TOWN OF NORTHLAKE

ENGINEERING DESIGN MANUAL

PART II – PAVING

PART II - PAVING

I. STREET AND ARTERIAL CLASSIFICATIONS

1.01 GENERAL

Town streets and arterials are classified into types according to their use and locations as indicated in Table II-1. The basic types include the residential streets which provide direct access and frontage to adjacent properties, collectors which serve as the distributor-collector routes and provide direct access to adjacent properties, and minor and major arterials which carry high volumes of traffic. Each roadway is made up of elements which are related to the use of that particular facility. These elements include right-of-way, pavement width, median width if required, arrangement of traffic lanes, curb radii at intersections and other characteristics.

The Town of Northlake intends to maintain the rural character of certain areas of the Town as shown on the Land Use Development Concept Plan. Toward that end, rural roadway standards will be permitted in rural residential areas. Rural standards employ paved shoulders in lieu of curb and use bar ditches for drainage.

II. STREET AND ARTERIAL DIMENSIONS

2.01 GENERAL

Geometrics of streets and arterials may be defined as the geometry of the curbs or pavement areas which governs the movement of traffic within the confines of the right-of-way. Included in the geometrics are the pavement widths, degree of curvature, width of traffic lanes, shoulders, turning lanes, median width separating opposing traffic lanes, median nose radii, curb radii at street intersections, crown height, cross fall, geometric shapes of islands separating traffic movements and other features.

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TABLE II-1

STREET AND ARTERIAL CLASSIFICATIONS
AND DIMENSIONS

STREET TYPE	DESCRIPTION	PVMT. WIDTH	MIN. ROW WIDTH	LANES	SHOULDER WIDTH	MIN. PARKWAY WIDTH	MEDIAN WIDTH	MIN. PVMT. THICKNESS	DESIGN SPEED (MPH)
Alley		10'	15'	1-10'	N.A.	2.5'	N.A.	7"	10
Urban Standards									
L2U-U	Local Residential	31'	50'	2-15'	N.A.	9.5'	N.A.	6"	30
C2U-U	Local Collector	37'	60'	2-18'	N.A.	11.5'	N.A.	7"	35
M2U-U*	Minor Arterial (undivided)	41'	60'	2-20'	N.A.	9.5'	N.A.	8"	40
M4U-U	Minor Arterial (undivided)	55'	80'	2-15' & 2-12'	N.A.	12.5'	N.A.	8"	40
M4D-U	Minor Arterial (divided)	2-28'	100'	2-15' & 2-12'	N.A.	11.5'	21'	8"	45
P6D-U	Primary Arterial (divided)	2-40'	120'	2-15' & 4-12'	N.A.	9.5'	21'	8"	45
* For Industrial Areas Only									
Rural Standards									
L2U-R	Local Residential	24'	60'	2-11'	2-1'	18'	N.A.	6"	30
C2U-R	Local Collector	36'	70'	2-12'	2-6'	17'	N.A.	7"	35
M4U-R	Minor Arterial (undivided)	64'	100'	4-12'	2-8'	18'	N.A.	8"	40
M4D-R	Minor Arterial (divided)	2-32.5'	120'	4-12'	2-8'	17'	21'	8"	45
P6D-R	Primary Arterial (divided)	2-44.5'	140'	6-12'	2-8'	15'	21'	8"	45

Note: All pavement and median width dimensions are to back of curb or edge of pavement.

2.02 DESIGN VEHICLES

The geometrics of Town streets and arterial intersections vary with the classification of intersecting streets. Criteria for the geometric design of intersections must be based on certain vehicle operating characteristics, and vehicle dimensions. The American Association of State Highway and Transportation Officials (AASHTO) has standardized vehicle criteria into three general designs which is published in the AASHTO Publication, "A Policy on Geometric Design of Highways and Streets", dated 2001. In the design of street and thoroughfare intersections for the Town, these vehicle designs are adopted for use. Table II-2, Intersection Design Standards, shall be used for intersection design.

TABLE II-2

INTERSECTION DESIGN STANDARDS
(All dimensions are minimums)

	A_1*	A_1+	A_1#	A_2*	A_3	B	C	D	E	F	R_1	R_2	Corner Clip
P6D-U & R6D-R	275'	150'	100'	150'	150'	150'	10'	330'	600'	60'	50'	50'	25 X 25
M4D-U & M4D-R	200'	150'	100'	150'	150'	150'	10'	330'	600'	60'	50'	50'	25 X 25
M4U-U & M4U-R	200'	150'	100'	150'	150'	150'	N/A	330'	N/A	N/A	40'	40'	20 X 20
M2U-U	150'	150'	100'	150'	150'	150'	N/A	300'	N/A	N/A	40'	40'	20 X 20
C2U-U & C2U-R	100'	150'	100'	100'	150'	150'	N/A	270'	N/A	N/A	30'	30'	15 X 15
L2U-U & L2U-R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30'	30'	10 X 10

* When intersecting street is a principal or minor arterial.
+ When intersecting street is a collector or a rural road.
# When intersecting street is a local street.
** For dual left-turn standards, consult the Town
A_1 and A_2 may be increased to allow for stacking truck traffic.
Corner clip based on 90 degree intersection, may be adjusted for angled intersection.
Radius and corner clip are based on highest classification street at intersection.

