Background Paper #5

Access Management Classification and Spacing Standards

prepared for

Oregon Department of Transportation
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by

Robert D. Layton
Oregon State University
Department of Civil, Construction, and Environmental Engineering
Corvallis, OR 97331

and

Vergil Stover
Consultant

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Disclaimer

This background paper represents the viewpoints of the authors. Although prepared for the Oregon Department of Transportation (ODOT), they do not represent ODOT policies, practices, nor procedures.

General Objective

This and other background papers were prepared for the purpose of stimulating discussion among interested individuals representing a variety of agencies and groups having an interest in Oregon's highways, and for the purpose of providing technical background information for policies on this topic.

Specific Objectives

The specific objectives of this background paper are:

1. Provide an overview of the relationship between the functional integrity of the highway system and the access management classification system.
2. Review and evaluate the current ODOT access management classification system.
3. Propose a new category structure and set of access management measures.
4. Specify access management standards and guidelines.

Acknowledgments and Credits

Mr. Del Huntington is project manager for ODOT. Dr. Robert Layton, Professor of Civil Engineering at Oregon State University is project director for the Transportation Research Institute (TRI). Dr. Vergil G. Stover is consultant to TRI on this project. This paper, though written by Drs. Layton and Stover, has received input, review and editorial comment from numerous interested persons.

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Introduction

The functioning of our society and culture in Oregon, especially in our modern society, must have effective transportation. This effective transportation is the ability of our highway system to provide for movement of people and goods with adequate capacity, speed, safety and economy together with access to industrial centers, commercial activities and adjacent properties. The effectiveness and reliability with which this highway system and each of its component parts function together and individually to provide the transportation service defines the functional integrity of the highway system. The need to preserve the functional integrity of the highway system and the relation to access management are defined and supported in Background Paper #1, Functional Integrity of the Highway System. The preservation of the functional integrity of the highway system requires that the number, frequency and placement of access points must be managed.

The effective management of access requires that a system of standards, or recommended criteria, be identified that controls the planning, location, and design of access. This paper discusses the proposed access categories and standards for Oregon streets and highways.

There are a number of topics that must be addressed to arrive at an appropriate access management classification system. The logic in the selection of categories and criteria variables for the system, and the standards specified is described. This discussion paper addresses topics such as:

- the purposes of state, city and county roads
- objectives of access management categories
- relation of access management categories to planning
- the “reasonableness” of the current ODOT standards
- interim access management categories
- definition of access management categories
- the purpose of access management classification system
- the use of speed vs. rural or urban as the basis of access standards
- signalized intersection spacing

- median treatment
- approach spacing and corner clearance

This paper provides background and understanding for review and discussion of important factors, issues and criteria. The overall goal of the process is to develop access management policies, statutes, standards and guidelines that will both protect the utility of the highway system and enhance local land use and property development.

Background

Objective of Access Management Categories

The objective of specifying access management categories is to ensure that access is controlled to the extent that is consistent with the function and Level of Importance for a facility and the appropriate for standard level of service for planned or existing operations on the highway section. The Level of Importance of a highway is defined based on a policy defined by ODOT in the 1991 Oregon Highway Plan, to classify Oregon highways according to their importance to the state and to set funding, improvement and operational priorities.

The operating level of service standards for the state highway system are defined in the 1991 Oregon Highway Plan and are shown in Table 1.

The application of access management treatments may be long-term when planning or designing the facility, or short-term when evaluating operation and control strategies. Consequently, the level of service criteria used must be consistent with the time frame in which it applies. Therefore, for long-term or planning decisions, the design level of service criterion is typically used. The operating level of service criteria may be used for short-term or existing conditions for access management decisions that are not irreversible, that is, where the traffic control, the design or topographic and land use features can be altered in the future with acceptable costs and property owner reaction.

The access management treatments at a location may be the result of numerous access management decisions made at different times. Therefore, caution must be paid to assure the aggregate of these access management efforts yields an access control condition that meets the criteria for the assigned access management category. Consequently, effective access management requires an Access Management Plan that guides the decisions, plans, designs and access treatments that are applied to achieve the desired end result when the facility has reached the expected future volume level and anticipated development of the adjacent land use. The Access Management Plan will employ criteria, standards and guidelines that are specified for the access management category assigned to the facility, unless extenuating circumstances or conditions allow a variance granted by the variance process. Any existing accesses or design features that are not consistent with the Access Management Plan should be evaluated, and should be removed or modified as increased volumes, speeds, accidents, and/or congestion necessitate.

Table 1. Operating Level of Service Standards for the State Highway System

Levels for Design Hour Operating Conditions Through a 20-Year Horizon (1)						
Level of Importance	Type of Area Highway is In				Special Considerations	
	Urban (2) Parts of Metropolitan Areas (3)	Urban Parts of Other Cities	Urbanizing (4) Areas and Rural Development Centers (5)	Rural Areas (6)	Special Transportation Areas (7)	Within Exclusive Transit Corr. (8)
Interstate	D	C	C	B	NA	D/E (9)
Statewide	D	C	C	B	E	E
Regional	D	D	C	C	E	E
District	E	D	D	C	E	E

Notes:

1) Operating standards are not design standards. Operating standards are used by the department when making operating decisions, such as access management decisions. Design standards, which are used to guide the design of highway improvements, are often higher to provide acceptable operating conditions in the future.

2) Urban growth areas are those areas within an urban growth boundary that are generally developed at urban intensities as allowed by the comprehensive plan.

