

# Design Criteria Manual



Effective Date: August 12, 2003

## **RECORD OF REVISIONS/ORDINANCE HISTORY**

### **06/17/2003 Ord #03-077**

- Adoption of Design Criteria Manual (DCM)
  - Effective August 12, 2003 which coincide with Sub Regulations revisions.

### **10/06/2003**

- Appendix F, Thoroughfare Development Plan Map
  - Replaced March, 2002 map with June, 2003

### **01/13/2004 Ord #04-016**

- Chapter 4, Subdivisions
  - Edited Section 4.3.A.1 Revise the criteria that requires a Storm Water Management Site Plan.
  - Edited Section 4.3.A.2 Amend Best Management Practice (BMP) requirements to clarify factors used to evaluate and select BMPs. Clarify when the Site Layout BMP should be used.
- Chapter 5, Commercial Sites
  - Edited Section 5.3.A.1 Revise the criteria that requires a Storm Water Management Site Plan.
  - Edited Section 5.3.A.2 Amend Best Management Practice (BMP) requirements to clarify factors used to evaluate and select BMPs. Clarify when the Site Layout BMP should be used.

### **09/12/2006 Ord #06-092**

- Chapter 1, Introduction
  - Added Section 1.3 Administration which authorizes Director of Public Works & Transportation and Director of Water Utilities to enforce provisions of this Manual in their respective area of management and grant alternate material, design or methods of construction.

### **06/23/2009 Ord #09-030 (effective 07/23/2009)**

- Chapter 4, Subdivision
  - Revised Section 4.6 E 5 Paving Requirements, increasing the thickness of concrete and HMAC pavement and included the associated subgrade requirements for each of the street types. Revised items below the table to allow consideration of variance
- Chapter 5, Commercial Sites

- Revised Section 5.6 E 5 Paving Requirements, increasing the thickness of concrete and HMAC pavement and included the associated subgrade requirements for each of the street types. Revised items below the table to allow consideration of variance.
- Chapter 6, Capital Improvements
    - Revised Section 6.6 E 5 Paving Requirements, increasing the thickness of concrete and HMAC pavement and included the associated subgrade requirements for each of the street types. Revised items below the table to allow consideration of variance.

**01/12/2010 Ord #10-008 (effective 01/25/10)**

- Chapter 3, Capital Improvements
  - Added Section 3.1 (O) Electronic Scanning Fee to recover cost to Community Development & Planning to scan final accepted public improvements plans & other plans associated w these plans if applicant does not provide electronic copy.
- Chapter 4, Subdivision
  - Revised Section 4.1 Introduction – reworded purpose of chapter
  - Revised Section 4.2 Public Improvements Submittal – revised section title and revised to current process of plan submittal through CD&P and review process.

**04/20/2010 Ord #10-040 (effective 5/3/2010)**

- Replaced in its entirety
  - Updated stormwater standards, permit processes and other miscellaneous changes.

**06/22/2010 Ord #10-049 (effective 7/5/2010)**

- All Chapters (including Appendixes)
  - Revised terminology, definitions, and regulations for public improvements related to stormwater and street appurtenances, and other minor miscellaneous changes.

**City of Arlington  
Design Criteria Manual**

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# CHAPTER 1

## INTRODUCTION

### Section 1.1 Overview

This Design Criteria Manual was written by and includes criteria from the following departments:

- Water Utilities Engineering Department
- Department of Public Works and Transportation
- Community Development and Planning Department
- Parks and Recreation Department
- Fire Department

Much of the information included in this manual was previously included in various chapters of the Subdivision Regulations. The Subdivision Regulations have been revised to contain information primarily related to the platting portion of the development process. Thus, the design information related to plan/study preparation has been included in this manual as a mechanism to implement uniform design requirements, standards and procedures.

The owner and the owner's engineer shall be responsible for the applicability of the information contained in this manual to the particular development. The owner and the owner's engineer shall also be responsible for the accuracy of the information furnished in the design of all facilities as it pertains to both the development and other affected properties. Concurrence by the City in the design shall not be construed to relieve the owner or the owner's engineer of any responsibility.

### Section 1.2 Description

The following is a brief description of the contents of each chapter:

#### A. Chapter 2 - Definitions and Abbreviations

This chapter contains definitions and abbreviations used in the manual.

