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INTRODUCTION

What is Access Management?

Access management is the practice of coordinating the location, number, spacing and design of access points to minimize site access conflicts and maximize the traffic capacity of a roadway. Uncoordinated growth along some of the region’s major travel corridors has resulted in strip development and a proliferation of access points. In most instances, each individual development along the corridor has its own access driveway. Numerous access points along the corridor create conflicts between turning and through traffic which causes delays and accidents.

Historically, transportation and access management plans concentrated primarily on the movement of vehicles. Current planning efforts focus on all modes of transportation including vehicles, public transit, bicycles, and pedestrians. These guidelines consider all of these modes of transportation and discuss (1) the importance of managing access, (2) access management techniques, and (3) methods of implementing the techniques. The concepts presented are consistent with guidelines established by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), the Transportation Research Board (TRB), and the Institute of Transportation Engineers (ITE).

Why Access Management?

Numerous benefits are derived from controlling the location and number of access points to a roadway. The benefits include:

- Improving overall roadway safety,
- Reducing the total number of vehicle trips,
- Decreasing interruptions in traffic flow,
- Minimizing traffic delays and congestion,
- Maintaining roadway capacity,
- Extending the useful life of roads,
- Avoiding costly highway projects,
- Improving air quality,
- Encouraging compact development patterns,
- Improving access to adjacent land uses, and
- Enhancing pedestrian and bicycle facilities.

Access management techniques can preserve the existing capacity and improve safety as new development occurs. In addition to preserving capacity, access management techniques can be coordinated with design guidelines to significantly enhance the aesthetics of a roadway corridor. Currently, many of the congested roadway corridors are highly diverse, auto oriented environments that reflect a lack of vision. A common vision that includes guidelines for access in addition to a unified design for signage, landscaping, and pedestrian facilities can significantly improve the function and aesthetics of a roadway corridor.

Accident experience:

Research has found that accident rates increase exponentially as the speed differential in the traffic stream increases. While the accident rates may change over time and by location, the ratio of the accident rates is expected to provide a good indication of the relative accident potential at different speed differentials, as shown in Table on the next page.
Relative Accident Involvement Rates

<table>
<thead>
<tr>
<th>Speed Differential (mph)</th>
<th>Relative Accident Potential as Compared to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At-Grade Arterials</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>-10</td>
<td>2</td>
</tr>
<tr>
<td>-20</td>
<td>6.5</td>
</tr>
<tr>
<td>-30</td>
<td>45</td>
</tr>
<tr>
<td>-35</td>
<td>180</td>
</tr>
</tbody>
</table>

N/A = not available

The table indicates that on an arterial street, a vehicle traveling 30 mph slower than other traffic is 45 times more likely to become involved in an accident than a vehicle traveling the same speed as the other traffic; and a vehicle traveling 35 mph slower than other traffic is 180 times more likely to become involved in an accident.

PRINCIPLES OF ACCESS MANAGEMENT

Constantly growing traffic congestion, concerns over traffic safety, and the ever-increasing cost of upgrading roads have generated interest in managing the access to not only the highway system but to surface streets as well. Access management is the process that provides access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity, and speed. Access management attempts to balance the need to provide good mobility for through traffic with the requirements for reasonable access to adjacent land uses.

Arguably the most important concept in understanding the need for access management is to insure the movement of traffic and access to property are mutually exclusive. No facility can move traffic well and provide unlimited access at the same time. The figure below shows the relationship between mobility, access, and the functional classification of streets. The extreme examples of this concept are the freeways and the cul-de-sac. The freeway moves traffic very well with few opportunities for access, while the cul-de-sac has unlimited opportunities for access, but doesn’t move traffic very well. In many cases, accidents and congestion are the result of streets trying to serve both mobility and access at the same time.

A good access management program will accomplish the following:

- Limit the number of conflict points at driveway locations.
- Separate conflict areas.
- Reduce the interference of through traffic.
- Provide sufficient spacing for at-grade, signalized intersections.
- Provide adequate on-site circulation and storage.

The typical “vicious circle” of traffic congestion found in many areas of the country is shown in the figure on the following page. Access management attempts to put an end to the seemingly endless cycle of road improvements followed by increased access, increased congestion, and the need for more road improvements.
Poor planning and inadequate control of access can quickly lead to an unnecessarily high number of direct accesses along roadways. The movements that occur on and off roadways at driveway locations, when those driveways are too closely spaced, can make it very difficult for through traffic to flow smoothly at desired speeds and levels of safety. The American Association of State Highway and Transportation Officials (AASHTO) state that “the number of accidents is disproportionately higher at driveways than at other intersections . . . thus their design and location merits special consideration.” Studies have shown that anywhere between 50% and 70% of all crashes that occur on the urban street system are access related.

Fewer direct accesses, greater separation of driveways, and better driveway design and location are the basic elements of access management. There are fewer occasions for through traffic to brake and change lanes in order to avoid turning traffic when these techniques are implemented uniformly and comprehensively.

Consequently, with good access management, the flow of traffic will be smoother and average travel speeds higher, as well as less potential for accidents. According to the Federal Highway Administration (FHWA), before and after analyses show that routes with well managed access can experience 50% fewer accidents than comparable facilities with no access controls.

ROADWAY FUNCTIONAL CLASSIFICATION
Concepts:
Access spacing should recognize that access and mobility are competing functions. This recognition is fundamental to the design of roadway systems that preserve public investments, contribute to traffic safety, reduce fuel consumption and vehicle emissions, and do not become functionally obsolete. Suitable functional design of the roadway system also preserves the private investment in residential and commercial development.

A typical trip on an urban street system can be described as occurring in identifiable steps. These steps can be sorted into a definite hierarchy with respect to how the competing functions of mobility and access are satisfied. At the low end of the hierarchy are highway facilities that provide good access to abutting properties but provide limited opportunity for through movement. Vehicles entering or exiting a roadway typically perform the ingress or egress maneuver at a very low speed, momentarily blocking through traffic and impeding the movement of traffic on the roadway. At the high end of the hierarchy are facilities that provide good mobility by limiting and controlling access to the roadway, thereby reducing conflicts that slow the flow of through traffic. The Hierarchy of Movements diagram above shows a hypothetical example of a trip using a freeway, where the main movements of vehicles are uninterrupted, high-speed flow.

Roadway specialization simply means using each individual street facility to perform the desired mix of the functions of access or movement. This is accomplished by classifying highways with respect to the amount of access or mobility they are to provide and then identifying and using the most effective facility to perform that function.
The functional system of classification divides streets into three basic classes identified as arterials, collectors, and local streets. The function of an arterial is to provide for the mobility of through traffic. Access to an arterial is controlled to reduce interferences and facilitate through movement and should only be accessed by collector streets. Collector streets provide a mix for the functions of mobility and access, and therefore accomplish neither well. The predominate purpose of local streets is to provide good access. As noted in the 1994 AASHTO A Policy on Geometric Design of Highways and Streets, driveways create intersections with the street system.

Each class of roadway has its own geometric, traffic control, and spacing requirements. The general types of facilities and their characteristics are summarized in the table below. This table provides a broad guide in setting access spacing standards that are keyed to functional classes of roadways.

