amount of time and at a given level of service.

**Highway System** - All public highways and roads, including controlled access highways, freeways, expressways, other arterials, collectors, and local streets.

**Industrial/Commercial Collector Street** - Street that collects traffic to and from commercial or industrial areas and distributes it to arterial streets.

**Interchange** - A grade-separated facility that provides for movement between two or more roadways.

**Internal Circulation** - Traffic flow that occurs inside a private property.

**Internal Site Design** - The layout of a private property, including building placement, parking lots, service drives, and driveways.

**Intersection** - An at-grade facility that provides mobility between two or more roadways.

**Interstate** - A federally-designated roadway system for relatively uninterrupted, high-volume mobility between states.

**Joint (or Shared) Access** - A private access facility used by two or more adjacent sites.

**Lane** - The portion of a roadway used in the movement of a single line of vehicles.

**Left-Turn Lane** - A lane used for acceleration, deceleration, and/or storage of vehicles conducting left-turning maneuvers.

**Level of Service** - The factor that rates the performance of a roadway by comparing operating conditions to ideal conditions; “A,” is the best, “F,” which is worst.

**Major Arterial Street** - Street that serve the highest traffic volume corridors and the longest trips.

**Median** - A barrier that separates opposing flows of traffic. Raised medians (with curbs and a paved or landscaped area in the center) are generally used in urban areas. Raised medians should not be confused
with more obtrusive Jersey barriers. Flush median (with no curbs and a grass-covered area in the center) are generally used in rural areas. Medians can be both functional and attractive.

**Median Width** - The distance between the near edge of the through travel lanes in each direction when separated by a median.

**Mid-Block Crossing** - A crossing that is provided so that pedestrians can conveniently cross a roadway in the middle of a block or segment of roadway.

**Minor Arterial Street** - Street that interconnect and augment the major arterial streets.

**Multi-Purpose Path** - A paved surface typically constructed parallel to a street to serve pedestrian and bicycle traffic.

**NCHRP** - The National Cooperative Highway Research Program, a program that sponsors research on highway safety, operations, standards, and other topics.

**Peak Hour Traffic** - The number of vehicles passing over a section of roadway during its most active 60-minute period each day.

**Police Power** - The general power vested in the legislature to make reasonable laws, statutes and ordinances where not in conflict with the Constitution that secure or promote the health, safety, welfare and prosperity of the public.

**Public Road** - A highway, street or road, open for use by the general public and which is under the jurisdiction or control of a public body.

**Queue Storage** - That portion of a traffic lane that is used to temporarily hold traffic that is waiting to make a turn or proceed through a traffic control device such as a stop sign or traffic signal.

**Raised Median** - The elevated section of a divided road that separates opposing traffic flows.

**Residential** - Property developed for the purpose of single family, multi-unit, or other housing quarters.

**Residential Access Street** - Street that carries traffic between residential lots and residential local street or residential collector streets.

**Residential Collector Street** - Street that collects traffic to and from residential areas and distributes it to arterial streets.

**Residential Local Street** - Street that carries traffic having its origin or destination within the immediate neighborhood.

**Reviewing Engineer** - An individual or individuals designated by the City Engineer to review development projects and make decisions as outlined in this Policy. The review should include input from the appropriate departments (fire, police, public works, planning & development, etc.).

**Right-In, Right-Out** - A driveway where left turns are prohibited either by physical or regulatory means.

**Right-of-Way** - Land reserved, used, or slated for use for a highway, street, alley, walkway, drainage facility, or other public purpose related to transportation or utilities.
Roadway Classification System - See “Functional Classification System”

Service Road - A local road that is used to provide alternative access to a road with higher functional classification; service roads may include internal circulation systems, frontage roads, or backage roads.

Shared Driveway - A single, private driveway serving two or more lots.

Side Friction - Driver delays and conflicts caused by vehicles entering and exiting driveways.

Sidewalk - A paved surface designed specifically to serve pedestrian traffic.

Sight Distance - The distance visible to the driver of a passenger vehicle measured along the normal travel path of a roadway to a specified height above the roadway when the view is unobstructed to oncoming traffic.

Spacing - For purposes of this policy, the distance between two roadways and or drives measured from the center of one roadway to the center of the next roadway, unless otherwise defined for a specific application.

Speed Differential - The difference in travel speed between through traffic, and traffic entering or exiting a roadway.

Stopping Sight Distance - The minimum distance required for a vehicle traveling on a roadway to come to a complete stop upon the driver seeing a potential conflict; it includes driver reaction and braking time and is based on a wet pavement.

Storage Length - see Queue Length.

Strip Development - A linear pattern of roadside commercial development, typically with relatively shallow lots and frequent drives. Also typically lacks a network of side streets permitting efficient traffic circulation between adjacent developments.

Taper - The transitional area of a roadway where lanes are added or dropped.

Throat Length - The distance parallel to the centerline of a driveway to the first on-site location at which a driver can make a right-turn or a left turn. On roadways with curb and gutter, the throat length shall be measured from the back of the curb. On roadways without a curb and gutter, the throat length shall be measured from the edge of the shoulder.

Traffic Flow - The actual amount of traffic movement.

Transportation Impact Study - A report that compares relative roadway conditions with and without a proposed development; typically including an analysis of mitigation measures.

Trip Generation - The estimated volume of entering and exiting traffic caused by a particular development.

Turning Radius - The radius of an arc that approximates the turning path of a vehicle.
Two-Way Left-Turn Lane (TWLTL) – A lane located between opposing traffic flows which provides a transition area for left-turning vehicles.

Uncontrolled Access - A situation that results in the incremental development of an uncontrolled number, spacing, and/or design of access facilities.

Upstream - Against (behind) the direction of the traffic flow.

Vehicle Trip - A vehicle moving from a point of origin to a point of destination.

Warrant - The standardized condition under which traffic management techniques are justified.

Weaving - Crossing of traffic streams moving in the same general direction through merging and diverging, for instance near an interchange or intersection.
Section 3 - Street Classification System

3.1. Street Classifications

Safe and efficient operation of streets and highways requires that these facilities be classified and designed for the functions that they will perform. The entire road system is traditionally classified by relating the proportion of through movement to the proportion of access. Freeways, which have full control of access and serve only the movement function, are at one end of the scale; local streets, which predominately provide for land access, are at the other end of the scale because they have little or no through movement. Collector and arterial streets normally must provide a balance between movement and access functions; it is along these streets that access management actions become important.

Freeways and expressways in Lee’s Summit are the responsibility of the Missouri Department of Transportation. City streets range from residential streets to arterial streets. Six street classifications are defined in the Design and Construction Manual maintained by the Lee’s Summit Public Works Department. These include:

- Major Arterial
- Minor Arterial
- Industrial/Commercial Collector
- Residential Collector
- Residential Local
- Residential Access

A number of frontage roads exist in Lee’s Summit, some owned by MoDOT and some by the City. Frontage roads are unique only by their proximity to access-controlled highways but the function of each should be categorized by one of the six aforementioned classifications.

3.2. Typical Sections

A typical section for each of the street types is included in the Lee’s Summit Public Works Department Design and Construction Manual. Some of the considerations that go into defining the needed cross section of any given street segment are described below.

3.2.A. Traffic Lanes

The number and types of lanes on any street should be determined by existing and projected traffic volumes and the nature of land use activity adjacent to it. Turn lanes are essential at many intersections.

3.2.B. Bicyclists

Bicycle routes are established on some city streets. Considerations for bicyclists could include a wider traffic lane, marked bike lanes, or multi-purpose paths.

3.2.C. Pedestrians

Sidewalks or multi-purpose paths are generally required on one or both sides of a public street. Requirements are outlined in the Design and Construction Manual and the Unified Development Ordinance.

3.2.D. Right-of-Way
Providing sufficient right-of-way to meet the long term growth potential of a street is one of the most important elements of the transportation network. Once development occurs adjacent to the roadway, additional expansion of the street may become very expensive or impractical if sufficient right-of-way is not available. This may in turn limit additional development if sufficient capacity cannot be provided on the street.

In addition to the basic number of through lanes, street elements that influence the amount of right-of-way required include left-turn lanes (double left-turn lane at some arterial street intersections), right-turn lanes, bike lanes, medians, and multi-use paths.

3.2.E. Corner Right-of-Way Triangles
A 25-foot triangle of additional right-of-way shall be provided at the corners or two intersecting streets that both have a designated classification of arterial or collector. The triangle is determined by measuring along both right-of-way lines 25 feet from their point of intersection and striking a line to connect the two points (see Figure 3-1). The purpose of this triangle is to allow room for utilities and sidewalks behind the corner radius of the intersection. Additional right-of-way or other provisions may be required to provide appropriate sight distances at the corner.

Figure 3-1
Corner Right-of-Way Triangle
Section 4 - Collector Street Planning

Collector streets are the backbone of effective access management. These streets, both those classified as collector streets and those within or adjacent to developments that serve in this capacity, allow many developments to be efficiently served from a limited number of connections to the major (arterial) street system.

4.1. Planning Requirements

The following requirements shall be applied in the development of the collector street system.

4.1.A. Prior to the approval of any new development, the City shall develop a conceptual collector street system for the area bounded by the section line roads containing the development based on zoned and master planned land uses within the area. Consideration must also be given to existing or planned connections and collector streets in adjacent sections, existing property lines and topographic features.

4.1.B. The proposed development plan may propose an alternative collector street system as long as the principles described above are followed. The alternative collector street system must be approved along with the development plan. Within exclusively residential areas, continuous collector streets are desirable, but not essential. In these areas, a less defined collector system may be utilized, but should provide connectivity between developments and relatively direct access to the designated collector street connections to the arterial street system (note that access at other connections to the arterial street system may be restricted per this policy).

4.1.C. Collector streets shall be public streets.

4.1.D. A collector street may serve both residential and commercial development, but should be planned to discourage use by commercial traffic into residential areas.

4.1.E. Collector streets should connect to arterial streets at full median opening locations in accordance with the standards in this policy. Where feasible, the connection should also be made at a location suitable for a traffic signal installation.

4.2. Example

An example of a collector street network is shown on Figure 4-1. Note that in order to maintain good connection spacing on the arterial roadways, commercial development areas should be at least 1/4 mile by 1/4 mile in size, larger where adjacent to major arterial streets.
Figure 4-1
Collector Street Planning Example
Section 5 - Review/Exceptions Process

Flexibility is essential when administering access spacing requirements to balance access management objectives with the needs and constraints of a development site. The following administrative procedures are intended to provide flexibility, while maintaining a fair, equitable and consistent process for access management decisions. The exception/waiver process described below applies to all of the standards in this policy.