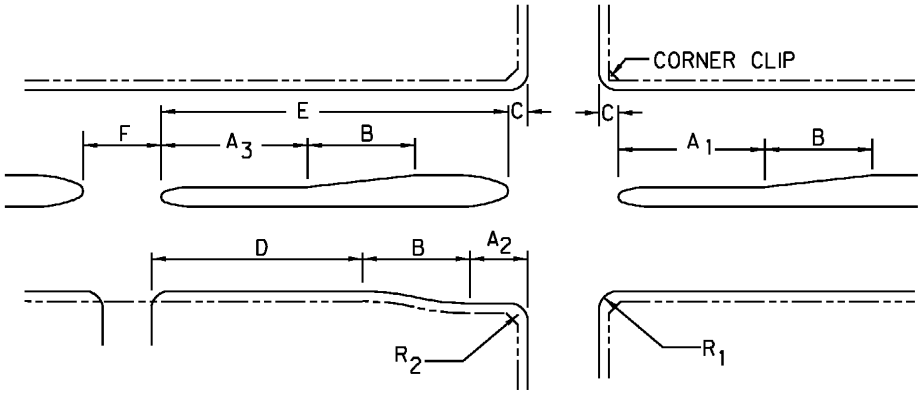


FIGURE II-1
INTERSECTION DESIGN DIAGRAM

2.03 DESIGN SPEED

The design speed is a primary factor in the horizontal and vertical alignment on Town streets and arterials. Design features such as curvature, superelevation, radii for turning movements and sight distance are directly related to the design speed. The design speed also affects features such as lane widths, pavement width, pavement cross-fall, pavement crown, and clearance.

The design speed is defined as the approximate maximum speed that can be maintained safely by a vehicle over a given section of road when conditions are so favorable that the design features of the roadway govern. The speed limit or posted speed is the maximum legal speed set by local authorities for a certain roadway or area. The design speed should always be greater than the likely legal speed limit for arterials.

The various street and arterial classifications, which make up the system within the Town, require different design speeds according to their use and location. The minimum design speeds for the various classifications within the Town of Northlake are presented in Table II-1. Lower design speeds may be required for all classifications for unusual conditions of terrain or alignment.

2.04 HORIZONTAL GEOMETRICS

a. General

The horizontal geometrics of Town streets and arterials include the segment of geometric design associated with the alignment, intersections, pavement widths, and related geometric elements. The various classifications, utilizing the design speed as a control, must have certain horizontal and vertical geometrics to provide a safe economical facility for use by the public. All curves shall provide proper sight distances.

b. Horizontal Curves and Superelevation

The alignment of Town streets and arterials is usually determined by the alignment of the existing right-of-way or structures which cannot be relocated. Changes in the direction of a street or arterial are minimized by constructing a simple curve having a radius compatible with the speed of vehicular traffic. To increase the safety and reduce discomfort to drivers traversing a curved portion of a street or thoroughfare, the pavement may be superelevated.

Curvature in the alignment of arterials and collectors is allowed, but greater traffic volume and higher vehicle speeds which accompany these facilities tend to increase accidents on curving roadways. Curves in the alignment of residential streets usually provide aesthetic values to the residential neighborhoods without affecting the orderly flow of traffic or sacrificing safety.

A recommended minimum radius of curvature for vehicle design speed and pavement cross-slopes is shown in Table II-3. These are based on traffic consisting of typical present day automobiles operating under optimum weather conditions. There are other important considerations in the design of curves on Town streets and arterials including the location of intersecting streets, drives, bridges and topographic features. When superelevation is required on collectors and arterials, the following basic formula shall be used:

$$R = \frac{V^2}{15\,(e + f)}$$

where:

e = rate of roadway superelevation, foot per foot

f = Side friction factor (See Table II-3)

V = vehicle design speed, mph

R = radius of curve in feet

TABLE II-3

MINIMUM CENTERLINE RADIUS
FOR ROADWAYS

Rate of Superelevation (In./Ft.)	Residential	Collector/Minor Arterial		Principal Arterial
	DESIGN SPEED (MPH)			
	30 mph	35 mph	40 mph	45 mph
-1/2	500 ft	710 ft	930 ft	1290 ft
-3/8	465 ft	655 ft	855 ft	1175 ft
-1/4	430 ft	605 ft	790 ft	1080 ft
-1/8	400 ft	565 ft	740 ft	1000 ft
0	375 ft	530 ft	690 ft	935 ft
+1/8	355 ft	495 ft	650 ft	875 ft
+1/4	335 ft	470 ft	610 ft	820 ft
+3/8	320 ft	445 ft	580 ft	775 ft
+1/2	300 ft	420 ft	550 ft	730 ft

Street Classification	Side Friction Factor (f)
Residential Streets	0.160
Collector Streets	0.155
Arterials	0.145

c. Turning Lanes

Turning lanes are provided at intersections to accommodate left-turning and right-turning vehicles. The primary purpose of these turning lanes is to provide storage for the turning

vehicles. The secondary purpose is to provide space to decelerate from normal speed to a stopped position in advance of the intersection or to a safe speed for the turn in case a stop is unnecessary. Left turn lanes at intersections are 11-12 feet in width. When turning traffic is too heavy for a single lane and the cross street is wide enough to receive the traffic, two turning lanes may be provided.

The location of the median nose at the end of the left turn lane should be located so that left turning traffic will clear the median nose while making a left turn. Other considerations include adequate clearance between the median nose, thru traffic on the intersecting thoroughfare and locations of the median nose to properly clear the pedestrian crosswalks.

Minimum length of left turn lanes for major thoroughfares shall be as specified in Table II-2.

The actual length shall be approved by the Town based upon projected left turn volume.

d. Street Intersections

The intersection at grade of arterials, collector streets, and residential streets shall be at ninety (90) degree angles. Intersections which are not a ninety (90) degree angle may be approved by the Town. Lanes shall be aligned for safe passage through the intersection.

e. Sidewalks

The purpose of the public sidewalks is to provide a safe area for pedestrians. The Town requires that sidewalks be constructed with the paving of streets, when building construction occurs, in all urban residential areas and wherever pedestrian traffic may be generated. All sidewalks shall conform to state laws for barrier free construction.