<table>
<thead>
<tr>
<th>Class of Roadway</th>
<th>Maximum ADT or [D.U.s]</th>
<th>Traffic Index</th>
<th>Maximum Grade %</th>
<th>Right of Way (ft)</th>
<th>Pavement Width 1 (ft)</th>
<th>Sidewalk Width (ft)</th>
<th>Right of Way (ft)</th>
<th>Pavement Width 1 (ft)</th>
<th>Planter Width (ft)</th>
<th>Sidewalk Width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Local</td>
<td>&lt;500 (2 to 50)</td>
<td>5</td>
<td>15</td>
<td>50</td>
<td>32</td>
<td>4</td>
<td>50</td>
<td>29</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Residential Standard</td>
<td>510 to 1,250 (51 to 125)</td>
<td>5</td>
<td>15</td>
<td>50</td>
<td>35</td>
<td>4</td>
<td>53</td>
<td>32</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Residential Collector</td>
<td>1,260 to 2,000 (201 to 600)</td>
<td>5.5</td>
<td>15</td>
<td>60</td>
<td>42</td>
<td>5</td>
<td>60</td>
<td>39</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Major Collector</td>
<td>2,010 to 6,000 (201 to 600)</td>
<td>6</td>
<td>12</td>
<td>66</td>
<td>49</td>
<td>6</td>
<td>70</td>
<td>46</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>6,000 to 20,000</td>
<td>7</td>
<td>10</td>
<td>90</td>
<td>67</td>
<td>6</td>
<td>90</td>
<td>65</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Arterial Major</td>
<td>&gt;20,000</td>
<td>8</td>
<td>8</td>
<td>&gt;100</td>
<td>as req.</td>
<td>6 (min)</td>
<td>&gt;100</td>
<td>as req.</td>
<td>6 (min)</td>
<td>6</td>
</tr>
<tr>
<td>Commercial Local</td>
<td>NA</td>
<td>10</td>
<td>8</td>
<td>60</td>
<td>43</td>
<td>4</td>
<td>66</td>
<td>42</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Industrial Local</td>
<td>NA</td>
<td>10</td>
<td>6</td>
<td>66</td>
<td>48</td>
<td>6</td>
<td>68</td>
<td>45</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

1. Pavement width measured from lip of curb to lip of curb.
2. A four-foot wide or wider planter strip shall be placed between the back of curb and front of sidewalk within right-of-way widths shown.
3. A planter strip may be required between back of sidewalk and any wall, fence, hedge, etc. This area can be private or public. If public, additional right-of-way will be required. Alternative sections with meandering sidewalks may be proposed.
4. Not used.
5. Configurations of major collector and higher classifications may be adjusted with proper justification and approval of City Engineer. May require widening at intersections for turning movements. Where on street parking is allowed, additional width and other considerations may be required.
6. The minimum right-of-way and pavement width is shown. Each may be increased when required by a traffic impact study.
7. If approved by the City, a 50’ wide right-of-way may be used with the three feet of sidewalk being placed in an appropriate easement.
ACCESS MANAGEMENT TECHNIQUES

There are a number of access management techniques that can be used to preserve or enhance the capacity of a roadway. Specific techniques for managing access are discussed in this section and illustrated with examples. Not all techniques will apply to every situation. Some techniques are more appropriate for less developed rural areas of the city, whereas others are more appropriate in the urban areas. In the urban areas, the techniques can be applied when existing sites are redeveloped or when negotiations with landowners are successful. Therefore, it is up to the City to determine what will work best based in each situation.

Number of Access Points

Controlling the number of access points or driveways from a site to a roadway reduces potential conflicts between cars, pedestrians, and bicycles. Each parcel should normally be allowed one access point, but could be permitted to have more as long as the spacing requirements are met on the table on the following page, and shared access is required where possible.

![Image of Good and Inadequate Spacing]

**Spacing of Access Points**

Establishing a minimum distance between access points reduces the number of points a driver has to observe and reduces the opportunity for conflicts. Spacing requirements should be based on the classification and design speed of the road, the existing and projected volume of traffic as a result of the proposed development, and the physical conditions of the site. Minimum spacing standards should be applied to both residential and commercial/industrial developments.

Signalized Intersections

To ensure efficient traffic flow, new signals should be limited to locations where the progressive movement of traffic will not be impeded significantly. Uniform or near uniform spacing of signals is essential for the progression of traffic. As a minimum, signals should be spaced no closer than one-quarter mile (1,320 feet). It may be recommended on principal arterial streets that signals be spaced at one-third mile (1,760 feet) to one-half mile (2,640 feet).

Unsignalized Driveways

Unsignalized driveways are far more common than signalized driveways. They affect all kinds of activity, not merely large activity centers. Traffic operational factors leading toward wider spacing of driveways (especially medium- and higher-volume driveways) include weaving and merging distances, stopping sight distance, acceleration rates, and storage distance for back-to-back left turns on high-volume streets. From a spacing perspective, these driveways should be treated the same as public streets. Sound traffic engineering criteria indicates that 500 feet or more should be provided between full movement unsignalized accesses.

Right In and Out Accesses

Restricted access movement can provide for additional access to promote economic development with minimal impact to the facility. This type of access should be spaced to allow for a minimum of traffic conflicts and provide distance for deceleration and acceleration of traffic in and out of the access.
Residential Lots
The number of accesses on residential lots shall be based on the following:
1. Number of Driveways: No residential lot shall not have more than two (2) driveways, unless approved by the City Engineer.
2. Distance, Width: For single family lots, no driveway shall be closer than twelve feet (12') to another driveway (as shown on the adjacent figure) nor be more than thirty two feet (32') in width, unless approved by the City Engineer. In no event shall the combined width of such driveways exceed forty six feet (46') or fifty percent (50%) of the entire lot frontage, whichever is less.
3. Corner Lots: In no event shall a driveway be placed on any corner lot within the distance of twenty five feet (25') from the point of the intersection of property lines nearest the intersection, whichever is further from the intersection.

The spacing requirement is based on the functional class of the facility and is shown in the table below.

### Street Intersection Separation Distances (Feet) Based on Functional Class

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Local</td>
<td>1320</td>
<td>150</td>
<td>N/A</td>
</tr>
<tr>
<td>Residential Standard</td>
<td>1320</td>
<td>150</td>
<td>N/A</td>
</tr>
<tr>
<td>Residential Collector</td>
<td>1320</td>
<td>250</td>
<td>N/A</td>
</tr>
<tr>
<td>Major Collector (Residential Zone)</td>
<td>1320</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>Major Collector (Commercial Zone)</td>
<td>1320</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>Arterial Minor</td>
<td>1320</td>
<td>500*</td>
<td>250</td>
</tr>
<tr>
<td>Arterial Major</td>
<td>2640</td>
<td>660*</td>
<td>330</td>
</tr>
<tr>
<td>Commercial Local</td>
<td>1320</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Industrial Local</td>
<td>2640</td>
<td>500</td>
<td>250</td>
</tr>
</tbody>
</table>

*When an arterial intersects another arterial, minimum signal spacing applies

### Driveway Access Separation Distance (Feet) Based on Functional Class

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Minimum Full Movement (ft)</th>
<th>Minimum Rt. In Rt. Out (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Local</td>
<td>75</td>
<td>NA</td>
</tr>
<tr>
<td>Residential Standard</td>
<td>75</td>
<td>NA</td>
</tr>
<tr>
<td>Residential Collector</td>
<td>125</td>
<td>NA</td>
</tr>
<tr>
<td>Collector Major Residential Zone</td>
<td>250</td>
<td>125</td>
</tr>
<tr>
<td>Collector Major Commercial Zone</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Arterial Minor</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>Arterial Major</td>
<td>660</td>
<td>330</td>
</tr>
<tr>
<td>Commercial Local</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Industrial Local</td>
<td>500</td>
<td>250</td>
</tr>
</tbody>
</table>
Access spacing shall be measured from center of access to center of access.