5.1. Approval Required

5.1.A. No person shall construct or modify any access connection to a Lee’s Summit street without approval from the City. Approval is typically granted through the preliminary and final development plan processes and/or engineering approval of construction plans for streets. All requests for connections to a roadway within the City shall be reviewed for conformance with this Access Management Code.

5.1.B. Access connections that do not conform to this policy and were constructed before the effective date of this policy shall be considered legal nonconforming connections and may continue until a change in use occurs as provided in Section 8. Temporary access connections are legal nonconforming connections until such time as the temporary condition expires.

5.1.C. Any access connection constructed without approval after the adoption of this policy shall be considered an illegal nonconforming connection and shall be issued a violation notice and may be closed or removed.

5.2. Requests for Modification

5.2.A. Access connections deemed in conformance with this policy may be authorized by the City Engineer (or designee). Any requests for modification shall require approval by the City Engineer (or designee). Any appeal of the decision of the City Engineer (or designee) shall be to the city council which has final authority.

5.2.B. Modifications of greater than 10 percent of the allowable spacing standard or 100 feet, whichever is less, shall require documentation justifying the need for the modification and an access management plan for the site that includes site frontage plus the distance of connection spacing standards from either side of the property lines. The analysis shall address existing and future access for study area properties, evaluate impacts of the proposed plan versus impacts of adherence to standards, and include improvements and recommendations necessary to implement the proposed plan.

5.3. Waiver for Nonconforming Situations

Where the existing configuration of properties and driveways in the vicinity of the subject site precludes spacing of an access point in accordance with the spacing standards of this policy, the City Engineer (or designee), in consultation with appropriate City departments, shall be authorized to waive the spacing requirement if all of the following conditions have been met:

5.3.A. No other reasonable access to the property is available.

5.3.B. The connection does not create a potential safety or operational problem as determined by the City Engineer (or designee) based on a review of a transportation impact study prepared by the applicant’s professional engineer.
5.3.C. The access connection along the property line farthest from the intersection may be allowed. The construction of a median may be required on the street to restrict movements to right-in/right-out and only one drive shall be permitted along the roadway having the higher functional classification.

5.3.D. Joint access shall be considered with the property adjacent to the farthest property line. In these cases:
- A joint-use driveway with cross-access easements will be established to serve two abutting building sites,
- The building site is designed to provide cross access and unified circulation with abutting sites; and
- The property owner agrees to close any pre-existing curb cuts after the construction of both sides of the joint use driveway.

5.4. Temporary Access

A development that cannot meet the connection spacing standards of this policy and has no reasonable alternative means of access to the public road system may be allowed a temporary connection. When adjoining parcels develop which can provide joint or cross access, permission for the temporary connection shall be rescinded and the property owner must remove the temporary access and apply for another connection.

Conditions shall be included in the approval of a temporary connection including, but not limited to the following:
- Applicants must sign an agreement to participate in any future project to consolidate access points.
- Applicants must sign an agreement to abandon the interim or temporary access when adequate alternative access becomes available.
- The transportation impact study should consider both the temporary and final access/circulation plan.

A limit may be placed on the development intensity of small corner properties with inadequate corner clearance, until alternative access becomes available.
Section 6 - Access Management and Subdivision Practices

The design of property access is established when land is subdivided for commercial or residential development. Therefore, all new lot splits and commercial and residential plats will be reviewed to assure that property access is designed in accordance with the access management guidelines of this policy. The following standards shall also apply.

6.1. Creation of New Lots

New lots shall not be created on any arterial or collector roadway unless they comply with the access spacing standards of this plan through existing, shared, or alternative access.

6.2. Subdivision Access

6.2.A. When a subdivision is proposed that would abut or contain an arterial or industrial/commercial collector street, it shall be designed to provide lots abutting the classified roadway with access from an interior local street. On arterial streets, appropriate measures may be required to buffer residential properties from the noise and traffic of the through street.

6.2.B. Direct residential driveway access to individual one-family and two-family dwellings should be avoided from any arterial or industrial/commercial collector street.

6.2.C. Residential corner lots shall obtain access from the street with the lowest functional classification, and access shall be placed as far from the intersection as possible to achieve the maximum available corner clearance.

6.2.D. Access locations to subdivisions shall provide appropriate sight distance, driveway spacing, and include a review of related considerations.

6.3. Connectivity of Supporting Streets

As the City of Lee’s Summit continues to grow and land is subdivided for development, it will be essential to provide for a balanced network of local and collector streets to avoid traffic congestion on major arterial roadways. Without a supporting street system, all local trips are forced onto a few major streets resulting in significant traffic delays and driver frustration. Reasonable connectivity of the local street network is also important. Fragmented street systems impede emergency access and increase the number and length of individual trips. Residential street systems should be designed in a manner that discourages through traffic, without eliminating connectivity.

To accomplish these objectives, the following standards shall apply:

6.3.A. New residential subdivisions shall be designed to coordinate with existing, proposed and anticipated streets.

6.3.B. All new developments shall be designed to discourage the use of local and residential collector streets by non-local traffic while maintaining the overall connectivity with the surrounding system of roadways. This may be accomplished through the use of modified grid systems, T-intersections, roadway jogs, or other appropriate traffic calming or street design measures within the development.

6.3.C. Proposed streets should be extended to the boundary lines of the proposed development where such an extension would connect with streets in another existing, platted or planned development. The extension or connection should be based upon traffic circulation or public safety issues and compatibility of adjacent land uses.
6.3.D. When a proposed development abuts unplatted land or a future development phase of the same development, stub streets should be provided to provide access to abutting properties or to logically extend the street system into the surrounding areas. All street stubs serving more or other than two residential units should be provided with a temporary turn-around or cul-de-sac, and the restoration and extension of the street would be the responsibility of any future developer of the abutting land.
Section 7 - Unified Access and Circulation

Internal connections between neighboring properties and shared driveways allow vehicles to circulate from one business or development to the next without having to reenter a major roadway. Unified access and circulation improves the overall ease of access to development and reduces the need for individual driveways. The purpose of this section is to accomplish unified access and circulation systems for commercial development.

7.1. Outparcels and Shopping Center Access

Outparcels are lots on the perimeter of a larger parcel that break its frontage along a roadway. They are often created along arterial street frontage of shopping center sites, and leased or sold separately to businesses that desire the visibility of major street locations. Outparcel access policies foster unified access and circulation systems that serve outparcels as well as interior development, thereby reducing the need for driveways on an arterial street.

In the interest of promoting unified access and circulation systems, development sites under the same ownership or consolidated for the purposes of development and comprised of more than one building site shall prepare a unified access and circulation plan. In addition, the following shall apply:

7.1.A. The number of connections shall be the minimum number necessary to provide reasonable access to the overall development site and not the maximum available for that frontage under the connection spacing requirements in this policy.

7.1.B. Access to outparcels shall be internalized using the shared circulation system of the principal development.

7.1.C. All necessary easements and agreements shall be recorded in an instrument that runs with the deed to the property.

7.1.D. Unified access for abutting properties under different ownership and not part of an overall development plan shall be addressed through the Joint and Cross Access provisions below.

7.2. Joint and Cross Access

Joint and cross access policies promote connections between major developments, as well as between smaller businesses along a corridor. These policies help to achieve unified access and circulation systems for individual developments under separate ownership that could not otherwise meet access spacing standards or that would benefit from interconnection, i.e., adjacent shopping centers or office parks that abut shopping centers and restaurants.

7.2.A. Adjacent commercial or office properties and major traffic generators, e.g. shopping plazas, shall provide a cross-access drive and pedestrian access way to allow circulation between adjacent properties. This requirement shall also apply to a building site that abuts an existing developed property unless the City Engineer (or designee) finds that this would be impractical.

7.2.B. To promote efficient circulation between smaller development sites, the City Engineer (or designee) may require dedication of a 30-foot easement that extends to the edges of the property
lines of the development site under consideration to provide for the development of a service road system. The service road shall be of sufficient width to accommodate two-way travel aisles and incorporate stub-outs and other design features that make it visually obvious that abutting properties may be tied in to it. Abutting properties shall be required to continue the service road as they develop or redevelop in accordance with the requirements of this policy. The easement may be provided to the front or rear of the site or across the site where it connects to a public roadway.

7.2.C. Property owners shall record all necessary easements and agreements, including an easement allowing cross access to and from the adjacent properties, an agreement to close driveways provided for access in the interim after construction of the joint use driveway(s) or service road system, and a joint maintenance agreement defining maintenance responsibilities of property owners that share the joint-use driveway and cross-access system.

7.2.D. Joint and cross access requirements may be waived by the City Engineer (or designee) for special circumstances such as incompatible uses, e.g. a gas station next to a child care center, or major physical constraints, e.g. change in grade between properties makes connection impractical.
Section 8 - Redevelopment

Access management policies are not retroactive. Existing nonconforming properties may continue in the same manner as they existed before this policy was adopted. This allowance, commonly known as “grandfathering”, protects the substantial investment of property owners and recognizes the expense of bringing nonconforming properties into conformance.

Yet nonconforming access situations may pose safety dilemmas, contribute to traffic congestion, deter economic development, or undermine community character. To address the public interest in these matters, without posing an undue burden on property owners, access to nonconforming properties is best addressed when a change in use occurs so applicants can finance access improvements as part of the overall property improvement. In some instances, opportunities to improve the location or design of property access can also occur during the roadway improvement process. This plan includes the following conditions or circumstances where property owners or permittees may be required to relocate or reconstruct nonconforming access features and/or pursue alternative access measures.

8.1. Requirements

Properties with nonconforming access connections shall be allowed to continue, but must be brought into compliance with this Access Management Code to the maximum extent possible when modifications to the roadway are made or when a change in use results in one or more of the following conditions:

8.1.A. When a new connection is requested or required.

8.1.B. When a preliminary and/or final development plan is required.

8.1.C. When a site experiences an increase of ten percent (10%) or greater in peak hour trips or 100 vehicles per hour in the peak hour, whichever is less, as determined by one of the following methods:

8.1.C.1.a. An estimation based on the ITE Trip Generation manual (latest edition) for typical land uses, or

8.1.C.1.b. Traffic counts made at similar traffic generators in the metropolitan area, or

8.1.C.1.c. Actual traffic monitoring conducted during the peak hour of the adjacent roadway traffic for the property.

8.1.D. If the principal activity on a property is discontinued for a period of one year or more, or construction has not been initiated for a previously approved development plan within a period of one year from the date of approval, then that property must thereafter be brought into conformance with all applicable access management requirements of this policy, unless otherwise exempted by the permitting authority. This shall include the need to update any previously approved transportation impact study where new traffic projections are available. For uses or approved plats in existence upon adoption of this policy, the one-year period for the purposes of this section begins upon the effective date of these requirements.