#### B. Chapter 3 – Miscellaneous

This chapter contains miscellaneous sections that may be applicable to various types of development or projects. The first portion of the section includes a brief description of various fees from the participating departments. The remainder of the chapter is organized by department.

#### C. Chapter 4 - Subdivisions

This chapter is intended for use with developments with multiple lots that require construction of public improvements prior to obtaining building permits for the individual lots. While the majority of subdivisions are for residential development, there

are cases where this chapter will apply to commercial developments if they include multiple lots. The information included in this chapter is applicable to the plan preparation for the public improvements required for subdivisions and is organized by department.

**D. Chapter 5 - Commercial Sites**

This chapter is intended for use with development of individual lots that are primarily commercial in nature and consists of both private and/or public improvements. These types of developments will be submitted when requesting a building permit. The information included in this chapter is applicable to the plan preparation for public improvements including public storm drain systems, public water lines, and median openings, etc., required for commercial sites. This chapter is organized by department.

**E. Chapter 6 - Capital Improvements**

This chapter is intended for use by design consultants when preparing street, drainage, water or sanitary sewer capital projects. The street and drainage may be combined with the water and sanitary sewer improvements as one set of plans or may be separate. The street and drainage plans typically include the design of streetlights, pavement markings, and median landscaping. The plans shall include signal design at intersections of state facilities. While this chapter includes the median landscaping requirements for the Parks and Recreation Department, it does not include guidelines for other Parks and Recreation capital improvement projects.

**F. Appendices**

The appendices are for reference purposes only. Contact the appropriate city department for the most updated version.

**Section 1.3 Administration** (Amended Ord #06-092, 8/22/06)

- A. The Director of Public Works and Transportation and the Director of Arlington Water Utilities (Directors) are hereby authorized to enforce the provisions of this Manual in their respective areas of management.
- B. The Directors shall have authority to approve an alternative material, design or method of construction for individual cases, when the Director(s) finds that the proposed material, design or method is satisfactory and complies with the intent of the provisions of this Manual, and that the alternative is at least the equivalent of that prescribed by this Manual in quality, strength, effectiveness, durability and safety. The applicant shall show with appropriate engineering evidence, sufficient to the Director, that the proposed alternative as offered for the intended purpose, is at least the equivalent of the requirements of this Manual in quality, strength, effectiveness, durability and safety.
- C. A grant of an alternative material, design or method of construction shall not affect nor relieve the owner and the owner's representative and design professional of an ongoing

obligation and responsibility for adequacy of such material, design or method of construction for intended purposes.

## CHAPTER 2

### DEFINITIONS AND ABBREVIATIONS

#### Section 2.1 Definitions

For the purposes of this manual, certain words, terms and abbreviations shall be defined as follows:

**Acceptance:**

Initial: The acceptance of the public improvements for a development subject to the maintenance bond period during which the City is not responsible for maintenance. For private improvements, initial acceptance shall mean that the infrastructure is complete.

Final: The acceptance of the public improvements for maintenance by the City upon expiration of the maintenance bond.

**Arterial**: Any existing or future roadway classified as a principal or minor arterial in the Thoroughfare Development Plan. For purposes of this manual, a freeway frontage road shall be classified as an arterial roadway.

**Auxiliary Lane**: A separate right turn lane, left turn lane, deceleration lane or acceleration lane.

**Best Management Practices (BMP)**: A physical, chemical, structural, or managerial practice or device that prevents, reduces, or treats pollution of stormwater, prevents or reduces soil erosion, and/or reduces or minimizes stormwater runoff. A BMP may be temporary to protect water during construction or permanent to protect water from the long-term effects of development.

**City**: The City of Arlington, Texas, a municipal corporation, authorized and chartered under the Texas State Statutes, acting by and through its governing body or its City Manager or his/her duly authorized representatives.

**Continuous Deceleration Lane**: A deceleration lane that serves two or more driveways, public streets or combination thereof.

**Deceleration Lane**: A lane, including tapered areas, in advance of a driveway or public street used to allow turning vehicles to exit the through traffic lane and slow before making the turn.

**Detention**: The practice of storing stormwater runoff by collection as a temporary pool of water and providing for its gradual (attenuated) release, thereby controlling peak discharge rates and allowing for sedimentation of pollutants.

**Development**: The construction of any structure or any activity that requires a building permit or the submission of a plat or plan to develop the property. Development will also include any land disturbance, including but not limited to, mining, dredging, filling, grading, paving, excavation, drilling operations or storage of equipment or materials.