The spacing of right-turn accesses on each side of a divided roadway can be treated separately. However, where left turns at median breaks are involved, the access on both sides should line up or be offset from the median break by at least 300 feet.

**Offset Distance**

Offset distance is the distance from the center of an access to the center of the next access on the opposite side of the road. See figure above.

On undivided roadways, access on opposite sides of the road should be aligned. Where this is not possible, driveways should be offset based on the values in the table below.

### Minimum Offset Distance

**Between Driveways on opposite sides of undivided Roadways**

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Minimum Offset*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Local</td>
<td>NA</td>
</tr>
<tr>
<td>Residential Standard</td>
<td>NA</td>
</tr>
<tr>
<td>Residential Collector</td>
<td>150</td>
</tr>
<tr>
<td>Major Collector</td>
<td>200</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>220</td>
</tr>
<tr>
<td>Arterial Major</td>
<td>600 ft for speed of 45 or greater, 300 for all other speeds</td>
</tr>
<tr>
<td>Commercial Local</td>
<td>200</td>
</tr>
<tr>
<td>Industrial Local</td>
<td>220</td>
</tr>
</tbody>
</table>

*Distance in table are measured from center to center of driveway

**VALUES based on TRB Access Management Guidelines**

**MEDIANS**

Medians are used to control and manage left turns and crossing movements as well as separating traffic moving in opposite directions. Restricting left turning movements reduces the conflicts between through and turning traffic, resulting in improved safety. Studies have shown that the installation of a non traversable median will reduce crashes by 30 % over that of a two way left turn lane (TWLTL). Medians are typically used on arterial or other roadways with high volumes of traffic and four or more lanes of traffic.

The use and design of a median is determined by the characteristics of the roadway: such as traffic volumes, speed, number and configuration of lanes, right-of-way width, and land uses along the roadway. The need for a median can be identified through engineering review (a traffic study assessing the impact of a proposed project) and should be considered on any roadway that has a speed limit greater than 40 MPH. Medians can improve pedestrian safety by providing a refuge area for the pedestrian. The designer should consider incorporating a pedestrian refuge at all major intersection crossings.
In addition, medians are often used in commercial and residential developments to separate lanes of traffic and limit conflicts caused by left turns. Medians can also add to the overall aesthetics of a roadway corridor or a development by incorporating landscaping or other items of visual interest. A well designed roadway with good access management can be aesthetically pleasing. It can provide the landscape architect greater opportunity in the development of practical and efficient landscape plans. However, care should be taken to maintain sight distance around the intersection/access locations. Therefore, it is required that only ground cover plantings be planted within 350 feet of an intersection/access opening. Also, care should be taken to select landscape materials that will not intrude into the roadway and to locate materials such that they will not cause a safety problem for the motorist. Care should be taken in selecting trees that will not be larger than 4 inches in diameter when mature.

Continuous two way left turn lanes can reduce the conflict and delays caused by vehicles turning left through on-coming traffic. Left turn lanes also reduce accidents caused by slowing vehicles and traffic going around on the right. Two way left turn lanes should only be used to retrofit areas of existing development and should be limited to roadways with less than 18,000 ADT. New roads that utilize other access management techniques should not need a two-way left turn lane. In areas with greater than 18,000 ADT, consideration should be given to raised median with appropriately spaced median openings.

**Median Openings**

Median openings are provided at all signalized at-grade intersections. They are also generally provided at unsignalized junctions of arterial and collector streets. They may be provided at driveways where they will have minimum impact on roadway flow.

The spacing of median openings for signalized driveways should reflect traffic signal coordination requirements and the storage-space needed for left turns. Minimum desired spacings of unsignalized median openings at driveways shall be based on the left turn storage requirements. Median openings for left-turn entrances (where there is no left-turn exit from the activity center) should be spaced to allow sufficient storage for left-turning vehicles.

See table below for typical spacing only. (Note: Values in table are typical only; exact values shall be based on a traffic engineering study.)

<table>
<thead>
<tr>
<th>Street Functional Classification</th>
<th>Spacing of Median Openings (ft)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
</tr>
<tr>
<td>Principal Arterial</td>
<td>660</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>500</td>
</tr>
<tr>
<td>Collector</td>
<td>330</td>
</tr>
</tbody>
</table>

*Values are for estimating, exact values shall be based on engineering studies

*Based on UDOT State Highway Access Management Standards, Table 7.4-1
Left-turn ingress or egress requires a median opening when traffic traveling in opposing directions is separated by a barrier median. Median widths commonly vary from 30 inches to over 30 feet. A 14-foot median is desirable in order to provide for an adequate left turn lane at intersections.

Design elements include the median width, the spacing of median openings, and the geometries of median noses at opening. Typically, median widths at intersections are 30 inches formed by two 15-inch curbs back to back with a plowable (tapered) end. This provides a positive separation of the traffic flows eliminating the potential for turning vehicles to impact the blunt end of the barrier.

**CORNER CLEARANCE**

Corner clearance is the distance between a driveway and an intersection. Providing adequate corner clearance improves traffic flow and roadway safety by ensuring that the traffic turning into the driveway does not interfere with the function of the intersection. Local regulations should require that driveways be located a minimum distance from an intersection based on roadway classification or speed. On a corner lot, access will be taken from the lower classified street.

Any access opening shall not be located within the functional area of the intersection. See diagram to the left.

Access locations shall be based on an engineering study based on the following:

<table>
<thead>
<tr>
<th>Clearance Type</th>
<th>Sample Clearance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;C - Upstream on the major roadway</td>
<td>Residential Local 50 feet</td>
</tr>
<tr>
<td></td>
<td>Residential Standard 50 feet</td>
</tr>
<tr>
<td></td>
<td>Residential Collector 100 feet</td>
</tr>
<tr>
<td></td>
<td>Collector Major Residential Zone 175 feet</td>
</tr>
<tr>
<td></td>
<td>Collector Major Commercial Zone 175 feet</td>
</tr>
<tr>
<td></td>
<td>Arterial Minor 200 feet</td>
</tr>
<tr>
<td></td>
<td>Arterial Major 250 feet</td>
</tr>
<tr>
<td></td>
<td>Commercial Local 100 feet</td>
</tr>
<tr>
<td></td>
<td>Industrial Local 100 feet</td>
</tr>
<tr>
<td>B&amp;D - Downstream on the major roadway</td>
<td>Residential Roadways 50 feet</td>
</tr>
<tr>
<td></td>
<td>Collector Major Residential 75 feet</td>
</tr>
<tr>
<td></td>
<td>Collector Major Commercial 150 feet</td>
</tr>
<tr>
<td></td>
<td>Minor Arterial Roadways 185 feet</td>
</tr>
<tr>
<td></td>
<td>Major Arterial Roadways 230 feet</td>
</tr>
</tbody>
</table>
WIDTH OF ACCESS POINTS

Uncontrolled access is a serious hazard for vehicles entering or exiting the site, vehicles passing by the site, bicycles, and pedestrians. In addition to limiting the number of access points, the width of the access point should be restricted based on the use of the site. Residential lot driveways should be limited to a maximum throat width of 32 feet at the back of the drive approach. The maximum width for a commercial or industrial site entrance with two-way traffic should be limited to 44 feet. This width includes 12 feet for right out, 12 feet for left out, 16 feet for an ingress lane, and two 2-foot shoulders. The width of the entrance should be determined based on the type of use for the site, the type of traffic (i.e. cars vs. 18 wheel trucks), and the projected volume of traffic.