8.1.E. Access to all change-in-use activities shall be approved by the City Engineer (or designee). All relevant requirements of this policy shall apply.
Section 9 - Transportation Impact Study Requirements

9.1. Background and Purpose

Land use and transportation are strongly interdependent. Transportation facilities and services are essential for development to occur, and high levels of mobility and accessibility are needed to attract the economic development to provide and maintain a high quality of life.

The primary purpose for evaluating the impact of development through transportation impact studies is to protect the integrity of the transportation systems. Neither public nor private interests are well served if transportation systems needlessly degrade due to poor planning and design.

In order to accomplish this objective, the review of transportation systems associated with development needs to be extensively scrutinized and needs to take a long-term perspective. What might be acceptable today may not be as an area develops and matures. This is certainly consistent with the City’s long-range planning for land use, major streets and other infrastructure.

These transportation impact study guidelines, and the resulting work products, will allow for more informed decision-making and could lead to a framework for the negotiation of mitigation measures for the impacts created by development.

9.2. Extent of Study Required

The necessity to review all land development applications from a transportation perspective as well as the wide variety of land use types and intensities suggest that multiple thresholds or triggers be established to warrant a transportation impact study. The following guidelines will be followed.

9.2.A. All Applications

9.2.A.1. Identify the specific development plan under study and any existing development on and/or approved plans for the site (land use types and intensities and the arrangement of buildings, parking and access). Also identify land uses (including types and the arrangement of buildings, parking and access) on property abutting the proposed development site, including property across public streets.

9.2.A.2. Identify the land uses shown in the Lee’s Summit Comprehensive Plan for the proposed development site under study, as well as the ultimate arterial and collector street network in the vicinity of the site.

9.2.A.3. Identify the functional classification of the public street(s) bordering the site and those streets on which access for the development is proposed.

9.2.A.4. Identify allowable access to the development site as defined by City design criteria and/or access management guidelines.

9.2.A.5. Document current public street characteristics adjacent to the site, including the nearest arterial and collector streets (number and types of lanes, speed limits or 85th percentile speeds, and sight distances along the public street(s) from proposed access).
9.2.A.6. Compare proposed access with established design criteria (driveway spacing, alignment with other streets and driveways, width of driveway, and minimum sight distances). Identify influences or impacts of proposed access to existing access for other properties. If appropriate, assess the feasibility of access connections to abutting properties, including shared access with the public street system.

9.2.A.7. Estimate the number of trips generated by existing and proposed development on the site for a typical weekday, weekday commuter peak hours (commonly referred to as A.M. and P.M. peak hours), and other peak hour(s). Calculate the net difference in trips between existing and proposed uses. If the development site already has an approved plan, also estimate the number of trips that would be generated by the approved land uses. If the development application is proposing a land use different than indicated in the Comprehensive Plan, also estimate the number of trips that would be generated by the land use indicated in the Comprehensive Plan. The Director of Planning & Development shall approve the potential land use intensity in such cases.

9.2.B. Development or Site Plan Generates 100 to 499 Trips in a Peak Hour
A transportation impact study will be required. The study area may tend to be confined to the street or streets on which access is proposed but should be extended to at least the first major intersection in each direction.

9.2.C. Development or Site Plan Generates 500 or More Trips in a Peak Hour
A transportation impact study will be required. The study area will include the street or streets on which access is proposed to at least the first major intersection in each direction but may also extend beyond the first major intersection and/or include other streets.

9.2.D. Proposed Land Use Modifies the Comprehensive Plan
Determine the extent of a transportation impact study based on anticipated trip generation. Conduct comparative analyses using the proposed land use and the land use identified in the comprehensive plan.

Table 9-1 lists several land use types and the approximate amount of development that would generate 100 or 500 trips in a typical weekday peak hour.
Table 9-1
Typical Development Size Thresholds

<table>
<thead>
<tr>
<th>ITE Code</th>
<th>Land Use</th>
<th>Units</th>
<th>Size to Generate 100 Trips</th>
<th>Size to Generate 500 Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Light Industry</td>
<td>Sq. Ft.</td>
<td>185,000</td>
<td>460,000</td>
</tr>
<tr>
<td>130</td>
<td>Industrial Park</td>
<td>Sq. Ft.</td>
<td>75,000</td>
<td>600,000</td>
</tr>
<tr>
<td>140</td>
<td>Manufacturing</td>
<td>Sq. Ft.</td>
<td>145,000</td>
<td>640,000</td>
</tr>
<tr>
<td>150</td>
<td>Warehouse</td>
<td>Sq. Ft.</td>
<td>120,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>210</td>
<td>Single Family</td>
<td>Units</td>
<td>90</td>
<td>550</td>
</tr>
<tr>
<td>220</td>
<td>Apartments</td>
<td>Units</td>
<td>150</td>
<td>n/a</td>
</tr>
<tr>
<td>310</td>
<td>Hotel</td>
<td>Units</td>
<td>170</td>
<td>n/a</td>
</tr>
<tr>
<td>565</td>
<td>Daycare</td>
<td>Sq. Ft.</td>
<td>8,000</td>
<td>n/a</td>
</tr>
<tr>
<td>710</td>
<td>Office (5th ed.)</td>
<td>Sq. Ft.</td>
<td>45,000</td>
<td>375,000</td>
</tr>
<tr>
<td>715</td>
<td>Single Tenant Office</td>
<td>Sq. Ft.</td>
<td>45,000</td>
<td>290,000</td>
</tr>
<tr>
<td>720</td>
<td>Medical Office</td>
<td>Sq. Ft.</td>
<td>30,000</td>
<td>n/a</td>
</tr>
<tr>
<td>812</td>
<td>Bldg Materials</td>
<td>Sq. Ft.</td>
<td>20,000</td>
<td>n/a</td>
</tr>
<tr>
<td>813</td>
<td>Discount Superstore</td>
<td>Sq. Ft.</td>
<td>all</td>
<td>130</td>
</tr>
<tr>
<td>816</td>
<td>Hardware Store</td>
<td>Sq. Ft.</td>
<td>16,000</td>
<td>n/a</td>
</tr>
<tr>
<td>820</td>
<td>Shopping Center</td>
<td>Sq. Ft.</td>
<td>6,000</td>
<td>70,000</td>
</tr>
<tr>
<td>831</td>
<td>Quality Restaurant</td>
<td>Sq. Ft.</td>
<td>15,000</td>
<td>n/a</td>
</tr>
<tr>
<td>832</td>
<td>Sit Down Rest.</td>
<td>Sq. Ft.</td>
<td>1,700</td>
<td>n/a</td>
</tr>
<tr>
<td>834</td>
<td>Fast Food w/DT</td>
<td>Sq. Ft.</td>
<td>5</td>
<td>n/a</td>
</tr>
<tr>
<td>843</td>
<td>Auto Parts</td>
<td>Sq. Ft.</td>
<td>12,000</td>
<td>n/a</td>
</tr>
<tr>
<td>845</td>
<td>Gas Sta. w/Conv. Store</td>
<td>Sq. Ft.</td>
<td>2,200</td>
<td>11,000</td>
</tr>
<tr>
<td>853</td>
<td>Conv. Store w/Gas</td>
<td>Sq. Ft.</td>
<td>13,500</td>
<td>n/a</td>
</tr>
<tr>
<td>853</td>
<td>Conv. Store w/Gas Pumps</td>
<td>Sq. Ft.</td>
<td>8,700</td>
<td>n/a</td>
</tr>
<tr>
<td>881</td>
<td>Pharmacy w/DT</td>
<td>Sq. Ft.</td>
<td>1,900</td>
<td>n/a</td>
</tr>
<tr>
<td>912</td>
<td>Bank w/DT</td>
<td>Sq. Ft.</td>
<td>1,000</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Institute of Transportation Engineers (ITE) Trip Generation, 7th Edition

9.3. Qualifications to Conduct and Review a Study

The parties involved in a land development application sometimes have different objectives and perspectives. Further, the recommended elements of a transportation impact study require skills found only in a trained professional engineer with specific experience in the field of traffic engineering.

For these reasons, the person conducting and the person reviewing the study must be registered professional engineers licensed in the State of Missouri with at least five years of demonstrated experience either in the preparation or review of transportation impact studies for land development.

The City Engineer (or designee) shall determine whether an individual professional engineer is qualified to conduct a transportation impact study. Credentials shall be provided upon request.

9.4. Review and Use of a Study
A transportation impact study should be viewed as a technical assessment of existing and projected transportation conditions. The extent to which individual professional judgment has to be applied will be minimized by provision of community policies and practices with respect to street and traffic control design and land development.

Ultimately, a transportation impact study will be used by professional staff to make recommendations to the planning commission and governing body. Transportation is one element amongst many that must be considered.

City personnel charged with reviewing transportation impact studies have several functions to consider:

9.4.A. Determine whether the impacts of development have been adequately assessed.

9.4.B. Ensure that proposed access is properly coordinated with existing and planned facilities, fits into the ultimate configuration of the street system, and is appropriately designed at its connection to the public street system.

9.4.C. Determine whether proposed improvements for the public street system are sufficient to mitigate the impacts created, and that the improvements meet local requirements.

9.4.D. Ensure that the development plan considers the needs of pedestrians, bicyclists, and transit users.

9.4.E. Determine whether the development layout can accommodate all anticipated vehicle types.

9.4.F. Invite other responsible and applicable transportation agencies or entities, e.g., Missouri Department of Transportation, to participate in the study and review processes.

9.4.G. Provide consistent, fair, and legally defensible reviews.

9.5. Standard Transportation Impact Study Procedures

9.5.A. Study Methodology Determination
Prior to conducting any transportation impact study it is necessary to determine the minimum technical responsibilities and analyses that will be performed. It is the applicant’s responsibility to ensure that the study utilize the techniques and practices accepted by the City and other participating agencies.

The following items shall be considered, discussed and agreed to by the City Engineer (or designee) and the applicant for transportation impact studies.