3) Metropolitan areas include Portland, Salem, Eugene, Medford and Rainier (part of Longview-Kelso) urban areas.

4) Urbanizing areas are those within an urban growth boundary that are undeveloped or are developing. They may include vacant lands and areas developed well below urban intensities as allowed by the local comprehensive plan.

5) Rural development centers are concentrations of development outside urban growth boundaries. Included are rural unincorporated communities.

6) Rural areas are areas outside of urban growth boundaries but not including rural development centers.

7) Special Transportation Areas (STAs) are compact areas in which growth management considerations outweigh this policy. STAs include central business districts, transit-oriented development areas and other activity or business centers oriented to non-auto (principally pedestrian) travel. They do not apply to whole cities or strip development areas along individual highway corridors.

8) Exclusive transit corridors are corridors within which the highway runs generally parallel to an exclusive transitway, such as a light rail line or exclusive busway.

9) LOS ‘D’ applies when the facility is located is an urbanizing area. LOS ‘E’ applies in an urbanized area.

The following factors should be taken into account when making access management class assignments:

- Existing and proposed roadside development patterns and intensities.
- Regional and local transportation system plans and comprehensive plans.
- The potential for increasing the use of local roads to provide property access and local circulation.
- The potential to consolidate accesses into a common/shared access.
- Topography, drainage or other land characteristics.
- Existing access agreements between ODOT and local jurisdictions.
- Existing and expected traffic volumes and travel patterns using the facility.
- Other operational and control aspects of the highway such as operating speed, current traffic control technology and strategies, expected future posted speed and future traffic control plans.
- Other operational aspects of access

Relation to Planning

Access management categories are ordinarily applied in conjunction with development of a Highway Corridor Plan. An Access Management Plan should be produced as part of the planning effort. Access management categories should also be applied where any rehabilitation or reconstruction work is to be undertaken; appropriate access management treatments should be implemented at that time in compliance with an Access Management Plan or an Intergovernmental Agreement. The anticipated access management treatment should also be approved through the local jurisdiction's approval process, and be consistent with their plans.

Each access management category implies a standard for location, design and operations / control of access that must be provided to meet the necessary level of service for the level of importance assigned to the facility.

The number, spacing, type and location of accesses and intersections have direct, significant effects on the capacity, speed, safety and overall performance of a highway. The impacts of the frequency of approaches and median treatment on the speed and capacity of multilane arterial highways are given by the 1994 Highway Capacity Manual[1] and McCoy et al.[2] The safety impacts are well covered in the notes for the NHI Workshop on Access Management[3] and in numerous other studies. The nature, location, and degree of signal control and coordination also impact the performance and the level of service achieved on the facility.[4] The number, location, design and capacity of access facilities can impact the development of land parcels and economic viability of property along roadways.[5]

Assignment of Interim Access Management Categories

Because the completion of highway corridor plans is a long-term process, interim access management categories may have to be assigned. The expected long-term development, use, control and character of the facilities and the adjacent land use should be used to determine the interim assignment.

Access decisions made on existing, short term or interim conditions, often are difficult if not impossible to reverse later. Therefore, any access management decisions or measures that may not meet the long term access control needs at a location should be allowed only with the agreement and acceptance of local land use activities and property owners. They should agree that the access control measures can be modified as future capacity, safety and land use service needs require.

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[1] 1994 update, Highway Capacity Manual, TRB, Washington, DC.

[2] McCoy et al., "Effect of Driveway Traffic on Saturation Flow Rates at Signalized Intersections," ITE Journal, February 1990.

[3] "Access Management Workshop," Vergil Stover et al., NHI, FHWA, Washington, DC.

[4] "Access Management for Streets and Highways," FHWA-IP-82-3, FHWA, USDOT, June 1982.

[5] "Guidelines for Medial and Marginal Access Control on Major Roadways," NCHRP Report 93, TRB, Washington, DC, 1970.

Former Definition of Access Management Categories

Six highway access management categories have been defined and used in the State Highway Plan in the recent past.

Category 1:

These highway segments provide for efficient and safe high speed and high volume traffic movements, on interstate, interregional, intercity, and some intracity routes in the largest urbanized areas. The segments do not provide direct land access. Access control and other methods shall be used on nearby cross streets in the area of interchanges to protect the operation of those interchanges. This category shall apply to all Interstate highways and other highways that function like freeways.

Category 2:

These highway segments provide for efficient and safe high speed and high volume traffic movements, on interstate, interregional, intercity and longer distance intracity routes. They should not provide direct land access unless such access prevents more impact to traffic operations, such as an additional signal. This category is distinguished by highly controlled connections, and medians. Traffic signals should be avoided and where they must be installed, their effect on mainline traffic flow should be minimized through traffic signal coordination among intersections on the arterial. Grade separations should be considered for high volume cross streets or other cases where signals do not meet L.O.S. standards. Some Category 2 facilities may be developed into Category 1 facilities over time. This category includes many of the statewide facilities.

Category 3:

These highway segments provide for efficient and safe medium to high speed and medium to high volume traffic movements, on interregional, intercity and longer distance intracity routes. The segments are appropriate for areas that have some historic, minor dependence on the highway to serve land access and where financial and social costs of attaining full access control would substantially exceed benefits. This category includes some of the statewide facilities.