TYPICAL 3-LANE ACCESS

<table>
<thead>
<tr>
<th></th>
<th>Width of Access Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Access</td>
<td>Normally 15 feet</td>
</tr>
<tr>
<td></td>
<td>Maximum of 32 feet</td>
</tr>
<tr>
<td></td>
<td>With engineer approval maximum of 46 feet *</td>
</tr>
<tr>
<td>Commercial or Industrial Access</td>
<td>Maximum of 44 feet</td>
</tr>
<tr>
<td></td>
<td>12 foot right/through lane</td>
</tr>
<tr>
<td></td>
<td>12 foot left turn lane</td>
</tr>
<tr>
<td></td>
<td>2-2 foot shoulders</td>
</tr>
<tr>
<td></td>
<td>16-foot receiving lane</td>
</tr>
</tbody>
</table>

* Not to exceed 50% of the total frontage

TURNING RADIUS

The turning radius of a driveway or access road affects both the flow and safety of through traffic as well as vehicles entering and exiting the roadway. The size of the turning radius affects the speed at which vehicles can exit the flow of traffic and enter a driveway. In general, the larger the turning radius, the greater the speed at which a vehicle can turn into a site. An excessively small turning radius will require a turning vehicle to slow down significantly to make the turn, therefore backing up the traffic flow or encroaching into the other lane. An excessively large turning radius will encourage turning vehicles to travel quickly, thereby creating hazards to pedestrians. Either of these situations increases the potential for accidents.

The speed of the roadway, the anticipated type and volume of the traffic, pedestrian safety, and the type of use proposed for the site should be considered when evaluating the turning radius. Proposed uses that would require deliveries by large trucks (such as major retail establishments and gas stations) should provide larger turning radii to accommodate such vehicles. Other uses such as banks, offices or areas with high pedestrian traffic could adequately be served with smaller turning radii based on the type of traffic they would generate.
THROAT LENGTH

Throat length is the length of the driveway that is controlled internally from turning traffic, measured from the intersection with the road. Driveways should be designed with adequate throat length to accommodate queuing of the maximum number of vehicles as defined by the peak period of operation in the traffic study. This will prevent potential conflicts between traffic entering the site and internal traffic flow. Inadequate throat length may cause turning traffic to back up onto the road, thereby impeding traffic flow and increasing the potential for accidents. The minimum throat length for an access into a minor commercial property is 50 feet, unless approved by City Engineer. For major commercial development, the City recommends a minimum throat length of 150 feet for a major driveway entrance with 300 feet desirable.

The table below shows the minimum driveway throat length at signalized access driveways.

<table>
<thead>
<tr>
<th>Number of Egress Lanes</th>
<th>Minimum Throat Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>75 feet</td>
</tr>
<tr>
<td>3</td>
<td>200 feet</td>
</tr>
<tr>
<td>4</td>
<td>300 feet</td>
</tr>
</tbody>
</table>

Figure: Poor throat length. Vehicles in the parking lot conflict with vehicles entering the parking lot.

Figure: Adequate throat length. Vehicles entering the lot have room to maneuver without conflict.

Example of good throat length
DRIVEWAY PROFILES

The slope of a driveway can dramatically influence its operation. Usage by large vehicles can have a tremendous effect on operations if slopes are severe. The profile or grade of a driveway will be designed to provide a comfortable and safe transition for those using the facility and to accommodate the storm water drainage system of the roadway. The grade for a commercial driveway shall be a maximum grade of 2 percent for a minimum of 50 feet. Street accesses and major traffic generators shall be designed to meet street standards with no water ways crossing the access opening.

The change in grade between the roadway cross slope and the slope of the driveway apron is important for accomplishing a smooth transition. Maximum changes in grade for different functional roadway classes are shown in the table below. If the grade changes exceed these values, a smoothing transition is required as shown in the driveway figures on downgrades and upgrades below.

The table below gives the maximum percent difference between roadway cross slope and driveway slope without designing for a vertical curve.

<table>
<thead>
<tr>
<th>Roadway</th>
<th>Driveway</th>
<th>Driveway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Volume</td>
<td>Low Volume</td>
</tr>
<tr>
<td>Major Arterial</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>Major Collector</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Minor Collector</td>
<td>-</td>
<td>≤10%</td>
</tr>
<tr>
<td>Local</td>
<td>-</td>
<td>≤12%</td>
</tr>
</tbody>
</table>
SHARED ACCESS
Access points shall be shared between adjacent parcels to minimize the potential for conflict between turning and through traffic. Shared access can be used effectively for both residential and nonresidential developments. Since the issues surrounding shared access for residential and nonresidential development are slightly different, they are discussed separately.

Residential
Residential subdivisions located along arterial or collector roadways shall be designed with an internal road system rather than be developed along the existing roadway frontage or a single access cul-de-sac. Subdivision proposals should encourage a coordinated street network by providing rights-of-way or stubs for the extension of streets to adjacent parcels. This will prevent the proliferation of driveways on arterial and collector streets and provide for an interconnected street network.

Shared driveways shall also be used to minimize the number of curb cuts in residential districts, particularly along rural arterial and rural major collector roads. If access is necessary from these roads, then shared driveways are required. Shared driveways serving more than two homes will be built to fire lane standards.

Commercial
Joint driveways providing access to adjacent developments, and interconnections between sites, are required for all development proposals on arterial and collector roadways. Interconnections between sites can eliminate the need for additional curb cuts, thereby preserving the capacity of the roadway. This is particularly important for commercial/industrial sites and should be used to encourage the development of internal or collector roadway systems servicing more than one parcel or establishment. Future roadway rights-of-way should also be provided to promote interconnected access to vacant parcels or to facilitate the consolidation of access points for existing developments.
Pedestrian access between developments will allow people to walk between establishments, thereby reducing the number of vehicle trips. Every opportunity should be taken to provide for interconnections between existing and future developments for both vehicles and pedestrians.

ALIGNMENT OF ACCESS POINTS

Street and driveway intersections represent points of conflict for vehicles, bicycles, and pedestrians. All modes of travel should be able to clearly identify intersections and assess the travel patterns of vehicles and pedestrians through the intersection. To minimize the potential conflicts and improve safety, intersections and driveways shall be aligned opposite each other wherever possible and roadways intersect at a 90 degree angle. Good driveway alignment will provide vehicles, bicycles, and pedestrians with a clear line of sight and allow them to traverse the intersection more safely.