The standard concrete sidewalk is 4 feet in width for residential areas and 5 feet in width for commercial areas. Special sidewalk designs to include a 6-foot sidewalk located adjacent to the street will be considered for approval where warranted. For rural paving section sidewalks shall be located in sidewalk easements adjacent to right-of-way lines. Sidewalks shall not be located in ditches. One foot of width shall be added to all sidewalks abutting retaining walls.

Sidewalk alignments may be varied to avoid the removal of trees or the creation of excessive slopes when approved by the Town Engineer. A waiver for deletion of the requirement for sidewalk shall be submitted in writing and will become effective only upon Town Council approval.

2.05 VERTICAL ALIGNMENT

a. Street Grades

The vertical alignment of Town streets and arterials should be designed to insure the safe operation of vehicles and should allow easy access to adjacent property. A safe travelway for vehicles is dependent on criteria which considers operating speeds, maximum grades, vertical curves and sight distance. In addition to these considerations, other factors related to vertical alignment include storm drainage, crown and cross slope and the grade and right-of-way elevation relationship.

1. Minimum Grades

Minimum longitudinal grades for streets and arterials are required to insure proper flow of surface drainage toward inlets and to provide minimum ditch grades. Minimum grades are five tenths percent (0.5%) for all urban roadways. Valleys across intersections shall be a minimum of five tenths percent.

2. Maximum Grades

Maximum longitudinal grades shall be compatible with the type of facility and the accompanying characteristics including the design speed, traffic conditions and sight distance.

Arterials must move large volumes of traffic at faster speeds and flatter grades will better accommodate these characteristics. Truck and bus traffic on these type facilities often controls traffic movement, particularly if steep grades prevent normal speeds. The normal maximum street grades allowed are shown in Table II-4. Steeper grades may be permitted for short lengths where topographical features or restricted alignment require.

TABLE II-4

MAXIMUM STREET GRADES

Street Types	Normal Maximum Grade In Percent
Residential	8%
Collector	6%
Arterial	6%

b. Vertical Curves

When two longitudinal street grades intersect at a point of vertical intersection (PVI) and the algebraic difference in the grades is greater than one percent (1%) for design speed less than 45 mph or one-half (0.5%) for design speeds greater than 45 mph, a vertical curve is required. Vertical curves are utilized in roadway design to effect a gradual change between tangent grades and should result in a design which is safe, comfortable in operation, pleasing in appearance and adequate for drainage. The vertical curve shall be formed by a simple parabola and may be a crest vertical curve or a sag vertical curve.

c. Stopping Sight Distance

1. Crest Vertical Curve

When a vertical curve is required, it must not interfere with the ability of the driver to see length of street ahead. This length of street, called the stopping sight distance, should be of sufficient length to enable a person in a vehicle having a height of 3.50 feet above the pavement and traveling at design speed to stop before reaching an object in his path that is 0.5-foot in height.

The minimum stopping sight distance is the sum of two distances: first, the distance traversed by a vehicle from the instant the driver sights an object for which a stop is necessary, to the instant the brakes are applied; and second, the distance required to stop the vehicle after the brake application begins.

The minimum safe stopping sight distance and design speeds are shown in Table II-5. These sight distances are based on each design speed shown and based on a wet pavement. The length of crest vertical curve required for the safe stopping sight distance of each street type may be calculated using the formula L = KA and the values of K for a crest vertical curve shown in Table II-5.

2. Sag Vertical Curve

When a sag vertical curve is required, the vertical curve shall be of sufficient length to provide a safe stopping sight distance based on headlight sight distance. The minimum length of sag vertical curve required to provide a safe stopping sight distance may be calculated using the formula L = KA and values of K for a sag vertical curve are shown on Table II-5.

TABLE II-5

MINIMUM LENGTH OF VERTICAL CURVE

CREST VERTICAL CURVE	SAG VERTICAL CURVE
L = KA where	L = KA where
L = Minimum Length Vertical Curve required for safe stopping	L = Minimum Length Vertical Curve required for Headlight Control
K = Horizontal Distance in feet requires to affect a one percent change in gradient	K = Horizontal Distance in feet required to affect a one percent change in gradient
A = Algebraic Difference in grade	A = Algebraic Difference in grade

Street Type	Design Speed	Safe Stopping Sight Distance	Normal Crest Vertical Curve K	Normal Sag Vertical Curve K	Minimum Length of Curve
Local Residential	30	200	19	37	60
Local Collector	35	250	29	49	100
Minor Arterial	40	305	44	64	100
Primary Arterial	45	360	61	79	120

d. Intersection Grades

The grade of an intersecting street with the principal street gutter should not generally be more than two percent (2%) either up or down within the first 20 feet beyond the curb line of the principal street. Grade changes greater than one percent (1%) will require vertical curves.

The grade of street or arterial, particularly at its intersections with another street, is of prime importance in providing a safe, comfortable riding surface. The intersection design of two arterials shall include grades which will result in a plane surface or at least a surface which approximates a plane surface. Grades in excess of 3% should be avoided. A maximum grade of 2% is desirable. A vehicle traveling on either thoroughfare should be able to traverse the intersection at the design speed without discomfort. For intersections involving streets of different classifications, the profile of street with the lesser classification shall be adjusted to meet the profile of the street with the higher classification. No valleys across major thoroughfares or collectors will be allowed. To accomplish a smooth transition, crossfall toward the median of one lane of each thoroughfare may be required. The use of storm drainage inlets in the median shall be avoided if possible.

In drawing the grades of intersecting thoroughfares in the profile view of plan/profile sheets, profiles of all four profiles shall be shown as a continuous line through the intersection. All intersections where any street is classified as a collector or arterial shall be contour graded with minimum contour intervals of 0.2 feet.

e. Street Cross Section

For curbed streets, the right-of-way shall be graded to drain to the street at a slope of 1/4" per foot. Street back slopes and embankment slopes shall not be steeper than 4:1.