Category 4:

These highway segments provide for efficient and safe medium to high speed and medium to high volume traffic movements, on higher function interregional and intercity highway segments. They are appropriate for routes passing through areas that have some dependence on the highway to serve land access and where the financial and social costs of attaining full access control would substantially exceed benefits. This category includes a small part of the statewide facilities and most regional facilities.

Category 5:

These highway segments provide for efficient and safe medium speed and medium to high-volume traffic movements, on intercity and intracity inter-community routes. There is a reasonable balance between the primary mobility demands and the secondary access needs.

Category 6:

These highway segments provide for efficient and safe slow to medium speed and low to high volume traffic movements, on intracity and intercommunity routes. This category will be assigned only where there is little value in providing for high speed travel. Providing for reasonable and safe access to abutting property is an important purpose of this access category, however, mobility should still be given priority over access.

Selection of Access Control Measures

The access control measures that are chosen to structure the standards in the Access Management Classification System must assure that equitable and necessary controls are imposed. Access control should be implemented where necessary to protect the highway utility, but should not be arbitrarily imposed, particularly if damaging to the development and use of adjacent properties. The access control measures and standards must be chosen carefully and implemented cautiously to assure the proper balance in mobility and access to property.

Comments on ODOT's Current System

The current Oregon Department of Transportation Access Management Classification System is shown in Table 2. The classification system covers categories of interstate, statewide, regional and district importance at the state level of interest. It addresses the two issues that are very critical to the design and operation of major roadways, namely, medians and signalized intersection spacing.

The signal spacing standards are appropriate and recognize the necessity of long spacing of signalized intersections in order to provide excellent progression over a range of conditions. However, it does not explicitly address the need for signal spacings which are multiples of 1/2 mile on major facilities. For example, the 1/2-2 mile range given for Category 2 roadways might be interpreted as meaning any interval within this range, for example, 3/5 mile is acceptable. A preferable method is to simply state a minimum spacing (i.e., 1/2 mile).

The term "full control" in the column labeled Access Treatment is incompatible with at-grade intersections as is the case with Category 2. If Category 2 roadways are to be ultimately upgraded to a freeway design, the term "at-grade" should be eliminated from the public road intersection type. If it is intended that Category 2 highways may have interchanges at locations where volumes warrant, and at-grade intersections elsewhere, the term "limited control" should be used in the access treatment column.

Table 2. Current Oregon DOT Access Standards

Intersection

				Public Road		Private Drive (3)			
				Type (2)	Spacing	Type	Spacing		
1	Full Control (Freeway)	Interstate / Statewide	U R	Intch Intch	2-3 mi. 3-8 mi.	None None	NA NA	None None	Full Full
2	Full Control (Express-way)	Statewide	U R	At grade/Intch At grade/Intch	1/2-2 mi. 1-5 mi.	None None	NA NA	1/2-2 mi. None (5)	Full Full
3	Limited Control (Express-way)	Statewide	U R	At grade/Intch At grade/Intch	1/2-1 mi. 1-3 mi.	Rt Turns Rt Turns	800' 1200'	1/2-1 mi. None (5)	Partial Partial (6)
4	Limited Control	Statewide / Regional	U R	At grade/Intch At grade/Intch	1/4 mi. 1 mi.	Lt/Rt Turns Lt/Rt Turns	500' 1200'	1/2 mi. None (5)	Partial/None (7) Partial/None (7)
5	Partial Control	Regional / District	U R	At grade At grade	1/4 mi. 1/2 mi.	Lt/Rt Turns Lt/Rt Turns	300' 500'	1/4 mi. 1/2 mi.	None None
6	Partial Control	District	U R	At grade At grade	500' 1/4 mi.	Lt/Rt Turns Lt/Rt Turns	150' 300'	1/4 mi. 1/2 mi.	None None

Notes:

1) The Level of Importance to which the Access Category will generally correspond. In cases where the access category is higher than the Level of Importance calls for, existing levels of access control will not be reduced.

2) The basic intersection design options are as listed. Special treatments may be considered in other than Category one. These include partial interchanges, jughandles, etc. The decision on design should be based on function of the highway, traffic engineering, cost-effectiveness and need to protect the highway. Interchanges must conform to Interchange Policy.

3) Generally, no signals will be allowed at private access points on Statewide and Regional Highways. If warrants are met, alternatives to signals should be investigated, including median closing. Spacing between private access points is to be determined by acceleration needs to achieve 70% of facility operating speed. Allowed moves and spacing requirements may be more restrictive than those shown to optimize capacity and safety.

4) Generally, signals should be spaced to minimize delay and disruptions to through traffic. Signals may be spaced at intervals closer than those shown to optimize capacity and safety.

5) In some instances, signals need to be installed. Prior to deciding on a signal, other alternatives should be examined. The design should minimize the effect of the signal on through traffic by establishing spacing to optimize progression. Long-range plans for the facility should be directed at ways to eliminate the need for the signal in the future.

6) Partial median control will allow some well-defined and channelized breaks in the physical median barrier. These can be allowed between intersections if no deterioration of highway operation will result.

7) Use of physical median barrier can be interspersed with segments of continuous left turn lane or, if demand is light, no median at all.

The terms “limited control” and “partial control” add confusion. In actuality, the column “access treatment” might be eliminated because all freeways are full control and the standards as to median control, signal spacing and type of public road (or private drive) intersection identifies the degree to which access is limited.