**Director:** The director of the department for which the text is applicable, or their authorized representative.

**Driveway Throat Width:** The shortest distance between the parallel edges of a driveway.

**Engineer:** A person who is licensed by the Texas Board of Professional Engineers to engage in the practice of engineering in the State of Texas.

**Floatables:** Litter and other pollutants that float on the surface of water. Examples are plastic bottles, aluminum cans, cigarette butts, and plastic grocery bags.

**Floodplain:** Any land area susceptible to being inundated by water from any source.

**Flow Line:** The flow line shall be the lowest conveyance elevation of a particular feature/structure.

**General Permit:** An authorization to discharge stormwater issued by the Environmental Protection Agency (EPA) or the Texas Commission on Environmental Quality (TCEQ) and its successor agencies for business sector and classes of activities based on meeting specified operating conditions and submitting a Notice of Intent to operate under the General Permit.

**Hazardous material:** Any substance or material determined to be hazardous by the Secretary of Transportation according to 49 CFR Part 171.8.

**High piled combustible storage:** Combustible materials in closely packed piles, or combustible materials on pallets or racks more than 12 feet high. For certain special hazard commodities including rubber tires, plastics, some flammable liquids and idle pallets, the maximum height may be as low as 6 feet high.

**High speed:** A speed limit greater than 40 miles per hour.

**Impervious surface:** Any material that substantially reduces or prevents the infiltration of stormwater.

**Improved Open Channel:** A creek or area of concentrated drainage modified as a feature to convey drainage.

**Indigenous Plants:** Plants native to the Arlington area or adjacent areas of the Blackland Prairie and Eastern Cross Timbers Regions, which are compatible with environmental conditions of a site or portions of a site. The standard reference for this criterion shall be Native Texas Plants by (verify author, publisher and date) and (second reference).

**Intersection sight distance:** Adequate sight distance based upon stopping sight distance (SSD) as determined by AASHTO.

**Intersection visibility triangle:** A triangle sight area at an intersection of two streets or driveways.

**Large Construction Project:** For stormwater purposes only, a large construction project is a construction activity, including clearing, grading, and excavation, that disturbs five acres or more. Construction activity also includes disturbance of less than five acres but is part of a larger common plan of development or sale with the potential to disturb five acres or more, such as a phased single-family home construction in a subdivision.

**Level of Service:** Qualitative measures describing operational conditions within a traffic stream and the perception by motorists.

**Local Street:** All streets, primarily residential in nature in which the pavement is less than 38 feet in width.

**Minor Collector Street:** Any current street or street shown on the Thoroughfare Development Plan having a pavement width of 38 feet.

**Major Collector Street:** Any current street or street shown on the Thoroughfare Development Plan as a 4-lane undivided roadway.

**Minor Arterial:** Any current street or street shown on the Thoroughfare Development Plan as a 4-lane boulevard or 5-lane undivided street within an 80-90 feet right-of-way.

**Major Arterial:** Any current street or street shown on the Thoroughfare Development Plan as a 6-lane boulevard or 7-lane undivided street, typically within a 110-120 feet right-of-way. Included in the classification of a major arterial are all freeway frontage roads. Six-lane arterials are frequently constructed as 4-lane boulevards within 120 feet of right-of-way as Phase I. Later, in Phase II, the inside lanes on each side of the median are constructed completing the six-lane section.

**Major Street Facility:** Any roadway with a classification of Major Collector or above.

**Municipal Separate Storm Sewer System (MS4):** The system of conveyances (including but not limited to roads with drainage systems, municipal streets, inlets, curbs, gutters, ditches, man-made channels, or storm drains) owned and operated by the City and designed or used for collecting or conveying stormwater.

**Natural Creek:** An existing drainage feature in its natural undisturbed state that has not been graded, filled, modified, cleared, or created by equipment. Natural creek also includes area that have been naturalized or restored to mimic an undisturbed state.

**Notice of Intent (NOI):** The Notice of Intent that is required by the Construction General Permit, the Multi-Sector General Permit, or other General Permit for the discharge of stormwater issued by the Environmental Protection Agency (EPA), or the Texas Commission on Environmental Quality (TCEQ) and its successor agencies.