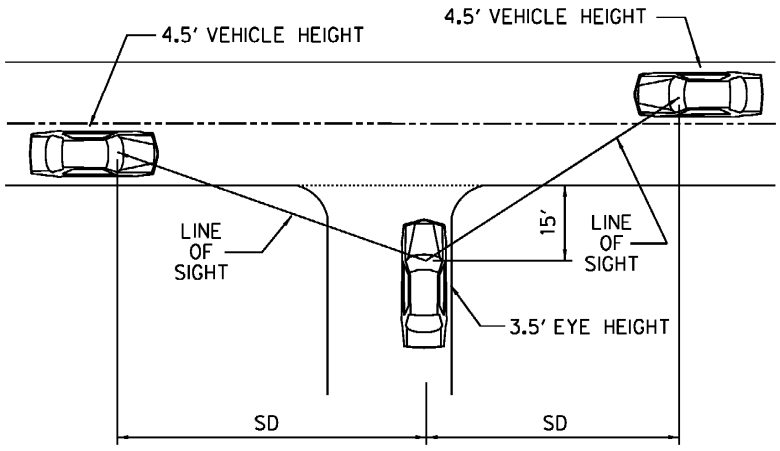
2.06 SIGHT DISTANCE AT INTERSECTIONS

An important consideration in the design of Town streets and arterials is the vehicle attempting to cross the street or thoroughfare from the side street or drive. The operator of the vehicle attempting to cross should have an unobstructed view of the whole intersection and a length of the thoroughfare to be crossed sufficient to permit control of the vehicle to avoid collisions. The minimum sight distance considered safe under various assumptions of physical conditions and driver behavior is related directly to vehicle speeds and to the resultant distance traversed during perception and reaction time and during braking. This sight distance, which is termed intersection sight distance, can be calculated for different street or thoroughfare widths and for various grades upwards and downwards. Intersection sight by AASHTO publication "A Policy on Geometric Design of Highways and Streets", 2001. Sight distance requirements are defined by Table II-6 and Figure II-2. As a minimum visibility triangles shall be provided as shown in Figure II-3.

TABLE II-6

SIGHT DISTANCE REQUIREMENTS

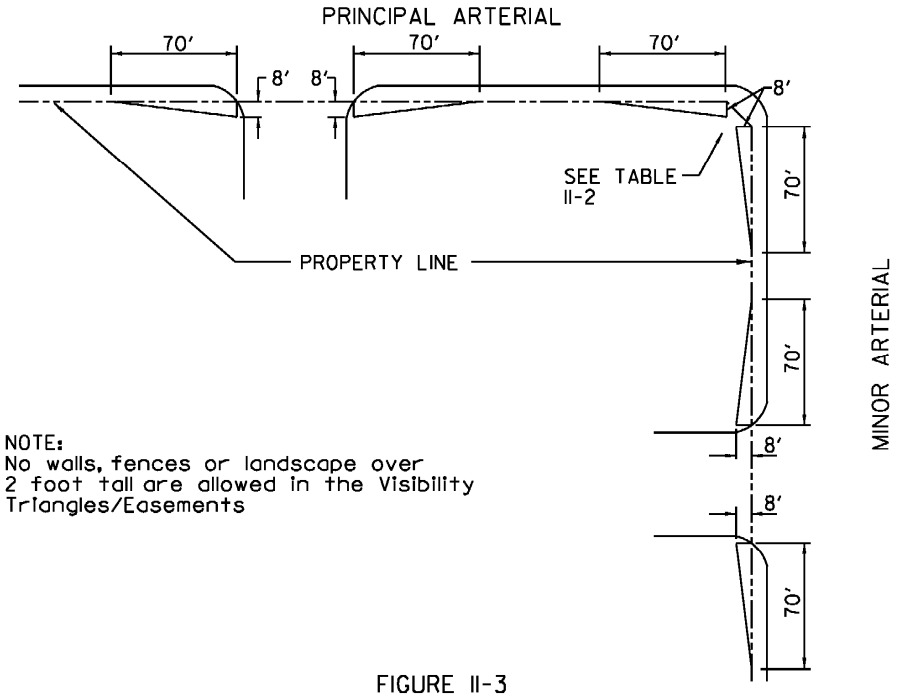
Design Speed (mph)	Stopping Sight Distance (feet)	Intersection Sight Distance for passenger Cars (feet)
30	200	335
35	250	390
40	305	445
45	360	500
55	495	610



(DRAWING NOT TO SCALE)

SD = Sight Distance

FIGURE II-2
SIGHT DISTANCE REQUIREMENTS



NOTE:
No walls, fences or landscape over 2 foot tall are allowed in the Visibility Triangles/Easements

FIGURE II-3
VISIBILITY TRIANGLES

2.07 MEDIAN OPENINGS

The following standards for median openings are established to facilitate traffic movement and promote traffic safety:

Major Streets

Median openings will normally be permitted at all intersections with dedicated Town streets. Exceptions would be at certain minor streets where due to unusual conditions a hazardous situation would result.

Midblock median openings or other openings with turns permitted into adjacent property will not normally be permitted unless all the following conditions exist:

a. The property to be served is a significant traffic generator with demonstrated or projected trip generation of not less than two hundred and fifty (250) vehicles in a twelve-hour period.

b. The median opening is not less than 600 feet from another median opening.

2.08 CUL-DE-SACS

The maximum length of any cul-de-sac shall be 500 feet measured from curb line of the intersecting street to the radius point of turn around. The right-of-way radius shall be 50 feet and the curb radius 40 feet within the cul-de-sac turn around. All cul-de-sac turnarounds shall be visible from the intersecting street.

III. DRIVEWAY STANDARDS

3.01 DRIVEWAY REQUIREMENTS

Driveways shall be governed by Tables II-7 and II-9. Refer to Figures II-1 and II-4.