The private drive spacings are consistent with what other states use. However, the absence of a median makes the right-turn/left-turn designation unnecessary. Where a median is present, the possibility of left-turns in, or out, is controlled by the location and design of the median opening and does not need to be specifically identified. In fact, in most cases, a left-turn should not be designated as a right for a private drive.

There has been confusion on what some terms mean, in particular, the designations for “Median Control” which are full, partial, and none. Some of the confusion arises from the use of the table to assign the access management category and to specify standards for the treatment and design of the facilities.

The Urban/Rural Dilemma

Urban, Suburban, and Rural have commonly been used to identify the highway environment to define access control. The logic of its use comes from several points of view including the following; the roadside environment is a significant source of information to drivers, and rural and urban facilities differ considerably in volumes, speeds, the pressure of pedestrians, traffic flow characteristics and traffic entering and leaving the roadway. The principal problem with the rural, suburban, urban classification is that urban areas tend to expand; areas which were once rural in nature become urban as the suburban fringe expands in response to increasing population and economic development. With these land use changes the arterial facilities experience increased volumes and decreased speeds. Consequently, speed is a better measure of the needed access control measures and design than the urban/rural character. However, the urban, suburban, rural definition of an area is critical to land use planning decisions and to the treatment of a roadway under the Transportation Planning Rule.

The Urban Growth Boundary (UGB) specifically defines the division between rural and urban conditions, either presently or for the foreseeable future. Regardless of whether the area within the UGB is presently undeveloped, suburban or urban in character, the important facilities must be protected from over-development. However, some major roadways have served as main streets historically and have numerous access points, short blocks and poor access control. The local land uses, businesses, and adjacent properties have developed in concert with the highway facilities available and the access they allowed. It would be difficult, if not impossible, to bring the access up to the desirable standards for urban areas. These "main street" facilities in fully developed urban areas should not have their access category changed, but should have their access treatment and standards "grandfathered" because of their importance and inability to adapt.

Advantages of Speed

There are some significant advantages for the use of speed as the primary basis for roadway design and access management standards; these include:

- Relatively high speeds must be ensured long into the future if the movement function of major roadways is to be preserved, and the public investment in them is to be protected. Thus, the use of speed is consistent with the philosophy of functional classification and design expressed in Chapter I of AASHTO's, <u>A Policy on the Geometric Design of Highways and Streets</u>, 1984, 1990 and 1994.
- Speed indirectly considers the rural and urban environment in that speeds are generally higher in the rural environment.
- Speed directly recognizes that for a given perception-reaction time, the distance between decision points must be increased as speed increases.
- Horizontal and vertical alignment is a function of speed.
- Maneuver distance, such as to change lanes or to enter a deceleration lane, is a direct function of speed and not the roadside environment.

It is recommended that the average operating speed under low volumes is used, rather than posted speed, because it better reflects the actual operations on the roadway.

Public Roads

The public road column provides little additional information on the access management criteria to be applied at a location. The typical signal spacing in most cases is the same as the spacing between major streets in the street network. The information about the type of public road interchange/intersection provides no criteria of assistance in controlling access. It is suggested that the median opening spacing and median type are more important criteria.

Private Drive or Approaches

The column giving private drive type and spacing provides useful information, however, the location of minor public road intersections should also be taken into account. Therefore, this criterion should treat approaches or connections that carry low volumes regardless of whether they are private drives or unsignalized intersections. The number, placement, facility speed and the design of the access should be taken into account in determining the spacing of approaches. This often requires a more in-depth analysis of the situation than provided by the facility's access management classification alone.

Proposed Access Management Measures and System Structure

The proposed access classification system is simplified by reducing the number of measures used to classify a facility for access management. In the past, the criteria to classify roadways for access management has included some of the access standards which were specified in the same table, given as Table 2 in this paper. The objective of the access classification is to provide the definition of the importance of a facility, the desired quality of flow, and the level of access that it should be able to accommodate.

The proposed classification system focuses on achieving that objective by using level of importance, the character of the adjacent land use to define a roadway's access category. The definition of the urban/rural character of the facility provides a tie to land use planning and Transportation Planning rule.

The standards for measures such as signalized intersection spacing, median treatments and design, and approach spacing are not given in the same table as the classification criteria. These standards for location, design and control of access measures are treated separately. This will allow the complexity and uniqueness of each roadway situation to be evaluated better. Each of these access measures will have typical standards specified for each access class of roadway, however, criteria and analytical methodology will be provided to take account of the variations in volume levels, speeds, local land use, and facility design characteristics. Further, it will allow a sequential logical selection of standards since the standard that should be imposed on one measure may be dependent on another. For example, the desired spacing of approach roads, or accesses, is dependent on the type of median control used and the spacing of median openings.

Freeway / Expressway Categories

It is suggested that Category 1 freeways and Category 2 expressways be addressed separately from other roadways for the following two reasons:

- Freeways and expressways are high speed facilities whether they are in an urban or rural environment. Although they are normally high speed facilities, the character of the design, treatment of intersections and level of control of access defines whether a facility is an expressway, not the speed of the operation.

- Interchange spacing needs to relate to the at-grade highway system which is largely related to the area being rural or urban.
- Neither facility type allow for median breaks or access at any location along the facility.

This proposed classification separates the freeway/expressway and non-freeway/expressway classifications. This assumes that Category 3 roadways are the highest type of roadways immediately below a full freeway/expressway design (Category 1 and Category 2). Freeways and expressways have controlled access at all locations, allowing access only at interchanges or major signalized intersections for expressways.