**Notice of Termination (NOT):** The Notice of Termination that is required by the Construction General Permit, the Multi-Sector General Permit, or other General Permit for the discharge of stormwater issued by the Environmental Protection Agency (EPA), or the Texas Commission on Environmental Quality (TCEQ) and its successor agencies.

**Owner:** For the purposes of this manual, owner refers to the person responsible for developing a particular site or project.

**Parks Master Plan:** The official adopted Parks, Recreation and Open Space (Master) Plan for the City of Arlington and amendments thereto, including policies or strategies contained in the City's Comprehensive Plan.

**Pole Contacts:** Attachment of streetlight arm to an existing utility pole, use of an existing utility pole for anchoring or support of streetlight conductor cable.

**Pollution:** The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to the public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

**Public Improvements:** For the purpose of this manual, public improvements are streets (including streetlights, street signs, signals and pavement markings), storm drainage systems, water lines, sanitary sewer lines, sidewalks or other similar improvements constructed within public rights-of-way, drainage easements, or utility easements. Typically, the City maintains public improvements after expiration of any applicable maintenance bonds.

**Qualified Personnel:** Persons who possess the appropriate competence, and ability (as demonstrated by sufficient education, training, experience, and/or, when applicable, any required certification or licensing) to perform a specific activity in a timely and complete manner consistent with the applicable regulatory requirements and generally accepted industry standards for such activity.

**Reportable Quantity:** The amount of a material that may be harmful to human health and the environment if spilled or otherwise released, thus requiring notification of federal officials upon a release per the Clean Water Act (40 CFR 110 and 117) and the Emergency Planning and Community Right-to-Know Act (40 CFR 302).

**Retention:** The practice of storing stormwater runoff by collection as a permanent pool of water without release except by means of evaporation, infiltration, or attenuated release when runoff volume exceeds storage capacity of the permanent pool.

**Shared Driveway:** A driveway constructed on or near a common property line between two or more properties and providing access to all such properties.

**Small Construction Project:** For stormwater purposes only, a construction activity, including clearing, grading, and excavation that disturbs less than five acres and is not part of a larger common plan of development or sale with the potential to cumulatively disturb five acres.

**Stabilization:** Covering of disturbed soil with vegetation, geotextile products, mulch, rock, soil modifiers, or pavement to prevent erosion and soil loss.

**Standard Industrial Classification (SIC) Code:** The four-digit number representing the type of service or product a business provides as published by the Office of Management and Budget in 1987 for the purpose of statistical tracking.

**Storm event - 100-year:** A storm having a one percent chance of being equaled or exceeded in any given year.

**Street:** For the purpose of this manual, street or street improvements shall include all its appurtenances, including but not limited to streetlights, street signs, signals and pavement markings.

**Thoroughfare Development Plan:** A comprehensive plan of current and future roadway locations and classifications. This plan offers the framework for orderly development and is responsive to present and future traffic needs within the community.

**Trapped Lane:** A lane that forces a driver into a turning movement at an intersection.

**Tree Canopy:** The geographic area covered by the horizontal projection of the drip line, or outer branches of a tree or group of trees, in a woodland tract.

## **Section 2.2     Abbreviations**

AASHTO	American Association of State Highway Transportation Officials
BMP	Best Management Practice
CDC	Corridor Development Certificate
CDP	Community Development & Planning Department
CLOMR	Conditional Letter of Map Revision
CLP	Cold layed plastic
CY	Cubic Yard
DRTCT	Deed Records, Tarrant County, Texas
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
ft	Feet
fps	Feet per second
gpm	Gallons per minute

HCM	Highway Capacity Manual
HDPE	High Density Polyethylene
HGL	Hydraulic grade line
HMAC	Hot mix asphalt concrete
HPS	High pressure sodium
HUD	Housing and Urban Development
ITE	Institute of Transportation Engineers
LF	Linear Feet
LOMR	Letter of Map Revision
MEP	Mechanical, Electrical and Plumbing
MFF	Minimum Finished Floor
Mils	1/1000 of an inch
mph	Miles per hour
MS4	Municipal Separate Storm Sewer System
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NCTCOG	North Central Texas Council of Governments
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service