- Definition of the proposed development, including type and intensity of the proposed land uses and proposed access.
- Study area limits based on the magnitude of the development.
- Impact or influence on access for adjacent and nearby properties.
- Time periods to be analyzed, e.g., weekday A.M. and P.M. peak hours.
- Scenarios or conditions to be analyzed, e.g. existing conditions, existing plus approved/unbuilt, existing plus approved/unbuilt plus development conditions, and future conditions (consistent with horizon year in City traffic model).
• Future analysis year(s), including special study procedures for multi-phase development plans.
• General assumptions for trip generation, trip distribution, mode split, and traffic assignment.
• Traffic analysis tools and acceptable parameters.
• Availability and applicability of known data.
• Traffic data collection requirements and responsibilities, including time periods in which traffic counts will be collected.
• Transportation system data, e.g. traffic signals, transit stops, etc.
• Planned transportation system improvements, including the anticipated timing, for all modes of transportation, e.g. street widening, bicycle trails, transit stops, etc.
• Methodology for projecting future traffic volumes.
• Current level of service and access management requirements.
• Acceptable mitigation strategies.

9.5.B. Study Area
The study area and the intersections and street segments to be included will vary for a number of reasons - the type and intensity of the development, the maturity of other development in the vicinity, the condition of the street network, etc. The study area should be large enough to assess the impact or influence of proposed access along street segments and to evaluate the ability of streets and intersections to absorb the additional traffic.

The study area should at least include those street segments onto which access is proposed and should typically extend to the next major intersection (arterial/arterial, arterial/collector, or collector/collector) in each direction.

9.5.C. Analysis Periods
Transportation impact studies should be based on peak-hour analyses. The analysis period(s) should be based on the peaking characteristics of both the public transportation systems and development traffic. The typical analysis periods for most development are the weekday A.M. and P.M. peak hours, often coincidental with peak commuter activity. Retail development that is typically not open early in the morning may not warrant study for the A.M. peak hour. On the other hand, intense retail activity in an area may warrant study during the Saturday peak hour. Some development generates its highest traffic volumes outside these time periods and may require study to ascertain the impact of its peak traffic activity.

9.5.D. Analysis Years
In general, the analysis years should be the current period and the horizon year in the City’s traffic model.

9.5.E. Method of Determining Future Traffic Volumes
Future traffic volumes on arterial and collector streets shall be identified from the traffic model used to develop the long-range transportation plan for each arterial and collector street segment in the study area.

9.6. Analysis of Existing Conditions
Once the parameters for the transportation impact study have been established, the first step in the study process is to collect relevant data and assess existing conditions. Actually, two baseline conditions will be studied - one called “Existing Conditions” that is based on conditions in the study area at the time of the study and another called “Existing Plus Approved/Unbuilt
Conditions” that is comprised of existing conditions plus traffic forecasts linked to development projects in the vicinity that have been approved but not yet built.

9.6.A. Data Collection
The applicant is responsible for collecting, assembling, analysis and presentation of all data. Typically, the following types of data are required for the study area.

9.6.A.1. Proposed Site Development Characteristics
Identify the specific development plan under study and any existing development on and/or approved plans for the site. This includes land use types and intensities and the arrangement of buildings, parking and access. Also identify land uses (including types and the arrangement of buildings, parking and access) on property abutting the proposed development site, including property across public streets.

Information for the proposed development shall be displayed on a scaled drawing. If detailed information regarding abutting property is not shown on the development plan, it may be exhibited on a current aerial photograph, or other drawing, along with the proposed development.

This information is needed to assess the proposed access in relation to existing driveways and side streets at the site and along the street corridors on which access is proposed. This process should also take into account potential access for undeveloped land in the vicinity.

9.6.A.2. Transportation System Data
This includes the physical and functional characteristics of the transportation systems in the study area. Data to be collected includes:

- The functional classification and jurisdiction responsible for each street.
- The number and types of lanes for all intersections and street segments.
- Traffic control devices such as traffic signals (including left-turn control type(s) and phasing), other intersection control, and speed limits.
- Transit, bicycle, and pedestrian routes and facilities.
- Available sight distances to/from each proposed point of access.
- Planned streets not yet built.
- Planned improvements for each street and/or intersection (either programmed for construction or included in the long-range transportation plan).

9.6.A.3. Transportation Demand Data
This includes current traffic volumes (intersection turning movement counts), percent trucks, peak hour factors, transit patronage, bicycle usage, and pedestrian usage. For some studies, additional data such as right-turn-on-red usage, traffic distribution by lane, or other similar data may be required.

Intersection turning movement counts shall be taken on a typical Tuesday, Wednesday, and/or Thursday for weekday conditions. It is preferred that morning and afternoon counts be taken on the same day. For a study requiring traffic counts at several intersections that cannot be accomplished all in one day, the counting program should be organized so that adjacent intersections are counted as close in time as possible. As a minimum, traffic volumes should be measured at any existing site driveway and on the adjacent streets, including the nearest arterial/arterial or arterial/collector intersection in each direction along
streets bordering the development site. If a proposed driveway or street will line up with an existing driveway or street opposite it, traffic volumes shall be collected at the existing intersection. The time periods in which existing traffic is counted should generally coincide with the highest combination of existing traffic plus traffic expected to be generated by the proposed development. A minimum of one hour is required but the count periods should extend at least 15 minutes before and at least 15 minutes beyond the anticipated peak hour to ensure that the highest one hour of traffic is identified. Traffic volume counts at intersections shall document left-turn, through and right-turn movements on all approaches and shall be tabulated in no greater than 15-minute increments. The City Engineer (or designee) shall determine, based on the nature of the development, additional time periods in which current traffic volumes shall be documented.

9.6.A.4. Traffic Forecasts for Approved/Unbuilt Development
The City Engineer (or designee) will determine which approved but unbuilt development influences the study area and will provide the traffic forecasts from those developments for each intersection and street segment in the study area.

9.6.A.5. Land Use Data
Identify the land use(s) shown in the Lee’s Summit Comprehensive Plan for the proposed development site under study.

9.6.B. Operational Analysis
Capacity analyses shall be performed for each intersection in the study area. All capacity analyses shall be performed using a method or software approved by the City Engineer (or designee). In general, capacity analyses must be based on methodologies outlined in the latest edition of the Highway Capacity Manual (HCM). Planning level methods of analysis will not be accepted.

While other types of capacity analyses may be required for some transportation impact studies, most will include only signalized and unsignalized intersections.

9.6.B.1. Signalized Intersections
9.6.B.1.a. Analysis programs require input of intersection-specific information such as traffic volumes, number and types of lanes, signal phasing, etc., but also include a number of parameters reflecting traffic characteristics and signal operations that typically have preset default values. Care must be exercised to ensure that these parameters provide a true reflection of actual traffic operations and are based on normal practices of the City.

9.6.B.1.b. Cycle lengths used in these analyses must be reasonable based on the signal phasing and traffic demand at the intersection. For example, an arterial/arterial intersection with 8-phase control and protected-only left-turn phasing would likely use a cycle length of at least 100 seconds but possibly as high as 120 to 140 seconds. The cycle length to be used for the analyses shall be based on either existing operations or a cycle length optimization available with most capacity analysis software. Likewise, the green time (or cycle split) allocated to each phase must provide an accurate reflection of existing conditions. For isolated intersections, it is preferred that green times be determined through an optimization program in order to show how well the intersection could operate. For signalized intersections in coordination, actual timings should be used. Other means of developing green times shall be reviewed in advance with the City Engineer (or designee).
9.6.B.1.c. Other considerations in most analyses include the peak hour factor (PHF), percent trucks, clearance intervals, and the queuing model. The PHF should reflect the actual counts taken at the intersection. Some percentage of trucks should be input - either the amount measured or an estimate agreed to with the City Engineer (or designee). Clearance intervals shall be calculated based on practices recommended by the Institute of Transportation Engineers (ITE). These practices will typically yield clearance intervals (yellow plus all red) in the range of 5 to 6 seconds. The type of queue model used should be applicable to the conditions and queue estimate should provide at least a 90 percent confidence level of the maximum anticipated queue.

9.6.B.1.d. On occasion, the lane utilization factor may need to be adjusted. Under some circumstances, near an interchange for example, the lane utilization may be imbalanced to such an extent that default values would not provide a likely representation of actual conditions.

9.6.B.1.e. The most important outputs of these analyses are the overall intersection level of service and the anticipated vehicle queuing in each lane.

9.6.B.1.f. Under some circumstances, traffic simulation modeling may be necessary or more appropriate to assess a street corridor. Closely-spaced traffic signals or corridors that employ traffic signal coordination are good candidates for simulation modeling. Any such model, however, must produce outputs comparable to HCM methodologies in order to estimate levels of service.

9.6.B.2. Unsignalized Intersections

9.6.B.2.a. The analysis on an unsignalized intersection is actually an analysis of only those movements that must yield to another movement. For example, at a two-way stop controlled intersection, the through and right-turn movements on the uncontrolled street are allowed free flow and are not subject to any delay.

9.6.B.2.b. Analysis results shall never be expressed as an overall intersection level of service; the term is meaningless.

9.6.B.2.c. The most important outputs of these analyses are the levels of service by lane or lane group and the anticipated vehicle queuing in each lane.

9.6.B.3. Acceptable Levels of Service

(Refer to Resolution Number 2004-15)

9.6.B.4. Vehicle Queuing Considerations

At signalized intersections, vehicle queues should be contained within turn lanes and should not extend into adjacent intersections. Vehicle queues in through lanes may influence the ability to access turn lanes and should be considered in assessing traffic operations.

At unsignalized intersections, vehicle queues should be contained within turn lanes. In the case of a side street or driveway serving a development site, vehicle queues should not impede site circulation, particularly inbound movements from public streets.

9.6.C. Background Traffic Growth

Background traffic is the expected increase in traffic volumes over time except for the specific development under study. Background traffic needs to be estimated out to the applicable horizon year in order to assess future traffic conditions. The Lee’s Summit traffic model shall be used to estimate background traffic growth in the following manner.
The model will need to be run four times to identify turning movement data for:

- Base Year Traffic Volumes;
- Base Year Select Zone Traffic Volumes;
- Future Year Traffic Volumes; and
- Future Year Select Zone Traffic Volumes.

Both the base year and future year models will need to be run two times. The first run will save the traffic volumes at the study intersections, as well as the select zone matrix for the TAZ’s in which the development is being evaluated (the TAZ’s under consideration will be identified by the City Engineer (or designee) prior to the study). The model will need to be re-run using an all-or-nothing assignment of the select zone matrix based on the adjusted travel times for the previous runs. Details of this procedure are included in the model guideline documentation.

The City Engineer (or designee) will provide instructions on the acceptable procedure for determining background traffic growth and future traffic volumes. Said procedure may be updated or revised from time to time.

9.6.D. Trip Generation

Trip generation is the process used to estimate the amount of travel associated with a specific land use or development. Trip generation is estimated through the use of “trip rates” that are based on some measure of the intensity of development, such as gross leasable area (GLA).