Interchanges must conform to the interchange management policy. Also, the cross street at interchanges and the nearest intersecting signalized roadways and approaches must meet the interchange management policy in their location, design and control. Some Category 2 facilities may be developed into Category 1 facilities over time.

Non-Freeway / Non-Expressway Facilities

The term “functional class” has been adopted rather than “access treatment” to relate it to the facility character and function. The “urban/rural” designation has been used to reflect both the operations on the facility and the character of the environment. The typical speed of a facility is implied by category of the facility and the type of area. “Typical median control” is included for information in the classification table because the operation of the facility and the nature of access is very dependent on the median design and control.

Category 3 would address standards for principal and major arterials. These highway segments provide for efficient and safe medium to high speed and medium to high volume traffic movements, on interregional, intercity and longer distance intracity routes. The segments are appropriate for areas that have some historic, minor dependence on the highway to serve land access, and where costs and impacts of attaining full access control would substantially exceed benefits. One condition not treated directly by the classification system is the presence of only two lanes on some arterials. A logical application of the standards suggests that median criteria be ignored for this condition.

Category 4 would include minor arterials. These highway segments provide for efficient and safe medium to high speed and medium to high volume traffic movements, on higher function interregional and intercity highway segments. They are appropriate for routes passing through areas that have some dependence on the highway to serve land access. Access control that does not unduly impede traffic flow and speeds would be appropriate for these facilities.

Category 5 for collectors is presented for information only. Under most circumstances these facilities would not have extensive access control imposed because they have a balanced responsibility for access and movement. They provide for efficient and safe medium speed and medium to high-volume traffic movements, on intercity and intracity inter-community routes.

Two-Lane Two-Way Facilities

The two-lane two-way highways are also non-freeway/non-expressway facilities in the character of their operation, except for their lack of medians. At times, two-lane facilities benefit from the addition of a traversable median, such as a continuous two-way left turn lane, CTWLTL. Left turn lanes, and at times right turn lanes, may be added to improve operations at intersections. Many miles of two-lane state and local highways exist throughout the state, so a subcategory for two-lane highways is also defined.

Proposed Access Management Classification System

The access management categories define various standards and criteria, including level of access control, typical speeds, signal spacings, median control, intersection spacings, and drive/access spacings. An Access Management Classification System is provided in Tables 3 and 4. The values given in these tables are the standards that should normally be used. To vary from these standards, reference should be made to the variance policy and procedures that treat each of the primary criteria or standards in depth to obtain the standard that may be applied for a given facility if there are extenuating conditions or elements.

a. Functional Class

The categories for access management and control are based primarily on the functional classification of highway facilities which defines the relative responsibilities for each class to provide mobility, or movement, and access to adjacent properties. It should be noted that although the functional classes used are relative to the state highway system, some facilities may qualify for a different functional class within a local jurisdiction. For example, district highways may be a major arterial for an urban area. Consequently, the standards for a major arterial may be more appropriate. The highest functional class, state or local, should be used to assign the access management category.

b. Level of Importance

The level of importance (LOI) will generall correspond to the access category assigned to a facility. If the LOI corresponding to the Access Category assigned to a facility is higher than the actual LOI for the facility, the access category and standards of access control should not be reduced. The standards corresponding to the access category should govern.

c. Area

The urban and rural definitions of the highway provide a good measure of the attitudes of drivers, presence of pedestrians and transit, volume of entering and exiting traffic, and the amount of interaction between drivers and the roadside environment. It is also a critical defining factor for land use planning and the treatment of roadways under the Transportation Planning rule. The urban/rural criterion supplemented by the facility functional class provides a good definition of the roadway character and its relationship to the roadside environment.

The urban area, for purposes of the assignment of access management categories, refers to the area within the UGB. Rather than a breakdown of urban and suburban for these areas, a designation of “fully developed urban” and (other) “urban” is recommended. The fully developed urban would refer to those areas that have been historically and traditionally a facility that could qualify as a “main street”. These areas and facilities would typically be in central business districts or well developed areas of the community. Since the land use activities and local property development occurred concomitant with the location and access provided by the highway, the access conditions may be deficient according to current access standards and desired level of operations. These thoroughfares, or “main street” segments will have to be accepted as they are because upgrading to current access standards will be too disruptive to the local economy and culture, too costly to justify and may even be impossible. Consequently, the fully developed urban subcategory will be employed to assure a consistent access management category over an extended length of roadway. The (other) “urban” subcategory will refer to all other urban and suburban areas within the UGB. The urban fringe around the UGB should also be treated as “urban” to direct the growth and development in a manner that can be served well by access controlled facilities.

d. Speed

The speed of operation on a facility is a major factor in evaluating the conflicts, congestion and safety on arterials. The speed differential between through vehicles and entering or exiting vehicles is a major determinant of the operation and safety of the facility at a location. Speeds on facilities are reflective of the environment within which they are located and the functional class of the facility. Speed dictates the design elements and sight distance that must be provided. Where the speeds on the facility to be classed are higher than the typical speed for facilities of that LOI, the design elements and sight distance should be determined based on the speed specific to the facility. The speed used to define operations and design for a facility is the operating speed at low volumes. This speed at low volumes is a very consistent indicator of the operation on any facility and provides the best measure for safe design.

e. Typical Median Control

Some breaks in the median may be permitted if impacts on delay, capacity and safety are acceptable. The levels of median control range from:

- Undivided - no control of or refuge for left turning vehicles.
- Continuous Two-Way Left-Turn Lane (CTWLTL) - a flush painted center lane providing refuge for left turning vehicles.
- Traversable - flush or slightly raised median which can be crossed easily.
- Non-traversable - a raised or depressed median that restricts crossing.