TABLE II-7

DRIVEWAY REQUIREMENTS

A - Driveway Throat Width	**Residential (Min) (Max)**	**Industrial (Min) (Max)**	**Commercial (Min) (Max)**
Local	15 – 28 ft	40 ft	30 – 40 ft
Collector	15 – 28 ft	40 – 60 ft *	30 – 40 ft
Minor Arterial	N/A	40 – 60 ft *	30 – 60 ft
Principal Arterial	N/A	40 – 60 ft *	30 – 60 ft
Driveway Curb Radius			
Local	5 ft	30 ft	20 ft
Collector	5 ft	40 ft	25 ft
Minor Arterial	N/A	40 ft	30 ft
Principal Arterial	N/A	50 ft	35 ft
B - Minimum Centerline Driveway Spacing Along			
Local	15 ft	110 ft	70 ft
Collector	25 ft	110 ft	120 ft
Minor Arterial	N/A	160 ft	170 ft
Principal Arterial	N/A	250 ft **	230 ft
Driveway Angle	90°	90°	90°
C - Minimum Distance from Driveway to Intersection			
Local	50 ft	100 ft	100 ft
Collector	50 ft	100 ft	120 ft
Minor Arterial	N/A	175 ft	150 ft
Principal Arterial	N/A	175 ft	150 ft
Maximum Approach Grade			
Local / Collectors	10%	6%	6%
All Others	10%	6%	6%
Right Turn Requirement	10%	6%	6%

* Can be wider based on site requirements.
** Driveways should be used jointly at median openings.
Based on 40 mph.
Driveway width plus radius must be contained within the property frontage, between the extended property lines.
State Standards, if more restrictive, shall apply to State maintained roadways.

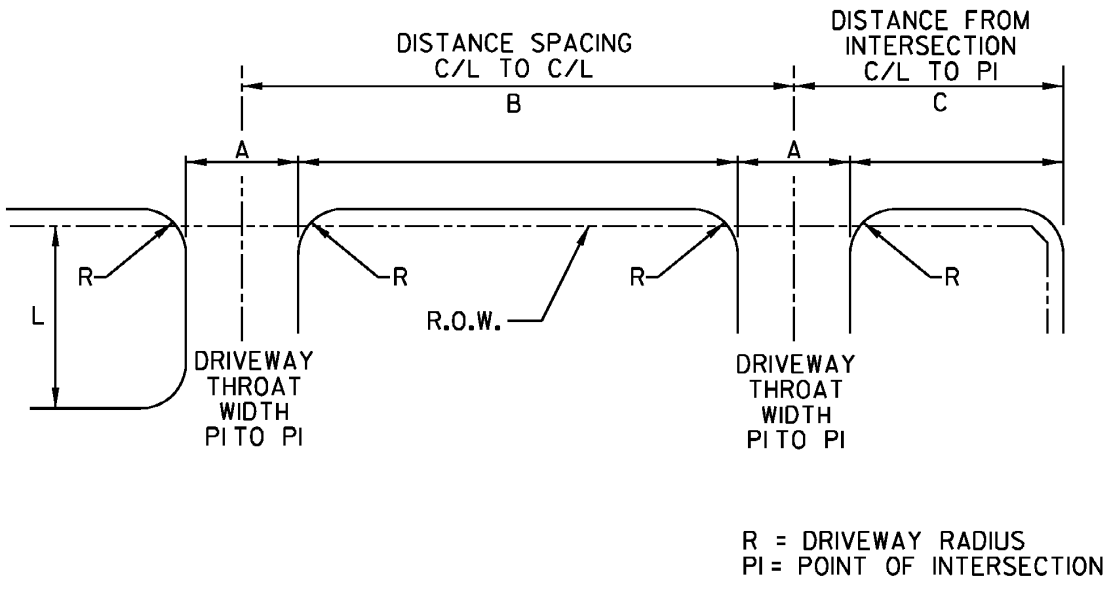


FIGURE II-4
DRIVEWAY REQUIREMENTS

TABLE II-8

MINIMUM DRIVEWAY STORAGE LENGTH (L)
(See Figure II-4)

Number of Parking Spaces per Driveway	Minimum Storage Length* (feet)
Less than 50	18
50 to 200	50
More than 200	78

* Storage length is defined as the distance between the street right-of-way line and the first intersecting aisleway on the side.

IV. TRAFFIC IMPACT ANALYSIS GUIDELINES

4.01 DEFINITIONS – THE FOLLOWING TERMS ARE USED IN THIS ARTICLE.

a. Projected traffic volumes – The number of vehicles that are expected/calculated to exist on streets after completion of the project.

b. Study area – The boundaries in which the study is conducted.

c. TIA (Traffic Impact Analysis) – An in-depth analysis of traffic.

d. Traffic queuing – A line of waiting vehicles.

e. Trip distribution – Estimates of percentage distribution of trips by turning movements from the proposed development.

f. Trip generation summary – A table summarizing the trip generation characteristics of the development for the entire day including AM and PM peak periods, rates and units used to calculate the number of trips.

g. Non-site traffic – Traffic not created or associated with the traffic generated by the project.

4.02 PURPOSE

The purpose of a Traffic Impact Analysis (TIA) is to assess the effects of specific development activity on the existing and planned roadway system. It is the intent of this ordinance to make traffic access planning an integral part of the development process.

4.03 APPLICABILITY

a. A Traffic Impact Analysis (TIA) will be required at the time of platting for land developments that are expected to meet a threshold level of change as described in Section 4.04 below, "When Traffic Impact Analysis (TIA) is Required". The Town reserves the right to require a TIA for land developments that do not meet the threshold requirements, but may impact a sensitive area with traffic issues or may be a known public concern.

b. A Traffic Impact Analysis (TIA) will be required when there is a request to amend the Thoroughfare Plan.