### Driveway Alignment

<table>
<thead>
<tr>
<th>Ideal Angle</th>
<th>90 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Angle</td>
<td>75 degrees</td>
</tr>
</tbody>
</table>

*Source: Policy on Geometric Design of Highways and Streets, AASHTO*

SIGHT DISTANCE

Sight distance is the length of the road that is visible to the driver. A minimum safe sight distance should be required for access points based on the roadway classification. The AASHTO publication, “A Policy on Geometric Design of Highways and Streets” contains recommendations for sight distance based on the roadway design speed and grade. It is essential to provide sufficient intersection sight distance at the driveway point for vehicles using a driveway to see oncoming traffic and judge the gap to safely make their movement. They should be able to enter and leave the property safely. Intersection sight distance varies depending on the design speed of the roadway to be entered and assumes a passenger car can turn right or left into a two-lane highway and attain 85 percent of the design speed without being overtaken by an approaching vehicle that reduces speed to 85 percent of the design speed. The table below gives intersection sight distance requirements for passenger cars. Sight distances should be adjusted with crossroad grade in accordance with AASHTO policies.
**Intersection/Driveway Sight Distance (feet)**

| Posted Speed Limit | Sight Distance Required * |  |  |  |  |  |  |  |
|--------------------|---------------------------|---|---|---|---|---|---|
|                    | Left Turn                 | 2 lanes | 3 lanes | 5 lanes | 2 lanes | 3 lanes | 5 lanes |
| MPH                |                           |          |          |          |          |          |          |
| 30                 | 335                       | 355      | 375      | 290      | 310      | 335      |
| 35                 | 390                       | 415      | 440      | 335      | 365      | 390      |
| 40                 | 445                       | 475      | 500      | 385      | 415      | 445      |
| 45                 | 500                       | 530      | 565      | 430      | 465      | 500      |
| 50                 | 555                       | 590      | 625      | 480      | 515      | 555      |
| 55                 | 610                       | 650      | 690      | 530      | 570      | 610      |
| 60                 | 665                       | 710      | 750      | 575      | 620      | 665      |
| 65                 | 720                       | 765      | 815      | 625      | 670      | 720      |

* Driver Eye is 15 feet measured from the traveled way

Normally, intersection sight distance will govern the required sight distance for the driveway, but it is also important to verify that the main roadway have sufficient stopping sight distance. For example, a driver of a vehicle approaching an intersection should have an unobstructed view of the entire intersection including any traffic control devices and sufficient length along the intersecting highway to permit the driver to anticipate and avoid potential collisions. The safe stopping sight distance should be reviewed to make sure that the approaching vehicle has a clear view of the roadway in the area of the access. Sight distance may be more of a consideration in rural areas because of higher speeds and rolling/hilly terrain. The sight distance will be greater for a roadway with a high speed and a downgrade as vehicles will take longer to stop in such a circumstance.

The table below gives the safe stopping sight distance that should be provided for a driver on the roadway to have a clear view of the access/driveway.

<table>
<thead>
<tr>
<th>Design Speed MPH</th>
<th>Flat</th>
<th>3%</th>
<th>6%</th>
<th>9%</th>
<th>3%</th>
<th>6%</th>
<th>9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>155</td>
<td>158</td>
<td>165</td>
<td>173</td>
<td>147</td>
<td>413</td>
<td>140</td>
</tr>
<tr>
<td>30</td>
<td>200</td>
<td>205</td>
<td>215</td>
<td>227</td>
<td>200</td>
<td>184</td>
<td>179</td>
</tr>
<tr>
<td>5</td>
<td>250</td>
<td>257</td>
<td>271</td>
<td>287</td>
<td>237</td>
<td>229</td>
<td>222</td>
</tr>
<tr>
<td>40</td>
<td>305</td>
<td>315</td>
<td>333</td>
<td>354</td>
<td>289</td>
<td>278</td>
<td>269</td>
</tr>
<tr>
<td>45</td>
<td>360</td>
<td>378</td>
<td>400</td>
<td>427</td>
<td>344</td>
<td>331</td>
<td>320</td>
</tr>
<tr>
<td>50</td>
<td>425</td>
<td>446</td>
<td>474</td>
<td>507</td>
<td>405</td>
<td>388</td>
<td>375</td>
</tr>
<tr>
<td>55</td>
<td>495</td>
<td>520</td>
<td>556</td>
<td>593</td>
<td>469</td>
<td>450</td>
<td>433</td>
</tr>
</tbody>
</table>

Source: Policy on Geometric Design of Highways and Streets AASHTO 2004

In making this determination for stopping sight distance, it should be assumed that the approaching driver’s eye is 3.5 feet above the roadway surface and that the object to be seen is 3.5 feet above the surface of the road.

**TURNING LANES**

Turning lanes remove the turning traffic from the through travel lanes. Left turning lanes are used to separate the left turning traffic from the through traffic. Right turn lanes reduce traffic delays caused by the slowing of turning vehicles. Designated right or left turn lanes are generally used in high traffic situations on arterial and collector roadways. A traffic impact study will identify the need for turning
lanes or tapers based on the existing traffic volumes, speed, and the projected impact of the proposed use and make recommendations on the design of the turning lane.

Right Turn Deceleration, Storage, and Taper are required when the project peak hour right turn ingress turning volume is greater than or equal to the values shown in the table below.

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Peak Hr Right Turn Volume VPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Collector</td>
<td>25</td>
</tr>
<tr>
<td>Major Collector</td>
<td>25</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>10</td>
</tr>
<tr>
<td>Arterial Major</td>
<td>10</td>
</tr>
</tbody>
</table>

Right of way shall be provided to accommodate dual left turn when two arterials are intersecting, and when it is anticipated that future left turn traffic volumes during the peak hour to exceed 200 vehicles per hour. An additional 12 feet for a dual left turn, and an additional 12 feet for a right turn deceleration lane is required.

Storage length: The length of the turning lane shall be a minimum of 100 feet. At an unsignalized intersection it shall be a minimum length to accommodate two 25-foot vehicles based on the number of vehicles likely to arrive in a 2-minute period at peak hour. For signalized intersections, the storage length shall be 10% of the peak hour design year volume expressed in feet.

<table>
<thead>
<tr>
<th>Turning Lane storage length (100 feet minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsignalized intersection</td>
</tr>
<tr>
<td>2 times the number of cars likely to arrive in a 2 minute period during peak hour*</td>
</tr>
<tr>
<td>Signalized intersection</td>
</tr>
<tr>
<td>10% of the peak hour design year volume expressed in feet*</td>
</tr>
</tbody>
</table>

* assume 25 feet per vehicle
* 2004 AASHTO Geometric Design of Highways and Streets

Lane width
Turning lanes shall normally be a minimum of 12 feet in width. Any exception will require approval from the City Engineer. For right turn lanes, provide an additional 12 feet of pavement to accommodate the lane.

Left-turn Lanes
The provision of left-turn lanes is essential from both capacity and safety standpoints, where left turns would otherwise share the use of a through lane. Shared use of a through lane will dramatically reduce capacity, especially when opposing traffic is heavy. Left-turn lanes shall be provided at a signalized intersection. The table below provides warrants when auxiliary lanes are to be installed.
Guide for Left-Turn and Right-Turn Lanes on Two Lane Highways

<table>
<thead>
<tr>
<th>Speed</th>
<th>Left Turn Lane</th>
<th>Right Turn Lane</th>
<th>Right Turn Acceleration Lane</th>
<th>Left Turn Acceleration Lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 MPH and less</td>
<td>25 VPH</td>
<td>50 VPH</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>45 and up</td>
<td>10 VPH</td>
<td>25 VPH</td>
<td>50 VPH</td>
<td>**</td>
</tr>
</tbody>
</table>

* Farm Access Excluded

** Optional for 50 MPH and less; for 55 MPH as required by the City Engineer

*** As required by the City Engineer

VPH = vehicles per hour in any one-hour period in passenger car equivalents

Source UDOT Standard drawing

Right-turn lanes

Right-turn lanes remove the speed differences in the main travel lanes, thereby reducing the frequency and severity of rear-end collisions. They also increase capacity of signalized intersections and may allow more efficient traffic signal phasing. The table above, from the Manual of Uniform Traffic Control Devices, illustrates typical warrants for left- and right-turn lanes, based on posted speed and traffic volumes.