Undivided and CTWLTL medians allow left turns anywhere in the block. Traversable medians exercise partial control of left turns. Non-traversable medians may exercise partial or complete control of left turns, depending on the presence and spacing of median openings for left and U turns.

“Full” median control provides complete restriction of any left turning movements. “Partial” median control allows some well-defined and channelized breaks in the physical median barrier, or island; this control can be provided by physical median barriers, or islands interspersed with segments of continuous two-way left-turn lanes. “No” control of left turns refers to an undivided highway, continuous two-way left-turn lane or any traversable median that can be crossed easily.

Proposed Access Management Standards and Guidelines

The standards to be applied on a specific roadway for location spacing, design and control measures are determined from criteria and methods spelled out in technical background papers for spacing of signalized intersections, median treatments, and driveways or street approaches. Each of these issues is currently being treated in separate background papers. These papers after review, comment and approval, will be rewritten into policies.

Table 9, at the end of this section, is given as an example of typical values for the important access management standards. The rationale behind these standards is now given. Each of these standards would be set following a comprehensive analysis that would take account of important information, including such factors as volume levels, character of land use, trip generation rates of land uses, facility design, and presence of pedestrians. Some of the important factors for each of these issues are discussed in the following.

a. Signal Spacing

Signalized intersections that dictate progression speed should be spaced to minimize delays and disruptions to through traffic. The optimum spacing of signals is dependent on the speed, cycle length, traffic volumes and efficiency of signal progression. The volumes on urban arterials during morning and afternoon peak periods are high, requiring long cycle lengths of 120 to 150 seconds on major urban arterials. Since the concern for access management is greatest when the local land use is at maximum build-out, consequently with high demand volumes, and the greatest level of conflict, a 120-150 second cycle should be adopted for urban areas to determine the signal spacing. Further, as facility speeds increase, the signal spacings must also increase. However, allowable speeds on arterials reduce as an area becomes more urbanized. The figure shown below may be used to determine the appropriate signal spacing. Typical values for cycle lengths are:

120-150 sec - urban major arterials with speeds of 30-45 mph

90 sec - suburban arterials with speeds of 40-50 mph

60 sec - rural arterials with speeds of 45-55 mph

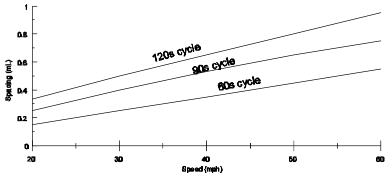

Figure 1. Signal Spacing vs. Speed

As a rural area becomes more urbanized and peak hour volumes increase, the cycle times increase from 50-60 seconds to about 120-150 seconds. Also, as the area becomes urbanized, the speeds of operation reduce from 55 mph typical of rural areas to 35-45 mph in an urbanized area. In general from the figure, note that the most appropriate signal spacing for rural, suburban, or urban arterials using the typical cycle lenths given above, is 1/2 mile. Signals may be spaced at intervals closer than shown to optimize capacity and safety, or where it operates as a secondary signal and doesn't impact progression excessively.

However, caution must be exercised to assure that decision on signal spacing and location meet both near term and long term growth and needs. The signal intersections, individually and as a coordinated system, must be able to accommodate present and future development and redevelopment. The signalized intersections, and coordinated signalized intersection system, must be able to handle future traffic volumes at the full build-out of the adjacent land-use plan and potential future pedestrian crossing activity.

Traffic signal spacing, or spacing of the primary coordinated signalized intersections, is of critical importance in maintaining the functional integrity of a facility. Other access management standards and controls cannot be effectively implemented if the traffic signal spacing and signal coordination are seriously flawed. The warranting and installation of traffic signals is not typically a progressive and orderly process, moving from the urban center outward. Special care must be taken to approve and implement signal locations to ensure that they meet the plan for the highway and the planned future traffic signal locations.

A more comprehensive treatment of the signalized intersection standard is provided in Background Paper #9, which after reviews and approval, will be rewritten and adopted as a policy to guide the analysis and decisions on this standard.

b. Median Opening Type and Spacing

The basic median design options that would typically be used are:

- full control - restriction of left or U turns
- partial control - well defined and channelized break in the median
- No control or NA - no turn restrictions

Unique treatments may be considered based on engineering analysis and design. The final decision should be based on current standards, highway engineering design principles, cost effectiveness and the need to protect the utility of the highway, as defined in the Background Paper on Median Treatments, #4. Type of median refers to the design at the location.

c. Approach Type and Spacings

The standards for the spacing and design of approaches, that is, unsignalized intersections or driveways, must take account of safety, sight distance, and operational impacts on the traffic stream, such as, delays, air pollutant emissions and energy consumption. These are approach spacings for the median treatment specified. The spacing between drives and other accesses should take account of operating speeds, acceleration requirements, entering/exiting volumes and the potential for overlapping influence areas. Typically, no signals would be permitted at private access points on statewide and regional highways. Signals may be considered at common shared drives, particularly at high volume locations, where a secondary signal can be introduced with no loss to arterial coordination and progression. Alternatives to signals may be used to offset negative impacts from drives, such as, non-traversable medians or controlled right-in/right-out channelization. Approaches should be located at median openings, where possible, to accommodate the turns permitted.