Trip Generation, published by ITE, is the most comprehensive collection of trip generation available. The rates provided are based on nationwide data but many rates are not supported with a large amount of data. Nevertheless, this manual is generally accepted as the industry standard and the latest edition shall be used for studies in the City of Lee’s Summit. Caution needs to be applied when limited data points exist for a land use category. Local trip generation characteristics may be used if deemed to be properly collected and are consistent with the subject development application. The City Engineer (or designee) shall make this determination.

In making the estimate of trips, the instructions and recommendations included in Trip Generation shall be followed. Typically, the trip generation equations, where available, provide the best estimates. Where data is provided for multiple independent variables, the one yielding the highest number of trips and is based on at least 10 samples (studies) shall be used.

Trip generation shall be estimated for the proposed development for daily, A.M. peak hour, and P.M. peak hour conditions. Other time periods may be necessary based on the land use and/or the inclusion of additional analysis periods in a particular study.

If the development site already has an approved plan, also estimate the number of trips that would be generated by the approved land uses. If the development application is proposing a land use that requires an amendment to the comprehensive plan, also estimate the number of trips that would be generated by the land use indicated in the Comprehensive Plan. The Director of Planning & Development shall approve the potential land use intensity in such cases for the purpose of estimating vehicle trips.

If internal capture rates and/or pass-by and diverted trips are used by the applicant, the applicable rates must be justified and approved by the City Engineer (or designee) prior to use. In general,
the number of pass-by trips should not exceed 10 percent of the adjacent street traffic during a peak hour or 25 percent of the development’s external trip generating potential.

9.6.E. Trip Distribution

Trip distribution is the general direction of approach and departure to/from a development site. Trip distribution will typically be estimated using existing travel patterns exhibited in the area, the position of the development in the community, and the likely market area of the development. Data from similar development in the immediate vicinity could be useful as well. Good judgment is necessary to develop reasonable estimates of trip distribution.

9.6.F. Mode Split

Mode split is the estimate of number of travelers anticipated to use transportation modes other than automobiles. Data associated with most transportation impact studies is taken from suburban locations where there is little to no alternative to automobile transportation. Further, the trip generation rates are based on the actual number of vehicles, not persons, entering and departing a particular land use. Therefore, mode split will not be applicable to most transportation impact studies.

Mode split, or modified trip generation rates, can be applied where the influence of alternative transportation modes is clearly demonstrated and documented. Prior approval must be received from the City Engineer (or designee).

9.6.G. Trip Assignment

Trip assignment involves the determination of traffic that will use each access point and route on the street network. While it certainly uses the trip distribution estimates, it is a different process. This is also the step where trip-reduction factors such as pass-by and diverted traffic are applied.

The assignments should reflect the conditions anticipated to occur in the analysis year. Assignments are estimates of how drivers will travel and need to account for physical and operational characteristics of the roadway and the habits of typical drivers. Some of these factors might include:

- The type of traffic control device at an intersection. For example, drivers might avoid a protected left-turn movement if they can reach their destination via the through movement and the left-turn phase has expired on approach.
- The design of internal circulation systems on the development site.
- The number of opportunities to enter from the same street. Typically, most drivers will use the first opportunity to enter but exiting trips tend to be more balanced.
- The difficulty turning left onto a major street at an unsignalized intersection.
- Drivers tend to travel in the most direct path towards their destination. In other words, drivers tend to avoid backtracking unless conditions either require it or an overall gain in safety and efficiency is expected.

Since some of these factors conflict, good judgment is necessary. Further, an iterative process might be necessary based on internal circulation alternatives and/or traffic mitigation alternatives considered. For example, the initial access plan may show a full-access driveway but the mitigation may call for it to be limited to right turns in and out.
9.6.H. Existing Plus Approved/Unbuilt Plus Development Conditions Analysis

The analysis of existing plus approved/unbuilt plus development conditions is based on the combination of existing traffic, traffic estimated for approved development yet to be built, and development traffic anticipated on opening. The methods of analysis shall be the same as described in Step 2.

Two sets of conditions shall be analyzed in this step:

- Existing Plus Approved/Unbuilt Plus Development Traffic with No Improvements
- Existing Plus Approved/Unbuilt Plus Development Conditions with Improvements

In the first scenario, existing plus approved/unbuilt plus development traffic is analyzed with the current street geometry and traffic control except for the proposed access. The purpose is to demonstrate likely traffic conditions before mitigation measures are considered.

The second scenario is typically an iterative process where mitigation measures are necessary to achieve acceptable levels of service and/or to manage vehicle queuing. The final results of that process are to be documented along with the mitigation measures associated with those results. Improvements that become warranted by City design criteria or access management guidelines shall be identified and included in this process.

Mitigation measures might include:
- Additional turn lanes on the public streets and/or the site access.
- Additional through lanes on public streets.
- Revised traffic control, including new traffic signals.
- Access management strategies, e.g. build a raised median on the public street.
- Site plan or land use changes.

Mitigation measures should be logical for the conditions at a specific location, consistent with the corridor design and operations, and should contribute towards or at least be consistent with the ultimate configuration of the public street. The ramifications of mitigation measures must be clearly identified. For example, adding a second left-turn lane on one approach to an intersection will typically necessitate widening of the opposite approach.

In addition to achieving acceptable levels of service, anticipated vehicle queuing needs to be assessed to ensure that turn lanes are properly designed and that queues from one intersection do not impact operations at other intersections. This applies to the development site where access driveways connect to the public street system. In general, the site circulation layout should not create conditions where entering traffic might queue back onto the public street and/or the efficiency of exiting traffic is diminished. Further, the site plan and design should allow for all vehicle circulation to take place on-site and not on the public streets.

9.6.I. Future Conditions Analysis

The analysis of future conditions is important to further assess proposed access in relation to the configuration of the public streets at a more mature stage of development. What might be deemed acceptable today might not fit with the long-range configuration of a street corridor. It may also prove useful in determining when improvements to major streets need to be planned.
The analysis methods are outlined in Steps 2 and 8. The analyses should reflect street improvements planned to occur prior to the horizon year. Traffic associated with approved/unbuilt development is included in the background traffic growth.

9.6.J. Pedestrian, Bicyclist, Transit and Truck Considerations

While transportation impact studies primarily address automobile traffic, recognition of other vehicle types and travel modes is appropriate, particularly in a community that strives for multi-modal choice. The following text by no means represents a comprehensive list of site planning elements but each must be addressed.

9.6.J.1. Pedestrians
Sidewalks along public streets or off-street paths provide mobility for pedestrians. Pedestrians should be provided the opportunity to readily travel between these public infrastructure and adjacent land uses. All development plans should provide this connectivity.

9.6.J.2. Bicyclists
Similar to pedestrians, development sites should provide reasonable opportunities to travel between adjacent public streets or bicycle trails and the land use. This does not imply that separate facilities are needed; rather, the conditions within a development site should be comparable to conditions adjacent to and near the site. Adequate and properly placed parking facilities for bicycles are a key component to encouraging bicycle travel.

Bus transportation is currently provided by several private and publicly funded agencies, generally to targeted customers. More widespread public transit could be implemented in the future. Site development should account for both current and potential bus services. Some of these considerations are similar to trucks due to the relatively large size of buses; however, the primary difference is that buses need to circulate with customer traffic flow. Bus turnouts may be planned for specific corridors or intersections, or adjacent to major generators.

9.6.J.4. Trucks
Site driveways and internal circulation must be designed to accommodate the largest truck anticipated to serve the development. Vehicle turning paths need to be provided such that trucks do not encroach over curbs and medians. Encroachment into opposing turning lanes should be minimized but can be consistent with the scale of the development and the frequency and timing of truck movements. Truck circulation through a development site should minimize conflicts with customer traffic and loading docks should be configured such that parked trucks do not impede normal traffic flow.

9.6.K. Documentation

The transportation impact study shall be documented in a typewritten, bound report outlining the findings and conclusions of the study, including exhibits illustrating the site plan, traffic volumes (current and projected), and existing and proposed street conditions (lane configurations and intersection traffic controls). The report, or an appendix, shall include all analysis worksheets and traffic volume count spreadsheets listing data by the minimum time increment in which the
data was collected (no less than 15-minute increments). Four (4) bound copies and one PDF of the final report shall be submitted to the Planning & Development Department.

The report shall be well organized and generally follow the study process chronology. The report should be divided into sections to clearly distinguish between the site plan details, assessment of existing conditions, assessment of existing plus development conditions, and the assessment of future conditions. The concluding section of the report shall summarize the significant findings and outline the mitigations measures needed to meet accepted standards. Trip generation information, trip distribution assumptions, and analysis results should be organized in tables and page numbering should be used.

Documentation of the mitigation measures shall include a detailed description of the proposed improvements. For example, turn lanes shall include a recommended length. It is expected that sufficient due diligence has been conducted to reasonably conclude that the mitigation measures can be implemented without disruption to existing roadside facilities, other public street facilities, e.g., another turn lane, and/or existing access. If proposed access or a mitigation measure will cause such a disruption, the impact shall be clearly described.

It is not appropriate to define or suggest funding responsibilities in the study report.

Any deviation from established guidelines/policies shall be clearly identified and justification provided as to the basis for such a condition and its potential ramifications on the public street system.

All assumptions and analysis methodologies should also be identified. The final report should be complete to the extent that the reviewer could find all information necessary to understand how analyses were conducted and could even recreate those analyses and achieve the same results.

The professional engineer responsible for completing the study shall sign and seal the final report.
Section 10 - Interchange Areas

The purpose of this section is to preserve the safe and efficient operation of traffic on interchange crossroads and interchanges, while preserving the accessibility of interchange areas for economic development. Specific purposes are to ensure adequate storage and maneuver distances for drivers between the first signalized intersection and the highway ramp and to avoid access connections to interchange crossroads that would interfere with traffic operations at interchange ramps. In addition, this section seeks to promote the development of local streets and service roads for access in the functional area of interchanges as an alternative to individual driveway access.

The standards in this section apply to areas where grade-separated facilities, e.g. Interstates and other freeways, interchange with surface streets, highways, and roads. In such cases, adequate areas need to be provided for traffic to make the transition from a high-speed highway to the surface street system.

10.1. Interchange Functional Area Standards

These requirements shall be applied in the vicinity of interchanges where substantial development has not yet occurred, as determined by the City Engineer (or designee). In developed areas, these standards may be difficult to achieve, however they should be considered the desirable standard. The connection spacing standards will be the minimum standards.

10.1.A. Requirements:

10.1.A.1. In order to provide a safe distance for transitional activity to occur, the spacings identified in *Figure 10-1* shall be provided from the end of the off ramp to the first private driveway, median opening, or intersection with a public road.