Length of Auxiliary lane

A separate turning lane consists of a taper plus a full width auxiliary lane. The design of turn lanes is based primarily on the speed at which drivers will turn into the lane, the speed to which drivers must reduce in order to turn into the driveway after traversing the deceleration lane, and the amount of vehicular storage that will be required. Other special considerations include the volume of trucks that will use the turning lane and the steepness of an ascending or descending grade.

The total length of an auxiliary lane is made up of the storage length plus the distance necessary to come to a stop from the prevailing speed of the road and the taper distance which varies based on speed. The length required to come to a stop from either the design speed or an average running speed of a roadway are indicated on the Figure below. These lengths assume the roadway is on a 2 percent or less vertical grade. It is a common practice to include the taper length and in the deceleration distance as shown below. This plus the storage distance will result in the total distance needed including taper.

<table>
<thead>
<tr>
<th>Speed mph</th>
<th>Deceleration distance (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>170</td>
</tr>
<tr>
<td>35</td>
<td>220</td>
</tr>
<tr>
<td>40</td>
<td>275</td>
</tr>
<tr>
<td>45</td>
<td>340</td>
</tr>
</tbody>
</table>

Taper Length

Taper Length will vary based on speed. A length of 90 feet for speeds below 45 mph, 140 feet for speeds of 45 and 50 mph and 180 feet for speeds over 50 mph. If a two-lane turn lane is to be provided, it is recommended that a 10:1 taper be used to develop the dual lanes. The taper will allow for additional storage during short duration surges in traffic volumes.
PEDESTRIAN AND BICYCLE ACCESS

A key aspect of access management is reducing the number of vehicle trips. This can be accomplished by providing safe and appealing pedestrian access within developments and between adjacent developments.

All new development and redevelopment of existing sites should address pedestrian and bicycle access to and within the site. Sidewalks should be provided in all urban residential subdivisions and in or adjacent to commercial or industrial developments. Sidewalks and other pedestrian facilities should comply with the Americans with Disabilities Act Standards for Accessible Design.

Crosswalks should be clearly marked and located in appropriate areas. Paint or paving materials can be used to delineate crosswalks.
Parking lot designs need to address pedestrian access to the site and circulation within the site. Five-foot wide sidewalks or striped pedestrian crossings should be provided from adjacent sites through parking lots to promote safe pedestrian access. Safe and appealing pedestrian circulation systems allow people to park their cars once and walk to different establishments resulting in an overall reduction in the number of vehicle trips. Joint and cross access between developments can provide opportunities for shared parking.

St. George City's vision is to construct bicycle and pedestrian pathways connecting neighborhoods with schools, downtown, employment centers, and commercial districts. Maintaining existing and developing new corridors for walking and biking will promote the use of these transportation modes and reduce the overall number of vehicle trips.

**GRADE SEPARATIONS**

Interchanges in an access management context provide several important functions. They enable the signal green time to be maximized along expressways and principal arterials. They also allow access to large activity centers where such access might be precluded by traffic signal spacing criteria. More specifically, a grade separated interchange may be appropriate in the following situations:

1. Where two expressways cross, or where an expressway crosses arterial roads;
2. Where principal arterials cross and the resulting available green time for any route would be less than 40 to 50 percent;
3. Where an existing at-grade signalized intersection along an arterial roadway operates at level of service (LOS) F, and there is no other reasonable improvement that can be made to provide sufficient capacity;
4. Where a history of accidents indicates a significant reduction in accidents can be realized by constructing a grade separation;
5. Where a new at-grade signalized intersection would result in LOS E in urban and suburban settings and LOS D in rural settings;
6. When the location to be signalized does not meet the signal spacing criteria and signalization of the access point would impact the progressive flow along the roadway, and there is no other reasonable access to a major activity center;
7. Where a major public street at-grade intersection is located near a major traffic generator, and effective signal progression for both the through and generated traffic cannot be provided; and
8. The activity center is located along a principal arterial, where either direct access or left turns would be prohibited by the access code, or would otherwise be undesirable.

Minimum interchange spacing along various roadways should be as shown in the table below. Spacing may be closer where access is provided to or from collector-distributor roads. Privately-developed interchanges should become part of a regional transportation plan to ensure they are consistent with local and regional plans.
Minimum Interchange Spacing Guidelines

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Minimum Interchange Spacing (miles) Urban/Suburban</th>
<th>Minimum Interchange Spacing (miles) Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Expressway</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Principal Arterial</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*Based on AASHTO Geometric Design of Highways and Streets

ROUNDABOUTS

Many communities in the United States are beginning to embrace the concept of “roundabouts.” A roundabout is an intersection control measure used successfully in Europe and Australia for many years. A roundabout is composed of a circular, raised, center island with deflecting islands on the intersecting streets to direct traffic movement around the circle. Traffic circulates in a counter-clockwise direction making right turns onto the intersecting streets. There are no traffic signals; rather, entering traffic yields to vehicles already in the roundabout.

St. George City has taken progressive steps in designing and constructing roundabouts, and they have proven to be a superior traffic control device in many cases. Advantages of roundabouts include reduced traffic delays, increased safety, and reduced right-of-way requirements. Roundabouts can reduce delays because the stop signal phase (when vehicles entering the intersection are unable to move) is eliminated. At the same time, roundabouts can improve safety because the number of potential impact points and the number of conflict points the driver must monitor are both substantially reduced over a conventional four-way intersection. Properly designed roundabouts can also accommodate emergency vehicles and trucks.

Unlike the typical New England “traffic circle” or “rotary,” design standards for roundabouts are very specific and the Federal Highway Administration (FHWA) has prepared a design guide for modern roundabouts in the United States. Development of a roundabout should only occur as a result of an intersection study by a qualified Traffic Engineer and when the minimum capacity and design criteria can be met. The FHWA has determined that the maximum flow rate that can be accommodated at a roundabout depends on the geometric elements (circle diameter, number of lanes), the circulating flow (vehicles going around the circle), and entry flow (vehicles entering the circle). A single-lane roundabout can accommodate up to 1,800 vehicles per hour and a double lane roundabout can accommodate up to 3,400 vehicles per hour. The capacity of a roundabout will be lower, however, as the entry flow increases (ie. more vehicles trying to enter on the roundabout conflicting with those already going around the circle).
The National Transportation Research Board examined traffic delays before and after roundabouts were installed at eight intersections in the United States. The study determined that delays (the time spent stopped and moving up to the intersection) decreased on average by 78% and 76% during the AM Peak Hour and PM Peak Hour, respectively. The results indicate that roundabouts can reduce congestion in certain circumstances. In addition, the FHWA studied safety characteristics of a sample of eleven roundabouts in the United States. The agency determined that the number of personal injury accidents and property damage-only accidents decreased 51% and 29%, respectively, after roundabouts replaced conventional intersections. Roundabouts may be an appropriate solution for certain congested intersections in St. George City.
APPENDIX
APPENDIX

Traffic Impact Studies: A Traffic Impact Study (TIS) is a specialized study of the impacts that a certain type and size of development will have on the surrounding transportation system. A TIS is essential for many access management decisions, such as spacing of driveways, traffic control devices, and traffic safety issues. It is specifically concerned with the generation, distribution, and assignment of traffic to and from new development. The purpose of this sub-section is to establish uniform guidelines for when a TIS is required and how the study is to be conducted.