A number of methods can be used to determine the spacing between approaches and driveways including: minimum stopping sight distance; right-turn conflict overlap; maximum egress capacity; and rule of thumb.

i) Minimum Stopping Sight Distance

The minimum stopping sight distance according to the AASHTO Greenbook[6] distance, is determined based on:

$$SSD = \frac{1.47Vt + V^2}{30(f \pm g)}$$

where SSD = desirable minimum stopping sight distance, ft.

V = design speed, or speed of operation, mph

t = 2.5 sec. perception reaction time for 85% of drivers

f = coefficient of friction for braking on a poor, wet pavement

g = roadway grade, in decimal, with plus/upgrade and minus/downgrade

The stopping sight distances are given in Table 5. Some analysts express concern over the high deceleration rates required with the coefficients assumed in the AASHTO criteria. For example, at 20 mph, the deceleration rate corresponding to f_{WET} = 0.40 is

F=ma and $f \times W = \frac{W \times a}{32.2\,fps^2}$, therefore,

$$a = f \times 32.2 = 0.4 \times 32.2 \approx 12.8 \text{ ft/sec}^2$$

Assuming more comfortable average deceleration rates acceptable to 50% of drivers at 9 fps^2, and 85% of drivers with 6 fps^2, the stopping distances are calculated.

[6] Policy on Geometric Design of Streets and Highways, AASHTO, Washington, DC, 1990.

Table 3. Suggested Freeway / Expressway Access Standards

Category	Functional Class (a)	Level of Importance (b)	Area (c)	Typical Signal Spacing*	Typical Speed (d)	Typical Median Control (e)	Median Opening Spacing			
							Type	Spacing	Type	Spacing
1A	Full control (Freeway)	Interstate/ Statewide	Fully Developed Urban	NA	55 mph	Full	Interchange	2 mi.	NA	NA
1B			Suburban Developing Urban	NA	55-65 mph	Full	Interchange	3 mi.	NA	NA
1C			Rural	NA	60-65 mph	Full	Interchange	6 mi.	NA	NA
2	Expressway	Statewide	Urban Rural	1/2 mi. NA	45-55 mph 55 mph	Full/ partial Full/ partial	NA NA	1/2 mi. 1/2 mi.	None None	NA NA

NA=Not Applicable

* Note: Signals are not permitted on freeway, but are allowed on expressways.

(X) in the column heading for each topic refers to the subsection in the Proposed Access Management Classification System section where the topic is discussed in detail.

Table 4. Suggested Non-Freeway Access Management Classification System

Category	State Highway Functional Class* (a)	Level of Importance (b)	Multilane or Two-Lane	Area (c)	Typical Operating Speed (d)	Typical Median Control (e)
3.	Major Arterial	Statewide / regional	Multilane	Rural	55 mph	full / partial
				Urban	45 mph	full / partial
				Fully developed**	35 mph	n/a
			Two-Lane	Rural	55 mph	none
				Urban	45 mph	none
				Fully developed**	35 mph	none / partial
4.	Minor Arterial	Regional / district	Multilane	Rural	55 mph	partial
				Urban	45 mph	none / partial
				Fully developed**	35 mph	NA
			Two-Lane	Rural	55 mph	partial
				Urban	45 mph	none / partial
				Fully developed**	35 mph	none / partial
5.	Major Collector	District	Multilane	Rural	45 mph	none / partial
				Urban	40 mph	none
				Fully developed**	35 mph	NA
			Two-Lane	Rural	45 mph	none
				Urban	40 mph	none / partial
				Fully developed**	35 mph	none / partial

* The functional class stated is for the state highway system. Some facilities may qualify for a higher functional class for the local jurisdiction. The highest functional class, state or local, should be used to assign the access management category.

** Fully developed refers to urban areas that have historically and traditionally been served by the main streets for urban areas, typically in and near the central business district.

(X) in the column heading for each topic refers to the subsection in the Proposed Access Management Classification System section where the topic is discussed in detail.

Table 5. Stopping Sight Distance[7]

Speed, mph	f_{WET}	SSD	Calculated Stopping Distance	
			9 fps^2 decel	6 fps^2 decel
20	.40	110	120	145
25	.38	145	165	205
30	.35	195	220	275
35	.34	250	275	350
40	.32	315	340	435
45	.31	385	410	530
50	.30	460	485	640
55	.30	540	565	750

Figure 2. Right Turn Conflict Overlap

[7] "Driveway and Street Intersection Spacing," TRB Circular 456, TRB, Washington, DC, March 1996.

ii) Right Turn Conflict Overlap

The concept with criteria centers around the minimization of the number of access points that a driver must monitor within the driving task. The criteria is developed based on the adequate separation of conflict points, that is, approaches or driveways. Figure 2 demonstrates the concept.

The distance for the right turn conflict is equal to the stopping distance, with 1.0 s perception reaction time and 6.0 fps^2 average deceleration. Entering vehicles accelerate at an average of 2.1 to 3.1 fps^2. Typically, the right turn conflict does not require much speed reduction of vehicles in the through lanes, about 10 mph, if one driveway is visible. Table 6 presents the minimum distance to reduce collision potential for right turn conflict with the single right turn conflict condition.