10.1.A.2. The measurement basis for this standard is from the near edge of the ramp to the center of the intersection. At “diamond” type interchanges where traffic (including right turns) is controlled by a stop sign or traffic signal, the distance is measured from center to center of the intersections.

10.1.A.3. Local roads or service roads shall be used for direct access to property within interchange areas.

10.1.A.4. Where properties are under the same ownership or consolidated for the purposes of development, the local street shall be constructed by the developer. Where the street will serve properties under separate ownership, a method will be established by the City Engineer (or designee) to apportion the costs of initiating and constructing the street.
$X = 750 \text{ feet}$

$Y = 1,320 \text{ feet}$

$Z = 750 \text{ feet}$

**Figure 10-1**

Connection Spacing Near Interchanges
Section 11 - Intersection Functional Area

The functional area of an intersection consists of more than the area bounded by the stop lines or crosswalks. The functional area of the intersection also includes the area upstream of the intersection where vehicles have to react to slowing traffic in front of them, decelerate and wait in queues. The downstream functional area includes the area where through traffic merges with traffic turning from the cross street. It also includes the distance required to accelerate back to driving speeds. The intersection functional area is shown schematically in Figure 11-1.

11.1. Upstream Intersection Functional Area

The upstream intersection functional area can be determined by summing two primary components:

11.1.A. Reaction/Deceleration Time
This is the distance traveled while the driver recognizes that action is required, i.e. sees vehicles stopping ahead, reacts, i.e. presses break pedal, and decelerates i.e., slows to a stop. These values can be calculated from Table 11-1. The City Engineer (or designee) shall determine where limiting conditions can be applied.
### Table 11-1

<table>
<thead>
<tr>
<th>Speed (MPH)</th>
<th>Desirable Conditions</th>
<th>PIEV Plus Deceleration</th>
<th>Limiting Conditions</th>
<th>PIEV Plus Deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>225</td>
<td>315</td>
<td>170</td>
<td>215</td>
</tr>
<tr>
<td>35</td>
<td>295</td>
<td>370</td>
<td>220</td>
<td>270</td>
</tr>
<tr>
<td>40</td>
<td>375</td>
<td>490</td>
<td>275</td>
<td>335</td>
</tr>
<tr>
<td>45</td>
<td>465</td>
<td>595</td>
<td>340</td>
<td>405</td>
</tr>
<tr>
<td>50</td>
<td>565</td>
<td>710</td>
<td>410</td>
<td>485</td>
</tr>
<tr>
<td>55</td>
<td>675</td>
<td>835</td>
<td>485</td>
<td>565</td>
</tr>
<tr>
<td>60</td>
<td>785</td>
<td>960</td>
<td>565</td>
<td>605</td>
</tr>
</tbody>
</table>

1. *all distances rounded to 5ft*
2. 2.0 second perception-reaction time; 3.5 fps | average deceleration while moving laterally into turn lane, 6.0 fps | average deceleration thereafter; speed differential < 10 mph
3. 1.0 second perception-reaction time; 4.5 fps | average deceleration while moving laterally into turn lane, 9.0 fps | average deceleration thereafter; speed differential < 10 mph
4. distance to decelerate from through traffic speed to a stop while moving laterally into a left-turn or right-turn lane
5. distance traveled during perception-reaction time plus deceleration distance

11.1.B. Queue Storage Length

Queue lengths should be calculated based on existing (or existing plus development for new development projects) and future (horizon-year) traffic conditions. For development projects, turn lane storage improvements may be based on existing plus development conditions, however, site access and right-of-way should be planned to accommodate ultimate conditions.

Queue lengths should be calculated for left-turn, through and right-turn lanes. Queue lengths should consider 90th percentile queues and should be calculated using established procedures or software that reports 90th percentile or maximum back of queue. As traffic signals on most arterial corridors have the potential to be coordinated, it is recommended that a cycle length of at least 120 seconds be used. Analysis should conform to Highway Capacity Manual methods. In areas with closely spaced or coordinated signals, software that analyzes coordinated signal timings, e.g. TRANSYT, CORSIM, etc., may be needed to supplement the analysis. In these cases, queue lengths should be evaluated for both coordinated arrival and random vehicle arrival and the larger of the two values used, as future changes in coordination timings can significantly change queue patterns.

The City Engineer (or designee) may elect to define the upstream functional area at a value less than that calculated by the aforementioned method based on existing or anticipated conditions at an intersection.

11.2. Downstream Functional Area

The functional area of an intersection extends some distance downstream from the crosswalk location because of the need to establish guidance and tracking after having passed through the area in which there are no lane lines. This is especially true following a left turn. It can be argued that a vehicle should clear a major intersection before the driver is required to respond to vehicles entering, leaving or crossing the major roadway. The logic of this criterion is to simplify the driving task and thus minimize the chances of driver mistakes and collisions. Stopping sight distance is one criterion which would allow the driver to clear the intersection before having to
rapidly decelerate in response to a maneuver at a downstream intersection. Downstream functional areas based on AASHTO stopping sight distances are given in Table 11-2.

<table>
<thead>
<tr>
<th>Speed</th>
<th>AASHTO Stopping Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>125</td>
</tr>
<tr>
<td>25</td>
<td>150</td>
</tr>
<tr>
<td>30</td>
<td>200</td>
</tr>
<tr>
<td>35</td>
<td>250</td>
</tr>
<tr>
<td>40</td>
<td>335</td>
</tr>
<tr>
<td>45</td>
<td>400</td>
</tr>
<tr>
<td>50</td>
<td>475</td>
</tr>
<tr>
<td>55</td>
<td>550</td>
</tr>
<tr>
<td>60</td>
<td>650</td>
</tr>
</tbody>
</table>

*Source: Reference (1) Table III-1, page 120, 1990 AASHTO “Green Book” (rounded to 25 ft.)
Section 12 - Medians and Continuous Center Turn Lanes

Restrictive ("raised" or "non-traversable") medians and well designed median openings are known to be some of the most important features in a safe and efficient street system. The design and placement of these medians and openings is an integral part of the access management practice. Raised medians are important for several reasons.

- Vehicular Safety - to prevent accidents caused by crossover traffic, headlight glare distraction and traffic turning left from through lanes.
- Pedestrian Safety - to provide a refuge for pedestrians crossing the street.
- Vehicular Efficiency - to remove turning traffic from through lanes thereby maintaining/increasing operating speed. This reduces fuel consumption and emissions which is an environmental benefit.
- Improved Aesthetics - Landscaped and grass medians offer aesthetic benefits over paved turn lanes or undivided roadways.

Properly implemented median management will result in improvements to traffic operations, minimize adverse environmental impacts, and increase highway safety. As traffic flow is improved, delay is reduced as are vehicle emissions. In addition, roadway capacity and fuel economy are increased, and most importantly, accidents are less numerous and/or less severe.

Continuous two-way center turn lanes ("two-way left-turn lanes" or "TWLTL" or "traversable" medians) do not provide all of the safety benefits of restrictive medians, but do offer substantial safety improvements over roadways where no left-turn lanes are provided, particularly in areas with frequent driveways. These facilities provide more flexibility than restrictive medians and operate safely and efficiently under appropriate circumstances. However, once the driveway density, left-turning traffic volumes, and through traffic volumes reach certain levels, the safety benefits diminish rapidly. Under such conditions, restrictive medians are the more effective alternative with regard to safety and operations.

12.1. Median Standards

Restrictive medians shall prohibit vehicles from crossing the median except at designated median openings through the use of a barrier curb or wide landscaped median treatment. Restrictive medians shall be required under the following conditions:

- On all major arterial streets.
- On minor arterial and collector streets where existing daily traffic volumes are in excess of 24,000 (where traffic volumes are projected to exceed 24,000 in the future the roadway and access should be designed to accommodate the future installation of a raised median, e.g. identify potential median opening locations, use 16-foot center turn lane).
- Speeds are posted at 45 MPH or above.
- Adjacent to left-turn lanes at signalized intersections (existing or planned signal locations) where drives are present within the intersection functional area.
- Adjacent to all dual left-turn lanes.
- On multi-lane roadways (two or more through lanes in each direction) within the functional area of an interchange.
- On roadways with three or more through lanes in each direction.
12.2. Continuous Two-Way Center Turn Lanes

Continuous two-way center turn lanes shall be considered under the following conditions (except where restrictive medians are required as described above):

12.2.A. On all minor arterial and collector streets adjacent to property that is developed as or planned for commercial development or in areas where there is a need for frequent left-turn lanes.
Section 13 - Median Openings

Openings in raised medians should only be provided to accommodate turning traffic in locations where this can be safely done. Where openings are provided, an adequate spacing between them is required to allow for weaving of traffic so as to preserve traffic flow and provide for safe lane changes and turns.

A full opening allows turns to be made in both directions; a directional opening allows turns to be made in only one direction. An example of a directional median would be one that allows left turns into a driveway, but does not allow left turns to be made out.

Examples of these median opening types are shown on Figure 13-1 and Figure 13-2.

![Figure 13-1](image)
**Figure 13-1**
**Full Median Opening**

![Figure 13-2](image)
**Figure 13-2**
**Directional Median Opening**

13.1. Median Opening Standards

13.1.A. The minimum spacing standards for full median openings shall be one-quarter (1/4) mile subject to the limitations listed below.

13.1.B. No median openings shall be permitted within the functional area of an interchange.

13.1.C. Median openings shall not be permitted where an opening would be unsafe due to inadequate sight distance.

13.1.D. Full median openings must meet the requirements of both one-quarter mile spacing and the minimum connection spacing.

13.1.E. Directional median openings may be provided at any connection that meets the connection spacing requirements, and is found to be an acceptable location based on a transportation impact study.

13.1.F. Left-turn lanes shall be required at all median openings. Median openings shall not be permitted where adequate queue storage cannot be provided for the left-turn lanes.

13.2. U-Turns

As access management principles and standards are applied, the U-turn becomes an increasing important movement for accessing local streets and driveways. A standard passenger vehicle cannot make a U-turn from a left-turn lane with minimal median width, e.g. 4 feet, and only two lanes in the opposing direction. In order to accommodate U-turn movements at median openings on a four-lane roadway, there are two options - provide a wide median near the intersection (30 feet or more) or provide some sort of widening of the downstream approach near the U-turn location. Downstream widening can be accommodated by allowing vehicles to turn on the shoulder or by flaring the pavement width at the U-turn locations. Ultimately, the width between
the left edge of the left-turn lane and the right edge of the downstream travel lane needs to be at least 44 feet for a typical automobile to make a U-turn. Examples of these techniques are illustrated on Figure 13-3 and Figure 13-4.
Section 14 - Traffic Signals

This section addresses the distance between signalized at-grade intersections on public streets. Minimum spacing is mainly intended to preserve efficient traffic flow and progression on urban arterial streets; for instance, a quarter or half-mile spacing allows traffic signals to be effectively interconnected and synchronized. Effective signal coordination will also tend to reduce rear-end collisions and stop-and-go driving that increases congestion, delay, and air pollution.