1. When Required: A complete TIS should be performed if any of the following situations are proposed:
   1. All new developments or additions to existing developments, which are expected to generate more than 100 new peak-hour vehicle trips (total in and out vehicular movements).
   2. In some cases, a development that generates less than 100 new peak hour trips should require a TIS if it affects local "problem" areas. These would include high accident locations, currently congested areas, or areas of critical local concern.
   3. All applications for rezoning when there is a significant increase in traffic volume.
   4. All applications for annexation.
   5. Any change in the land use or density that will change the site traffic generation by more than 15 percent, where at least 100 new peak-hour trips are involved.
   6. Any change in the land use that will cause the directional distribution of site traffic to change by more than 20 percent.
   7. When the original TIS is more than 2 years old, access decisions are still outstanding, and changes in development have occurred in the site environs.
   8. When development agreements are necessary to determine "fair share" contributions to major roadway improvements.

The specific analysis requirements and level of detail are determined by the following requirements.

TIS Categories
- CATEGORY I -- Developments which generate from 100 up to 500 peak hour trips. The study horizon shall be limited to the opening year of the development. The minimum study area shall include site access drives and adjacent signalized intersections and/or major unsignalized street intersections.
- CATEGORY II -- Developments which generate from 500 up to 1,000 peak hour trips. The study horizon shall include both the opening year of the development and five years after opening. The minimum study area shall include the site access drives and all signalized intersections and/or major unsignalized street intersections within one-half mile of the development.
- CATEGORY III -- Developments which generate 1,000 or more peak hour trips. The study horizon shall include the opening year of the development, five years after opening, and ten years after opening. The minimum study area shall include the site access drives and all signalized intersections and/or major unsignalized street intersections within one-half mile of the development.

2. Initial Work Activity. The St. George City's representative makes the final decision on requiring a TIS and determining whether the study falls within Category I, II, or III.

A developer or their agent shall first estimate the number of vehicular trips to be generated by the proposed development to determine if a TIS may be required and the applicable category. The City's representative must give concurrence on the number of trips to be generated by the proposed development. The developer may, if desired, request that the City's
representative assist in estimating the number of trips for the purpose of determining whether a TIS is required for the proposed development.

Next, the City's representative shall make a ruling whether a TIS is required and what the study category shall be. As previously outlined, the City's representative may make an independent finding that a TIS is required. If a study is required, the developer shall have prepared for submittal to the City's representative for review and approval a draft table of contents for the TIS. The table of contents will be sufficiently detailed to explain the proposed area of influence for the study, intersections and roadways to be analyzed, and level of detail for gathering of traffic volume information and preparation of level of service analyses. There shall also be included in the DRAFT a proposed trip distribution for site traffic. After approval of the draft table of contents and trip distribution by the City's agency representative, the actual TIS work activities may begin.

The Traffic Impact Study Scope of Work agreement between the developer and his consulting engineer shall conform to the pre-approved draft table of contents. The findings, conclusions and recommendations contained within the TIS document shall be prepared in accordance with appropriate professional Civil Engineering Canons.

The TIS shall be conducted and prepared under the direction of a Professional Engineer (Civil) licensed to practice in the State of Utah. The subject engineer shall have special training and experience in traffic engineering and has a demonstrated experience and ability to conduct TIS studies and be a member of the Institute of Transportation Engineers.

4. Analysis Approach and Methods:
   The traffic study approach and methods shall be guided by the following criteria.
   - STUDY AREA. The minimum study area shall be determined by project type and size in accordance with the criteria previously outlined. The extent of the study area may be either enlarged or decreased, depending on special conditions as determined by the City's representative.
   - STUDY HORIZON YEARS. The study horizon years shall be determined by project type and size in accordance with the criteria previously outlined and as directed by the City's representative.
   - ANALYSIS TIME PERIOD. Both the morning and afternoon weekday peak hours shall be analyzed, unless the proposed project is expected to generate no trips or a very low number of trips during either the morning or evening peak periods. If this is the case, the requirement to analyze one or both of these periods may be waived by the City's representative.
   - Where the peak traffic hour in the study area occurs during a different time period than the normal morning or afternoon peak travel periods (for example mid-day) or occurs on a weekend, or if the proposed project has unusual peaking characteristics, these additional peak hours shall also be analyzed.
   - SEASONAL ADJUSTMENTS. When directed by City's representative, the traffic volumes for the analysis hours shall be adjusted for the peak season in cases where seasonal traffic data is available.
   - DATA COLLECTION REQUIREMENTS. All data shall be collected in accordance with the latest edition of the ITE Manual of Traffic Engineering Studies, or as directed by the City's representative.
     1. Turning movement counts. Manual turning movement counts shall be obtained for all existing cross-street intersections to be analyzed during the morning and afternoon peak periods. Turning movement counts may be required during other periods as directed by the City's representative. Available turning movement counts may be extrapolated a maximum of two years with the concurrence of the City's agency representative.
     2. Daily traffic volumes. The current and projected daily traffic volumes shall be presented in the report. If available, daily count data from the City may be extrapolated a maximum of two years with the
concurrence of the City's agency representative. Where daily count data is not available, mechanical
counts will be required at locations agreed upon by the City's agency representative.

3. Accident data. Traffic accident data shall be obtained for the most current three-year period
available.

4. Roadway and intersection geometries. Roadway geometric information shall be obtained. This
includes, but is not limited to, roadway width, number of lanes, turning lanes, vertical grade, location
of nearby driveways, and lane configuration at intersections.

5. Traffic control devices. The location and type of traffic controls shall be identified.

6. Master plan roadways. The development area shall incorporate the master planned roads as shown
on the approved city of St. George Road Master Plan.

- TRIP GENERATION. The latest edition of ITE's Trip Generation shall be used for selecting trip generation rates.
  Other rates may be used with the approval of the City's agency representative in cases where Trip Generation
does not include trip rates for a specific land use category, includes only limited data, or where local trip rates
have been shown to differ from the ITE rates.

- Site traffic shall be generated for daily, AM and PM peak hour periods. Adjustments made for “passer-by”
  and “mixed-use” traffic volumes shall follow the methodology outlined in the latest edition of Trip Generation.
  A “passer-by” traffic volume discount for commercial centers shall not exceed twenty five percent unless
  approved by the City's agency representative. A trip generation table shall be prepared showing proposed land
  use, trip rates, and vehicle trips for daily and peak hour periods and appropriate traffic volume adjustments,
  if applicable.

- TRIP DISTRIBUTION AND ASSIGNMENT. Projected trips shall be distributed and added to the projected non-
  site traffic on the roadways and intersections under study. The specific assumptions and data sources used in
deriving trip distribution and assignment shall be documented in the report. Future traffic volumes shall be
  estimated using information from transportation models or applying an annual growth rate to the base-line
  traffic volumes. The future traffic volumes shall be representative of the horizon year for project development.
  If the annual growth rate method is used, the City's agency representative must give prior approval to the
  percentage used. In addition, any nearby proposed “on-line” development projects shall be taken into
  consideration when forecasting future traffic volumes. The increase in traffic from proposed “on-line” projects
  shall be compared to the increase in traffic by applying an annual growth rate.

  If modeling information is unavailable, the greatest traffic increase from either the “on-line” developments, the
  application of an annual growth rate, or a combination of an annual growth rate and “on-line” developments
  shall be used to forecast the future traffic volumes.

  The site-generated traffic shall be assigned to the street network in the study area based on the approved trip
distribution percentages. The site traffic shall be combined with the forecasted traffic volumes to show the
  total traffic conditions estimated at development completion. A “figure” will be required showing daily and
  peak period turning movement volumes for each traffic study intersection. In addition, a “figure” shall be
  prepared showing the base-line volumes with site-generated traffic added to the street network. This “figure”
  will represent site specific traffic impacts to existing conditions.