4.04 WHEN TRAFFIC IMPACT ANALYSIS (TIA) IS REQUIRED

a. A TIA will be required of the property owner (or designated agent) when an activity or change to the property occurs and any of the following occur:

1. More than 500 Peak Hour Trip (PHT) generation
2. More than 5,000 vehicle trips per day generation
3. More than 100 acres of property is involved
4. Any changes or alterations to the Town Thoroughfare Plan

b. The property owner (or designated agent) shall perform and submit to the Town of Northlake a TIA performed at a minimum as established in Section 4.06, "Traffic Impact Analysis Requirements". The TIA must be signed and sealed by a professional engineer, registered to practice in Texas, with experience in Transportation Engineering sufficient to assess traffic impacts.

c. The engineer conducting the study must be approved by the Town prior to performing the study. The Town of Northlake Public Works Department must approve all TIA's before final acceptance. After acceptance of the TIA, the review process will determine further actions.

4.05 ROLES OF APPLICANT AND TOWN

A TIA that is required of the applicant by the Town of Northlake is part of the development review and approval process. The primary responsibility for assessing the traffic impacts associated with a proposed development rest with the applicant. The Town serves in a review capacity for this process.

4.06 TRAFFIC IMPACT ANALYSIS (TIA) REQUIREMENTS

a. The Traffic Impact Analysis (TIA) must be prepared and evaluated by a consultant who meets the qualifications described in Section 4.04 (b) to perform such studies.

b. The analysis is required to contain at a minimum, the following:

1. Traffic Analysis Map

(a) Land Use, Site and Study Area Boundaries, as defined (provide map).

(b) Existing and Proposed Site Uses.

(c) For TIA's where land use is the basis for estimating projected traffic volumes and existing and Proposed Land Uses on both sides of boundary streets for all parcels within the study area (provide map).

(d) Existing and Proposed Roadways and Intersections of boundary streets within the study area of the subject property, including traffic conditions (provide map).

(e) All major driveways and intersecting streets adjacent to the property will be illustrated in sufficient detail to serve the purposes of illustrating traffic function. This may include showing lane widths, traffic islands, medians, sidewalks, curbs, traffic control devices (traffic signs, signals, and pavement markings), and a general description of the existing pavement condition.

(f) Photographs of adjacent streets of the development and an aerial photograph showing the study area.

2. Trip Generation and Design Hour Volumes (provide table).

(a) A trip generation summary table listing each type of land use, the building size assumed, average trip generation rates used (total daily traffic and a.m./p.m. peaks), and total trips generated shall be provided.

(b) Vehicular trip generation may be discounted in recognition of other reasonable and applicable modes, e.g., transit, pedestrian or bicycles. Trip generation estimates may also be discounted through the recognition of passby trips and internal site trip satisfaction. All such estimates shall be subject to the approval of the Town.

(c) Proposed trip generation calculations for single-story commercial properties shall be based on a Floor-to-Area (building size to parcel size) ratio of 0.25 or more.

3. Trip Distribution (provide figure by Site Exit/Entrance). The estimates for percentage distribution of trips by turning movements to/from the proposed development.

4. Trip Assignment (provide figure by site entrance and boundary street). The direction of approach of site-attracted traffic via the area's street system.

5. Existing and Projected Traffic Volumes (provide figure for each item). Existing traffic volumes are the numbers of vehicles on the streets of interest during the time periods listed below, immediately prior to the beginning of construction of the land development project. Projected traffic volumes are the number of vehicles, excluding the site-generated traffic, on the streets of interest during the time periods listed below, in the build-out year.

   (a) A.M. Peak Hour site traffic (including turning movements) if significant impact.

   (b) P.M. Peak Hour site traffic (including turning movements).

   (c) Weekend Peak Hour site traffic (including turning movements).

   (d) A.M. Peak Hour total traffic including site-generated traffic and Projected Traffic (including turning movements).

   (e) P.M. Peak Hour total traffic including site-generated traffic and Projected Traffic (including turning movements).

   (f) Weekend Peak Hour total traffic including site-generated traffic and Projected Traffic (including turning movements).

   (g) For special situations where peak traffic typically occurs at non-traditional times, e.g., major sporting venues, entertainment venues, large specialty Christmas stores, etc., any other Peak hour necessary for complete analysis (including turning movements).

   (h) Total daily existing traffic for street system in study area.

   (i) Total daily existing traffic for street system in study area and new site traffic.

   (j) Total daily existing traffic for street system in study area plus new site traffic and projected traffic from build-out of study area land uses.

6. Capacity Analysis (provide Analysis Sheets in Appendices).

   (a) A capacity analysis shall be conducted for all public streets, intersections and junctions of major driveways with public streets, which are significantly impacted (as designated by the Town), by the proposed development within the previously defined study boundary.

(b) Capacity analysis will follow the principles established in the latest edition of the Transportation Research Board's *Highway Capacity Manual* (HCM), unless otherwise directed by the Transportation Services Director. Capacity will be reported in quantitative terms as expressed in the HCM and in terms of traffic Level of Service.

(c) Capacity analysis will include traffic queuing estimates for all critical applications where the length of queues is a design parameter, e.g., auxiliary turn lanes and at traffic gates.

7. Conclusions and Requirements.

(a) Roadways and intersections, within the Study Area, that are expected to operate at Level of Service D, E, or F, under traffic conditions including projected traffic plus site-generated traffic must be identified and viable recommendations made for raising the traffic conditions to Level of Service C or better (Level of Service A or B).

(b) Level of Service "C" is the design objective for all movements and under no circumstances will less than Level of Service "D" be deemed acceptable for site and non-site traffic including existing traffic at build-out of the study area. The Town must approve a Level of Service "D".