14.1. Traffic Signal Standards

An intersection should meet the following requirements to be considered for installation of a traffic signal.

14.1.A. The intersection shall meet a warrant or warrants in the Manual on Uniform Traffic Control Devices (MUTCD). Installation of a traffic signal based on the peak hour or four-hour warrant will only be considered at the intersection of an arterial street with a major collector street, or at expressway or freeway ramp terminals.

14.1.B. For intersections where one or more of the roadways is a collector street, existing traffic volumes shall be utilized in evaluating the signal warrants (installation of a traffic signal based on existing plus proposed development traffic volumes may be approved based on traffic volume increases projected to occur within the next 12 months).

14.1.C. The location of the traffic signal shall be at least one-quarter mile (1/4) from another traffic signal, either existing or anticipated.

14.1.D. Traffic signal interconnect (conduit and cable) shall be installed between traffic signals within 3,000 feet of the proposed location.
Section 15 - Connection Spacing

This standard governs the minimum allowable spacing between connections (side streets and private driveways) on various classifications of streets. Access points introduce conflicts and friction into the traffic stream. Vehicles entering and leaving the main roadway often slow the through traffic, and the difference in speeds between through and turning traffic increases accident potential. As stated in the AASHTO A Policy on Geometric Design of Highways and Streets, “Driveways are, in effect, at-grade intersections. . . . The number of accidents is disproportionately higher at driveways than at other intersections; thus their design and location merit special consideration.”

The consensus is that increasing the spacing between access points improves arterial flow and safety by reducing the number of conflicts per mile, by providing greater distance to anticipate and recover from turning maneuvers, and by providing opportunities for use of turn lanes. Many studies have shown that driveway spacing is one of the key factors that influence accidents.

15.1. Connection Spacing Standards

Connections to major streets shall conform to the following requirements. All applicable criteria must be met to be deemed conforming.

15.1.A. Be outside any interchange or intersection functional areas.
15.1.B. Provide sufficient separation for provision of warranted or required right-turn lanes and left-turn lanes.
15.1.C. Be aligned with existing or planned connectors on the opposite side of the street (except where movements are limited to right turns in and right turns out).
15.1.D. If offset from connections on the opposite side of the street (where no restrictive median is in place), minimum separations (measured from centerline to centerline) include:
   15.1.D.1. Major Arterial - 660 feet
   15.1.D.2. Minor Arterial - 400 feet
   15.1.D.3. Industrial/Commercial Collector - 300 feet
   15.1.D.4. Residential Collector - 200 feet
   15.1.D.5. Left-in only movements must be controlled through the use of a restrictive median.
Section 16 - Turn Lanes

Vehicles slowing to turn right or left onto cross streets or into driveways cause disruptions to through street traffic flow and increase accidents along a corridor. Thus, the treatment of turning vehicles has an important bearing on the safety and movement along arterial roadways. It is one of the major access management concerns.

Left turns may pose problems at driveway and street intersections. They may increase conflicts, delays, and accidents and often complicate traffic signal timing. These problems are especially acute at major suburban arterial intersections where heavy left-turn movements take place, but occur also where left turns enter or leave driveways serving adjacent land development. The following illustrate these problems:

- More than two-thirds of all driveway-related accidents involve left-turning vehicles.
- Where there are more than six left turns per traffic signal cycle, virtually all through vehicles in the shared lane may be blocked by the left-turning vehicles.

16.1. Left-Turn Lane Standards

16.1.A. Left-turn lanes should be provided on all approaches to intersections controlled by, or planned to be controlled by, traffic signals.

16.1.B. Left-turn lanes should be provided on arterial streets at the intersection with other arterial and collector streets. On major arterial streets, it should be at the intersection with all connectors.

16.1.C. Left-turn lanes should be provided on connectors intersecting with arterial streets (where left-turn egress is permitted).

16.1.D. Left-turn lanes should be provided at all median openings on roadways with medians.

16.1.E. Left-turn lanes should be provided on collector streets at the intersection with a connector serving non-residential development.

16.1.F. Continuous two-way left turn lanes may be used in lieu of individual left-turn lanes where permitted.

16.1.G. Dual-left-turn lanes should be planned for all approaches of an arterial/arterial intersection.

16.1.H. The minimum length should be 250 feet plus taper on an arterial street intersecting another arterial street and 200 feet plus taper at other locations.

16.1.I. The length of the left-turn lane should be increased as necessary to accommodate estimated queue length.

16.1.J. The introductory taper should be a reverse curve using a 150-foot radius for a single left-turn lane and 300-foot radii for a dual left-turn lane. The reverse curve does not define the redirection taper where a left-turn lane is introduced.

16.2. Right-Turn Lane Standards

16.2.A. Required on arterial streets at each intersecting street or driveway. Minimum length should be 250 feet plus the taper at the intersection with another arterial street and 150 feet plus the taper at other locations.

16.2.B. Required on collector streets in non-residential areas at the intersection with any street or driveway where the right-turn volume on the collector street is or is projected to be at least 100 vehicles in any hour. The minimum length should be 100 feet plus the taper.
16.2.C. The length of the right-turn lane at intersections controlled by traffic signals should be increased, if necessary, based on the longer of the queues in the turn lane or the adjacent through lane.

16.2.D. Right-turn lane lengths cover the full-width segment between the taper and the end of the lane at an intersection with a public street or driveway. The end of the lane at the intersection should be determined as the point of curvature for the corner radius.

16.2.E. The minimum length on controlled approaches should be exceeded based on the estimated queue length determined for 20-year traffic volume projections. The turn lane length should be based on the longer of the queues in the turn lane or the adjacent through lane.

16.2.F. The introductory taper should be a straight line and its length should be determined by using a rate of 12.5 to 1 based on the width of the right-turn lane.

16.2.G. The beginning of a taper should be no closer than 100 feet from the centerline of the nearest connector preceding the turn lane.

16.2.H. Continuous right-turn lanes will not be allowed.

16.3. Variances

The standards outlined in the section may be altered or waived by the City Engineer (or designee) for a specific situation in which extraordinary conditions are encountered.
Section 17 - Sight Distance

Sight distance for driveway construction should be considered essential in the design and issuance of permits for all driveways. If there is a request to construct a driveway at a questionable location, the transportation impact study must include a field inspection to evaluate the sight distance. Sight distance is always the most important consideration in allowing, not allowing, or placing driveways. Both vertical and horizontal alignment can limit sight distance. Special consideration is required for skewed intersections.

The sight distance standards are based on criteria in the 2001 AASHTO Green Book.

17.1. Sight Distance Standards

17.1.A. Stop-Controlled Intersections

The intersection sight distance is based on a gap-acceptance concept. It is assumed that drivers on the major road should not need to reduce to less than 70 percent of the initial speed. The intersection sight distance is determined from the size of acceptable gap that a driver requires to enter the roadway.

The acceptable gaps that drivers require to enter a major roadway for left turns and right turns from the stop are given in Table 17-1. Adjustments for roadway width and approach grades are given in footnotes to the table. Sight distances for passenger cars on various width roadways are summarized on Table 17-2. The speed used to calculate the minimum sight distance shall be the design speed or the 85th percentile speed, whichever is greater.

<table>
<thead>
<tr>
<th>Table 17-1</th>
<th>Gap Time for Stop Controlled Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Vehicle</strong></td>
<td><strong>Time Gap</strong></td>
</tr>
<tr>
<td>Passenger Car</td>
<td>7.5 sec.</td>
</tr>
<tr>
<td>Single Unit Truck</td>
<td>9.5 sec.</td>
</tr>
<tr>
<td>Combination Truck</td>
<td>11.5 sec.</td>
</tr>
</tbody>
</table>

1Passenger car design vehicle is typically sufficient for streets and drives serving residential, commercial and office development. For industrial developments, or on major streets with more than 3% trucks, consider using truck categories.
2Adjustment for multilane highways:
For left turns onto two-way highways with more than two lanes, add 0.5 sec for passenger cars or 0.7 sec for trucks for each additional lane, in excess of one, to be crossed by the turning vehicle. For right turns, no adjustment is necessary.
3Adjustment for approach grades:
If the approach grade on the minor road is an upgrade that exceeds 3 percent: Add 0.1 sec per percent grade for right turns, add 0.2 sec per percent grade for left turns.
Table 17-2
Sight Distance for Stop Controlled Intersections, in Feet
Passenger Cars, Grades Less Than 4%

<table>
<thead>
<tr>
<th>Speed(^2) (MPH)</th>
<th>Lanes to Cross(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One</td>
</tr>
<tr>
<td>20</td>
<td>220</td>
</tr>
<tr>
<td>25</td>
<td>280</td>
</tr>
<tr>
<td>30</td>
<td>330</td>
</tr>
<tr>
<td>35</td>
<td>390</td>
</tr>
<tr>
<td>40</td>
<td>440</td>
</tr>
<tr>
<td>45</td>
<td>500</td>
</tr>
<tr>
<td>50</td>
<td>550</td>
</tr>
<tr>
<td>55</td>
<td>610</td>
</tr>
<tr>
<td>60</td>
<td>660</td>
</tr>
<tr>
<td>65</td>
<td>720</td>
</tr>
<tr>
<td>70</td>
<td>770</td>
</tr>
</tbody>
</table>

\(^1\)Lanes to cross for left-turning vehicles (lanes with vehicles approaching from left including left and right-turn lanes, add one lane for each 15 feet of median width not including left turn lane)

\(^2\)Greater of design speed or 85th percentile speed.

17.1.B. Traffic Signal Controlled Intersections
The intersection sight distance at signal-controlled intersections requires that the first vehicle on each approach should be visible to the drivers of the first vehicle on all other approaches. If the signal is to be placed on two-way flashing operation, the requirements for left and right turns from a stop controlled intersection must be met. If right turns on red are permitted, the departure sight triangle for right turns for stop controlled intersections should be provided.

17.1.C. All-Way Stop Controlled Intersections
The first vehicle stopped on each approach should be visible to the drivers of the first vehicles stopped on all other approaches.