- CAPACITY ANALYSIS. Level of service (LOS) shall be computed for signalized and unsignalized intersections
  in accordance with the latest edition of the Highway Capacity Manual. The intersection LOS shall be calculated
  for each of the following conditions (if applicable):
  1. Existing peak hour traffic volumes (“figure” required).
  2. Existing peak hour traffic volumes including site-generated traffic (“figure” required).
3. Future traffic volumes not including site traffic (“figure” required).
4. Future traffic volumes including site traffic (“figure” required).
5. LOS results for each traffic volume scenario (“table” required).

The LOS table shall include LOS results for AM and PM peak periods if applicable. The table shall show LOS conditions with corresponding vehicle delays for signalized intersections and LOS conditions for the critical movements at unsignalized intersections. For signalized intersections, the LOS conditions and average vehicle delay shall be provided for each approach and the intersection as a whole.

Unless otherwise directed by the City’s agency representative, the capacity analysis for existing signalized intersections shall be conducted using the Highway Capacity Manual Planning Method for each study horizon year. When directed by the City’s agency representative, the capacity analysis shall be conducted using the Operational Analysis Method.

If an operational capacity analysis method is used for existing signalized intersections, it shall include existing phasing, timing, splits, and cycle lengths as observed and measured during the peak hour traffic periods.

For unsignalized intersections, the Highway Capacity Manual methodology shall be used.

If the new development is scheduled to be completed in phases, the TIS will, if directed by City’s agency representative, include an LOS analysis for each separate development phase, in addition to the TIS for each horizon year. The incremental increases in site traffic from each phase shall be included in the LOS analysis for each preceding year of development completion. A “figure” will be required for each horizon year of phased development.

- **TRAFFIC SIGNAL NEEDS.** A traffic signal needs study shall be conducted for all new proposed signals for the base year. If the warrants are not met for the base year they should be evaluated for each year in the five-year horizon.

  Traffic signal needs studies shall be conducted by a method pre-approved by City’s agency representative.

- **ACCIDENT ANALYSIS.** An analysis of three-year accident data shall be conducted to determine if the level of safety will deteriorate due to the addition of site traffic.

- **SPEED CONSIDERATIONS.** Vehicle speed is used to estimate safe stopping and cross corner sight distances. In general, the posted speed limit is representative of the 85th percentile speed and may be used to calculate safe stopping and cross corner sight distances.

- **IMPROVEMENT ANALYSIS.** The roadways and intersections within the study area shall be analyzed, with and without the proposed development to identify any projected impacts in regard to level of service and safety.

  Where the highway will operate at Level of Service C or better without the development, the traffic impact of the development on the roadways and intersections within the study area shall be mitigated to Level of Service C. Mitigation to Level of Service D may be acceptable with the concurrence of City’s agency representative.
CERTIFICATION. The TIS shall be prepared under the supervision of a Professional Engineer (Civil) registered in the State where the community is located. The report shall be sealed and signed.

5 Report Format. This sub-section provides the format requirements for the general text arrangement of a TIS. Deviations from this format must receive prior approval of the City's agency representative.

I. INTRODUCTION AND SUMMARY
   Purpose of Report and Study Objectives
   Executive Summary
      Site Location and Study Area
      Development Description
      Principal Findings
   Conclusions
   Recommendations

II. PROPOSED DEVELOPMENT
   Site Location (vicinity map)
   Land Use and Intensity
   Proposed Development Details
   Site Plan (readable version must be provided)
   Access Geometrics
   Development Phasing and Timing
   Master Planned Roads

III. STUDY AREA CONDITIONS
   Study Area
   Area of Significant Traffic Impact
   Influence Area
   Land Use
   Existing Land Use
   Anticipated Future Development
   Site Accessibility
   Existing and Future Area Roadway System

IV. ANALYSIS OF EXISTING CONDITIONS
   Physical Characteristics
   Roadway Characteristics
   Traffic Control Devices
   Pedestrian/Bicycle Facilities
   Traffic Volumes
   Daily, Morning, and Afternoon Peak Periods (two hours minimum, and others as required)
   Level of Service
   Morning Peak Hour, Afternoon Peak Hour (and others as required)
   Safety
   Data Sources

V. PROJECTED TRAFFIC
   Site Traffic Forecasts (each horizon year)
Trip Generation
Mode Split
Pass-by Traffic (if applicable)
Trip Distribution
Trip Assignment
Non-Site Traffic Forecasting (each horizon year)
Projections of Non-site Traffic (Methodology for the projections shall receive prior approval of governmental agency's representative)
Total Traffic (each horizon year)

VI. TRAFFIC AND IMPROVEMENT ANALYSIS
Site Access
Level of Service Analysis
Without Project (for each horizon year including any programmed improvements)
With Project (for each horizon year, including any programmed improvements)
Roadway Improvements
Improvements Programmed to Accommodate Non-site Traffic
Additional Alternative Improvements to Accommodate Site Traffic
Traffic
Traffic Safety
Sight Distance
Acceleration/Deceleration Lanes, Left-Turn Lanes
Adequacy of Location and Design of Driveway Access
Pedestrian Considerations
Speed Considerations
Traffic Control Needs
Traffic Signal Needs (base plus each year in five-year horizon)

VII. CONCLUSIONS

VIII. RECOMMENDATIONS
Site Access
Roadway Improvements
Phasing
Other

APPENDICES
Traffic Volume Counts
Capacity Analyses Worksheets
Traffic Signal Needs Studies
Accident Data and Summaries

FIGURES AND TABLES (The following items shall be documented in the text or Appendices)
Site Location
Site Plan
Existing Transportation System
Existing Peak Hour Turning Volumes
Collision Diagram(s)
Estimated Site Traffic Generation
Directional Distribution of Site Traffic
Site Traffic
Non-Site Traffic
Total Future Traffic
Projected Levels of Service
Recommended Improvements
(For Category I, many of the items may be documented within the text. For other categories the items shall be included in figures and/or tables which are legible.)

DESIGN STANDARD REFERENCE
Design in accordance with current governmental agency's Design and Construction standards.
Conduct capacity analysis in accordance with the latest edition of the Highway Capacity Manual

Existing Problem Areas
Introducing a “retrofit” program of access control to an existing roadway is often difficult. Land for needed improvements is often unavailable, making certain access management techniques impossible to implement and requiring the use of minimum rather than desirable standards. Rights of property access must be respected. Social and political pressures will emerge from abutting property owners who perceive that their access will be unduly restricted and their business hurt. The needed cooperation of proximate, sometimes competitive, developments in rationalizing on-site access and driveway locations may be difficult to achieve. And it may be difficult to compare the cost of economic hardship to an individual to the benefits accruing to the general public. Accordingly, the legal, social, and political aspects of access management are particularly relevant in retrofit situations and are understood by St. George City and should be thoroughly understood by the private groups responsible for implementing access control programs for retrofit projects.

The general reasons underlying retrofit actions include the following:
1. Increased congestion and accidents along a given section of road that are attributed to random or inadequate access;
2. Major construction or design plans for a road that makes access management and control essential;
3. Street expansions or improvements that make it practical to reorient access to a cross street and remove or reduce arterial access; and
4. Coordinating driveways on one side of a street with those planned by a development on the other side.

Types of Action: Most retrofit actions involve the application of accepted traffic engineering techniques that limit the number of conflict points, separate basic conflict areas, limit speed adjustment problems, and remove turning vehicles from the through travel lanes. The various access management techniques that are presented in this guideline will achieve each of these objectives and will apply to the retrofit situations.