(c) For phased construction projects, implementation of traffic improvements must be accomplished prior to the completion of the project phase for which the capacity analyses show that they are required. Plats for project phases subsequent to a phase for which a traffic improvement is required may be approved only if the traffic improvements are completed or bonded.

(d) Voluntary efforts, beyond those herein required, to mitigate traffic impacts are encouraged as a means of providing enhanced traffic handling capabilities to users of the land development site as well as others.

(e) Traffic mitigation tools include, but are not limited to, pavement widening, turn lanes, median islands, access controls, curbs, sidewalks, traffic signalization, traffic signing, pavement markings, etc.

(f) The applicant will provide five (5) copies of the Draft Report for review and nine (9) copies of the Final Report for submittal.

8. Other Items

(a) The Town may require other items be included in the TIA above those listed above.

V. PAVEMENT DESIGN

5.01 STANDARD STREET AND ARTERIAL PAVEMENT DESIGN

All new roadways within the Town of Northlake shall be constructed of reinforced concrete with the exception of rural residential streets (LTU-R). Asphalt pavements may also be used for temporary construction, if approved by the Town. Table II-9 shows the required pavement thickness for rigid pavement and the subgrade requirements for certain soil conditions for various street and thoroughfare types within the Town. The procedure for using this table requires that a soils

investigation be made including obtaining soil auger borings, classifying the soils encountered and determining the strength and physical properties of the underlying and supporting soils system in moisture content, and unit dry weight (see 5.02 – Geotechnical Investigation Required). For each soil classification encountered, the plasticity index shall be calculated and depending whether the P.I. is less or more than the critical percentage shown, the subgrade design shall consist of a 6-inch compacted subgrade or a lime or cement treated subgrade as shown in Table II-9. Table II-9 also presents the recommended pavement thickness of portland cement concrete pavement for the various street and arterial types.

5.02 GEOTECHNICAL INVESTIGATION REQUIRED

A geotechnical investigation must be performed for all new developments within the Town of Northlake containing public streets. As a minimum, the study must address the following:

- general soil and groundwater conditions
- earthwork recommendations
- recommendations for pavement subgrade type, depth, and concentration
- guidelines for concrete pavement design

The investigation must be based on samples obtained from drilling or from excavations on the site. Samples must be tested in a laboratory. Tests must include as a minimum:

- moisture content and soil identification
- liquid and plastic limit determination
- unit weight determination
- Eades and Grim lime series tests
- soluble sulfate tests

The geotechnical investigation must be performed by a qualified geotechnical firm. A report with findings and recommendations must be prepared. The report shall bear the seal of a licensed engineer in the State of Texas.

5.03 GUIDELINES FOR STABILIZATION OF SUBGRADE SOILS CONTAINING SULFATES

Lime induced heaving has been a cause of pavement failures in the North Texas area. There are four components which are the culprits in sulfate induced stress in stabilized soils: calcium, aluminum, water, and sulfates. Together, and in the proper combination, these components will produce calcium-aluminate-sulfate-hydrate minerals with an expansion potential as large as 250%.

The best approach when dealing with lime stabilization of clay with significant soluble sulfate content is to force the formation of the deleterious minerals prior to compaction. If these minerals form during the mellowing period before placement and compaction, no damage will be done to the pavement. This can be done by providing adequate mellowing time (time delay between application of stabilizer and compaction of the stabilized soil) and with addition of adequate water.

Generally if the total level of soluble sulfates is below 2,000 ppm, by weight of soil, then lime stabilization is not of significant concern.

Sulfate levels of moderate to high risk are those between 2,000 ppm and 10,000 ppm. These soils should be treated by the double lime application method. In this method one-half of the lime is mixed with the soil and excess water. Mixing water should be applied to bring the soil to at least 3% to 5% above optimum for compaction and maintained at that level through the mellowing period. The mellowing period should be at least 72 hours. After that time, the second half of the

required lime is mixed followed by compaction. Double treatment does not require twice the required lime, but rather the required lime placed in two separate treatments.

Sulfate levels of high risk, between 8,000 ppm and 10,000 ppm, should be treated with a double application of lime as required for moderate to high risk soils, but the mellowing period should be extended to a minimum of 7 days.

Soils with a sulfate level higher than 10,000 ppm are not suitable for lime stabilization. Other strategies for dealing with these soils may include removal and replacement or blending with other soils to reduce the concentration of sulfates. The geotechnical report must recommend alternative strategies for subgrades with high levels of sulfates. Alternative strategies are subject to approval by the Town Engineer.

The above guidelines were obtained from a paper and sponsored by the Lime Association of Texas, dated August 2000, and titled “Guidelines for Stabilization of Soils Containing Sulfates”.

5.04 ALTERNATE PAVEMENT DESIGN

The Department of Public Works will consider an alternate pavement design in lieu of selecting a design from Table II-9, particularly when there are circumstances which warrant an individual design.

TABLE II-9

STANDARD STREET AND THOROUGHFARE PAVEMENT DESIGN

Facility Type	P.I. less Than 15 (1)	P.I. = 15 or Greater (2)	Concrete Pvmt. (3)	Flex Base (4)	Type "B" Asphalt (5)	Type "D" Asphalt (6)
Fire Lane and Driveways	6" Cement	6" Lime	6"	N/A	N/A	N/A
Alleys	6" Cement	6" Lime	7"	N/A	N/A	N/A
Residential						
L2U-U and R	6" Cement	6" Lime	6"	N/A	N/A	N/A
L2U-R (Asphalt Alternative)	N/A	N/A	N/A	8"	4"	2"
Collector						
C2U-U and R	6" Cement	6" Lime	7"	N/A	N/A	N/A
Minor Arterial						
M4U-U and R	6" Cement	6" Lime	8"	N/A	N/A	N/A
M4D-U and R	6" Cement	6" Lime	8"	N/A	N/A	N/A
Principal Arterial						
P6D-U and R	6" Cement	8" Lime	8"	N/A	N/A	N/A

NOTE: 1) Minimum 5% by dry unit weight of Portland cement.
2) Minimum 6% by dry unit weight of hydrated lime.
3) Twenty-eight day concrete compressive strength shall not be less than 3,600 psi.
4) Crushed limestone compacted to 95% standard proctor density at optimum moisture.
5) Asphaltic concrete base meeting N.C.T.C.O.G. specification Item 302.
6) Asphaltic concrete surface course meeting N.C.T.C.O.G. specification Item 302.