17.1.D. Left Turns from a Major Road
The required intersection sight distance for left turns from the major road is the distance traveled by an approaching vehicle at the design speed of the major roadway for the distances shown in Table 17-3.
### Table 17-3
**Gap Time for Left Turns from Uncontrolled Street**

<table>
<thead>
<tr>
<th>Design Vehicle</th>
<th>Travel Time ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Car</td>
<td>5.5 sec.</td>
</tr>
<tr>
<td>Single Unit Truck</td>
<td>6.5 sec.</td>
</tr>
<tr>
<td>Combination Truck</td>
<td>7.5 sec.</td>
</tr>
</tbody>
</table>

¹Adjustment for multilane highways:
For left turns that must cross more than one opposing lane, add 0.5 sec for passenger cars and 0.7 sec for trucks for each additional lane to be crossed

Generally, no separate check for this condition is necessary where sight distance for stop intersections is available. Checks are required at three-legged intersections and at mid-block approaches or driveways. Locations on horizontal curves and with sight obstructions present in the median need to be checked as well.

#### 17.2. Exceptions to Sight Distance Requirements

Sight distance should be considered a key element in the location of all driveways with particular emphasis placed upon public street approaches, high volume commercial and industrial driveways, and all driveways on arterial streets. All driveway locations shall meet or exceed the requirements listed above.

If no location on the applicant’s frontage meets or exceeds the sight distance requirements, but a location does meet or exceed the distances shown in the *Minimum Stopping Sight Distance* column on *Table 17-4*, a driveway may be located with the City Engineer’s (or designee’s) approval, in accordance with the following criteria:

- The proposed driveway location has the maximum sight distance available on the entire property frontage.

- The classification for the street is not expressway or major arterial.

- The proposed location is not for a public street approach or a high-volume commercial driveway (more than 50 trips (in plus out) existing or projected during the peak hour).

- There is no other available access, having equal or greater sight distance.

- The Applicant will submit a letter to the City Engineer (or designee) stating the following: “Applicant is aware that the sight distance of this driveway is restricted. The sight distance is the minimum necessary for a vehicle traveling at the posted speed to come to a complete stop prior to the driveway.” The permit may also be issued with conditions limiting the number and types of vehicles using the driveway.
If these conditions are not met the permit shall not be issued for the driveway. The applicant should be advised of work that could improve sight distance for the location, such as minor grading or brush removal.

<table>
<thead>
<tr>
<th>Table 17-4</th>
<th>Minimum Stopping Sight Distance, in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed¹</td>
<td>30</td>
</tr>
<tr>
<td>Distance</td>
<td>200</td>
</tr>
</tbody>
</table>

¹Greater of design speed or 85th percentile speed.

17.3. How to Measure Sight Distance

The sight distance for the proposed driveway is measured for each direction of travel and the smaller distance is then located in the sight distance chart for the speed (greater of the design speed and 85th percentile speed) of the roadway to determine which sight distance criteria is met, if any.

To measure actual sight distance limited by vertical alignment in the field, place a sighting target 3.50 feet above the edge of pavement at a point 20 feet from the edge of the nearest travel lane (approximate location of a driver waiting to exit the driveway) at the proposed driveway location. On streets classified minor arterial and below, the target may be placed at a point 15 feet from edge of the nearest travel lane. Sighting from a height of 3.5 feet for cars (7.6 feet for trucks), move along the roadway away from the proposed driveway site to a point beyond where the target disappears. Move toward the target until it can first be seen and place a mark on the pavement. The target should remain visible as you continue toward the driveway. The line of sight should stay within the limits of the right-of-way. Measure the distance along the roadway between the mark and the target. This measured distance is the sight distance.

Sight distance should take into account both the horizontal and vertical profile of the roadway. Consideration may also be given to vegetation both on the right-of-way and adjacent to the right-of-way as it may impede vision more during certain times of the year. Where providing adequate sight distance requires visibility across private property, provisions must be made to preserve sight lines across the property.
Section 18 - Driveway/Connection Geometry

The design of driveways is important in access management in that it affects the speed of traffic turning into and out of driveways. This in turn affects the speed differential between through traffic and turning traffic where auxiliary lanes are not provided. Large speed differentials are created where driveways are inadequately designed and these higher speed differentials are associated with higher crash rates and diminished traffic operations.

Another critical aspect of the driveway or connection design is the potential for traffic operations off of the public street to become congested and spill or queue back onto the public street. The proper separation of internal conflict points from the public street is necessary to eliminate or diminish this potential.

Driveway designs should always be based on the results of a study of the traffic likely to use them.

18.1. Driveway/Connection Standards

18.1.A. Lining Up Driveways Across Roadways
Driveways shall align with driveways across the roadway on roadways without non-traversable medians or shall be offset as described in the connection spacing standards.

18.1.B. Angle of Intersection to the Public Roadway
18.1.B.1. Driveways that serve two-way traffic should have angles of intersection with the public street of 90 degrees or very near 90 degrees. The minimum acceptable angle for driveways that serve two-way traffic is 80 degrees.
18.1.B.2. Driveways that serve one-way traffic may have an acute angular placement of from 60 to 90 degrees.

18.1.C. Corner Radius
The corner radius at intersections should be large enough to allow entering vehicles to do so at a reasonable rate of speed. The Design and Construction Manual describes minimum corner radii, measured from the edge of the driving surface of the roadway. Larger approach radii are allowable for driveways, however the impact on lane definition, the view angle of right-turning traffic to see cross traffic, and the impact on pedestrian crossing times should all be considered. Corner radii of greater than 75 feet should not be used.

18.1.D. Driveway Width
Driveway widths shall be measured exclusive of any curb or curb and gutter. If monolithic curb is used, a 2-foot section measured from the back of curb shall be deemed a de facto curb and gutter section. Any medians contained in the driveway are above and beyond the minimum widths in the table. Minimum acceptable and maximum acceptable widths for various levels of traffic and directions of access are shown on Table 18-1.

18.1.D.1. All commercial and industrial driveways shall be curbed.
18.1.D.2. All parking lots and driveways leading to or connecting with parking lots shall also be curbed.
18.1.D.3. All driveways with four or more lanes shall have a raised, landscaped median at least 8 feet in width. On industrial drives with primarily heavy truck traffic, medians may
be omitted, or “rollover” or mountable type median may be used but should be constructed with a pavement surface of a contrasting color.

18.1.D.4. Single inbound or outbound lanes on driveways with a median shall be 16 to 18 feet in width.

18.1.D.5. The width of any residential driveway shall conform to the Unified Development Ordinance.

18.1.D.6. Low volume driveways may be permitted to have a width of 24 feet (back of curb to back of curb) on local roadways or in the Downtown Core provided no truck traffic will be allowed to use the driveway. In areas outside of the Downtown Core additional driveways must be provided for truck traffic.

### Table 18-1
Commercial/Industrial Driveway Widths (Back of Curb to Back of Curb)

<table>
<thead>
<tr>
<th>Driveway Traffic Category</th>
<th>Average Daily Traffic Using Driveway</th>
<th>Peak Hour Traffic Using Driveway</th>
<th>With Two-Way Access</th>
<th>With One-Way Access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min. Width</td>
<td>Max. Width</td>
</tr>
<tr>
<td>Low Volume</td>
<td>&lt; 1500</td>
<td>&lt; 150</td>
<td>28 feet²</td>
<td>42 feet³</td>
</tr>
<tr>
<td>Medium Volume</td>
<td>1500-4000</td>
<td>150-400</td>
<td>42 feet³</td>
<td>54 feet⁴</td>
</tr>
<tr>
<td>High Volume</td>
<td>&gt;4000</td>
<td>&gt;400</td>
<td>42 feet³</td>
<td>To Be Determined Through a Traffic Study</td>
</tr>
</tbody>
</table>

¹One-lane driveways.
²Driveway striped for two-lanes.
³Driveway striped for three lanes.
⁴Driveway striped for four lanes.

18.1.E. Driveways and Accommodation of Pedestrians

In current and future urban places, all driveways must adequately accommodate pedestrians using sidewalks or paths. The crosswalk location should be placed to balance the pedestrian crossing distance and the width of the intersection for vehicular traffic (typically this is at about the center point of the corner radius). Crosswalks should not be placed where pedestrians would likely have to cross behind or between stopped vehicles. Where four or more driveway lanes are created, they should be designed so that the pedestrians have a refuge from entering and exiting traffic.

18.1.F. Driveways and Accommodation of Bicycles

Where a new driveway crosses a bicycle facility (such as a dedicated bike path or an on-street bike lane), the driveway should be designed so as to accommodate the safe crossing of bicyclists. Likewise, when a new bicycle facility is built that crosses existing driveways, the bicycle facility should be designed with safe crossings in mind.

18.1.G. Driveway Throat Length

The driveway throat length should minimize or eliminate the condition where inbound traffic queues back onto a public street (see Figure 18-1). The throat length also provides for a place for
exiting vehicles to queue, better definition of the driving lanes, and separation between the parking area and the adjacent street. Driveway throat lengths shall meet the following requirements and should be based on the ultimate public street section anticipated:

18.1.G.1. All driveways shall provide at least 50 feet of throat length adjacent to local streets and 100 feet adjacent to collector and arterial streets.
18.1.G.2. For driveways serving between 100 and 400 vehicles in the peak hour (two-way traffic volumes) the driveways shall provide at least 125 feet of throat length.
18.1.G.3. For driveways serving over 400 vehicles per hour (two-way traffic volume) and for all driveways controlled by a traffic signal, adequate throat length shall be determined by a transportation impact study.
18.1.G.4. For driveways serving extremely low volumes (10 vehicles or less in the peak hours) on low volume (less than 100 vehicles existing or projected in any hour), low speed (25 miles per hour speed limit) streets, a throat depth of 30 feet may be permitted at the City Engineer’s (or designee’s) discretion.

![Driveway Throat Length Diagram]

Figure 18-1
Driveway Throat Length

18.1.H. Turning Radius
The path that a vehicle follows when turning left to or from a cross street or drive is defined as the turning radius. This path should be a continuous, smooth curve from the stopping point e.g. the stop line, the end of the median nose, or the location the vehicle typically waits to make a left turn, to beyond the farthest conflicting travel lane. Left-turning drivers should not have to pull out straight into the intersection and then begin the turn maneuver. The minimum turning radii are as follows:

- For low volume drives or streets (less than 100 vehicles in the peak hour) serving primarily passenger cars, 40 feet minimum.
- For dual left-turn movements, 75 feet minimum (for the inner left-turn movement).
For all other situations, 60 feet minimum.

Opposing left-turn movements, e.g. eastbound left turns and westbound left turns, at the same intersection shall provide at least 10 feet of separation between the outside edges of the two turning paths.