Table 6. Minimum Distances for Right Turn Conflict Overlap

Speed, mph	Separation, ft.
30	100
35	150
40	200
45	300

Where the double right turn conflict condition is acceptable, the values in Table 6 are halved.

iii) Maximum Egress Capacity

Driveways are spaced at distances greater than 1.5 times the distance required to accelerate from zero to the speed of through traffic. This reduces delay and improves the gap acceptance and absorption of entering vehicles into the traffic stream. This is based on work done by Major and Buckley.[8] The acceleration characteristics for passenger cars from the 1990 AASHTO Greenbook are used. Table 7 shows the minimum spacings for approaches based on the maximum egress capacity.

[8] I.T. Major and D.J. Buckley, "Entry to a Traffic Stream," Proceedings, Australian Road Research Board, 1962.

Table 7. Minimum Access Spacing to Provide Maximum Egress Capacity Speed

Speed, mph	Spacing, ft.
20	120
25	190
30	320
35	450
40	620
45	860
50	1125
55	1500

iv) Rule of Thumb

Some agencies use a rule of thumb that spaces driveways and approaches at a distance equal to five times the driveway width. This does not provide a logical or analytical base for specifying the approach and driveway spacing.

v) Decision Sight Distance

The decision sight distance could be used to provide smooth and safe operations on the arterial. This would accommodate the time and distance for drivers to see, understand conditions and either stop or change lanes. This would also allow for drivers with varying expectations to operate safely and smoothly. Table 8 presents the decision sight distance conditions for fully developed urban, (other) urban and rural conditions.

Table 8. Decision Sight Distance to Stop or for a Speed, Direction or Path Change

Area	Speed, mph	Stop, ft	Speed/Path/Direction
Fully developed urban	35	620	710 ft
Other (urban)	45	640	810 ft
Rural	55	590	870 ft

vi) Recommended Standard

It is recommended that on major arterials that capacity and safety are both concerns so the maximum egress capacity and decision sight distance should be provided. For the minor arterial the safety is a greater concern than capacity so decision sight distance should be used to set the spacing. For major collectors, the single conflict overlap criteria is recommended since it provides a reasonable measure of safety and available access is of more concern than capacity for these facilities.

The approach spacings and locations should consider the trips to be generated by the land uses, the frequency of left turns, the size of vehicles, and the opportunity for high speeds of access. Also, the potential for consolidating driveways should be evaluated. The Background Paper #12 on Approaches and Driveways will provide the analysis methods, standards and guidelines.

e. Variance Process

Unique locations, unusual land use conditions or specific access needs may require access designs, locations or spacings that vary from the standards specified herein. The application of all access control standards or strategies should be based on the test of reasonability. Standards should not be applied arbitrarily. A study of the potential access, impacts to the property, long-term development and traffic growth should be undertaken. A variance policy and procedures will allow deviations from the standards when justified.

Table 9. Access Control and Standards for Non-Freeway and Non-Expressway Facilities

Category	State Highway Functional Class	Multi-lane or Two-Lane	Area	Typical Speed	Typical Median Control	Typical Signal Spacing (a)	Median Openings (b)		Approach / Drives (c)	
							Type	Spacing	Type	Spacing
3.	Major Arterial	Multi-lane	Rural	55 mph	full / partial	1/2 mi	no break	1/2 mi	rt turn	1,320 ft
			Urban	45 mph	full / partial	1/2 mi	no break	1/4 mi	rt turns	990 ft
			Fully developed	35 mph	none	1/2 mi	NA	NA	rt turns	660 ft
		Two-Lane	Rural	45 mph	none	1/2 mi	NA	NA	rt turn	1,320 ft
			Urban	45 mph	none/partial	1/2 mi	CTWLTL	NA	rt turns	990 ft
			Fully developed	35 mph	none/partial	1/2 mi	CTWLTL	NA	rt turns	660 ft
4.	Minor Arterial	Multi-lane	Rural	55 mph	partial	1/2 mi	partial	660 ft	lt / rt turns	660 ft
			Urban	45 mph	none/partial	1/2 mi	full / NA	330 ft NA	lt / rt turns	660 ft
			Fully developed	35 mph	none	1/2 mi	NA	NA	lt / rt turns	660 ft
		Two-Lane	Rural	55 mph	none	1/2 mi	NA	NA	lt / rt turns	660 ft
			Urban	45 mph	none/partial	1/2 mi	CTWLTL	NA	lt / rt turns	660 ft
			Fully developed	35 mph	none/partial	1/2 mi	CTWLTL	NA	lt / rt turns	660 ft.
5.	Major Collector	Multi-lane	Rural	45 mph	none	1/2 mi	NA	NA 330 ft	lt / rt turns	660 ft
			Urban	40 mph	none	1/4 mi	NA	NA	lt / rt turns	330 ft
			Fully developed	35 mph	none	1/4 mi	NA	NA	lt / rt turns	160 ft
		Two-Lane	Rural	45 mph	none	1/2 mi	NA	NA	lt / rt turns	660 ft
			Urban	40 mph	none/partial	1/4 mi	CTWLTL	NA	lt / rt turns	330 ft
			Fully developed	35 mph	none/partial	1/4 mi	CTWLTL	NA	lt / rt turns	160 ft.

* The functional class stated is for the state highway system. Some facilities may qualify for a higher functional class for the local jurisdiction. The highest functional class, state or local, should be used to assign the access management category.

** Fully developed refers to urban areas that have historically and traditionally been served by the main streets for urban areas, typically in and near the central business district.

(X) in the column heading for each topic refers to the subsection in the Access Management Standards and Guidelines section where the topic is discussed in detail.