VI. PERMANENT LANE MARKINGS

6.01 PAVEMENT MARKINGS PLAN

Permanent lane markers shall be installed in accordance with the pavement markings plan and Pavement Marking Standard Details.

VII. LANDSCAPING IN PUBLIC RIGHT-OF-WAY

7.01 GENERAL

All unpaved public medians and parkways shall be landscaped with a minimum of four inches of topsoil, sodded or seeded in accordance with seeding requirements in the standard details and irrigated with a properly designed and installed system.

7.02 METERING

All water usage shall be metered and paid for by the developer until landscaping is accepted by the Town. Developers shall pay administrative fees, meter costs, and meter deposits, but shall be exempt from impact fees for meters installed on Town right-of-way. Within medians, no plantings or irrigation facilities shall be permitted within areas five feet or less in width or in median noses. Those areas shall be covered with brick pavers in accordance with the Standard Details.

7.03 OTHER REQUIREMENTS

a. Minimum landscape requirements will be established by the Town.

b. Trees or upright plantings must not be planted within 30 feet of intersections or utility poles. The Town may require greater setback for safety based on line of sight issues.

c. An 8-inch wide concrete mow strip shall be installed between all planting beds and grassed areas.

d. Seeded or sodded areas of medians shall be bermed a minimum of 6 inches.

e. Only trees with a mature height less than 30 feet may be planted closer than 20' either side of an overhead line. No trees shall be directly under utility lines.

f. Trees to be planted within the medians of divided roadways that are ultimately planned for widening by constructing additional lanes in the median shall not be planted within the path of future lanes. Trees shall not be planted within five (5) feet of existing or proposed curbs. Future lane widening shall be shown on the landscape plans.

g. Trees shall not be planted within five feet of existing or proposed water lines.

h. Irrigation systems shall be designed to meet all other Town Ordinances.

7.04 PLAN SUBMITTAL REQUIREMENTS

Landscape construction plans shall be submitted as part of the overall construction plans associated with the related project. Plans shall bear license seal of the designer. The plans shall include the following:

a. A scale drawing (1" = 40' or 1" = 20'), prepared on 22" by 34" sheets clearly indicating the location, type, size and description of all proposed landscape materials and existing utilities.

b. The name of the project, name and address of the Developer, north arrow, scale, and legend.

c. The configuration, location, type and size of all irrigation, piping heads and controllers.

d. All details necessary to provide a constructible installation.

7.05 OWNERSHIP AND MAINTENANCE

a. Upon final acceptance, all landscape and irrigation materials within medians and rights of way shall become the property of the Town.

b. Landscape areas shall be maintained by the Developer or owner for a minimum of one year. Within one year the Town will assume responsibility if 80% grass cover is obtained and all plantings are in a healthy condition. Developer maintenance will continue until adequate coverage is obtained.

VIII. STREET LIGHT REQUIREMENTS

8.01 GENERAL

Street lights shall be installed in all new subdivisions. The Developer shall pay the costs for all street lighting. Street light luminaries shall be high pressure sodium (HPS) or metal halide (MH). Street light materials and design shall be approved by the Town.

8.02 STREET LIGHT REQUIREMENTS BY STREET CLASSIFICATION

Street light installations will vary according to the classification of street. In general installations will be as follows:

a. Residential Streets: For residential streets, street lights shall be installed at each intersection, at major curves, at ends of cul-de-sacs, and at intervals of between 200 and 400 feet. Luminaires shall be either 100 Watt HPS or 175 Watt MH and mounted on poles at least 11 feet high as shown on standard details for street lights.

b. Collector Streets: For collector streets, street lights shall be installed at each intersection, at major curves, and at intervals of between 200 and 400 feet. Luminaires shall be either 100 Watt HPS or 175 Watt MH and mounted on poles at least 11 feet high with pole type to be approved by the Town.

c. Major Arterials: For major arterial streets, street lights shall be installed at each intersection, at major curves, and at intervals of between 200 and 300 feet. Luminaires shall be either 250 Watt HPS or 250 Watt MH and mounted on poles at least 30 feet high with pole type to be approved by the Town. Where a major arterial traverses a single-family neighborhood light fixtures shall be either 100 Watt HPS or 175 Watt MH and mounted on poles at least 11 feet high with pole type to be approved by the Town.

8.03 STREET LIGHT LOCATIONS

Street lights shall be installed in the public right-of-way, in a location at least three (3) feet behind the face of curb. Where there is no curb, street lights shall be installed at least eight (8) feet from the edge of pavement. Street lights on major arterials shall be installed in the median, where a median exists. In conjunction with the development of any subdivision, street light location and installation shall be coordinated with Coserv Electric and the Town. Installations in state right-of-way shall be coordinated with TxDOT and the Town.

8.04 PLAN SUBMITTAL REQUIREMENTS

Street light plans shall be submitted as part of the overall construction plans associated with the related project. The plans shall include the following:

a. A layout of the entire subdivision showing the location of each street light.

b. A plan for the location of underground conduits. All street lights shall be served by underground electric unless approved in writing by the Town. All wiring shall be placed in minimum two (2) inch schedule 40 PVC conduit.

c. Standard street light details.

8.05 COSTS

The developer shall be responsible for all engineering and plan preparation costs required for installation of street lights.