PWT	Public Works and Transportation Department
RCP	Reinforced concrete pipe
RME	Responsible Managing Employee
RPM	Raised pavement markers
PI	Plasticity Index
ppm	Parts per million
psi	Pounds per square inch
PVC	Polyvinyl Chloride
SIC	Standard Industrial Classification
sf	Square feet
SWMSP	Stormwater Management Site Plan
SWPPP	Stormwater Pollution Prevention Plan
sy	Square yard
TCEQ	Texas Commission on Environmental Quality
TDLR	Texas Department of Licensing and Regulation
TDP	Thoroughfare Development Plan
TIA	Traffic Impact Analysis
TMUTCD	Texas Manual on Uniform Traffic Control Devices
tpd	Trips per day
TPDES	Texas Pollutant Discharge Elimination System
TxDOT	Texas Department of Transportation
WUED	Water Utilities Engineering Department

**CHAPTER 3**  
**MISCELLANEOUS**

**Section 3.1 Fees**

Typical fees collected through the development process are briefly described below. The Community Development & Planning Department produces a Planning Atlas available on CD-ROM that includes a fee calculation worksheet. The CD is available at the Community Development & Planning Department.

**A. Impact Fees**

On May 25, 1989, the City of Arlington implemented the Impact Fee Chapter to the Arlington City Code. Each type of impact fee is listed below.

**1. Roadway Impact Fee**

The roadway impact fee is based on the number of development units and the collection rates as provided in the Impact Fees Chapter. The fee is paid to the Building Inspections Division prior to the issuance of a building permit.

**2. Water and Sanitary Sewer Impact Fees**

Water and sanitary sewer impact fees are based on the size of the water meter serving the property. A ¾ inch meter is considered the base (one) service unit. Fire lines are assessed as a 1-inch water meter. Water and sanitary sewer impact fees are paid at the time service is requested at a Water Customer Service Office.

**B. Park Component Fee**

All applications for new residential permits shall be subject to the collection of park component fees, pursuant to the Parks Chapter. Component fees are based on:

- The type of facility, including neighborhood parks, linear parks, and community parks; and
- The type of improvements typically included in a facility.
- The fee is collected by the Building Inspections Division prior to the issuance of a building permit.
- The current Arlington Parks and Open Space Master Plan and Park Improvements Plan provide information for the development of parks and are available at the Parks and Recreation Department office.

**C. Administration and Inspection Fee**

**1. Street and Drainage**

This fee is charged to the owner to recover a portion of the cost for reviewing plans, inspecting the construction of public street, its appurtenances (including but not limited to streetlights, street signs, signals and pavement markings), drainage improvements, and testing materials used in the construction of these facilities. The fee is based on a percentage of the construction contract amount for the public improvements. This fee is adopted by City Council and is paid to the City prior to the execution of three party contracts.

**2. Water and Sanitary Sewer**

This fee is charged to the owner to recover a portion of the cost to the WUED for reviewing plans, inspecting the construction of public improvements, and testing materials used in constructing public water and sanitary sewer improvements. This fee is paid to the WUED prior to the execution of three party contracts. The fee is based on a percentage of the construction contract amount for public water and sanitary sewer improvements and shall be a minimum as set forth by City Council.

**D. Traffic Signal Escrow**

The owner is responsible for all cost associated with the design and installation of traffic signals necessitated by the development as determined by an approved Traffic Impact Analysis or by the City Traffic Engineer. If it is determined at time of construction that installation of the signal(s) is not feasible with the construction, the owner shall then place funds in escrow with the City for the future installation of the signal(s).

The escrow amount will be equal to the owner's share of the design, right-of-way acquisition, utility relocation and construction. The escrow shall be paid prior to filing the plat or issuing a building permit, whichever occurs first.

**E. Streetlight Escrow**

Streetlight escrow may be collected for perimeter major collector or arterial streets if it is determined by the Director of PWT that the streetlights cannot feasibly be constructed with the development. The amount will be equal to the owner's share of design and installation of the streetlights along the perimeter street. Escrow will not be collected for streetlights internal to the development.

**F. Additional Water and Sanitary Sewer Fees**

There are fees for tapping existing water and sanitary sewer lines as well as meter activation. These fees are paid at the time service is requested at a Water Customer Service Office.

**G. Street and Sidewalk Escrow**

Street and sidewalk escrow will be collected for site-related facilities including deceleration lanes or left turn lanes that cannot feasibly be constructed with the development. The amount shall be based on an estimate prepared by an engineer and accepted by the City for the design, right-of-way acquisition, utility relocation and construction of the facility. The escrow is paid to the City prior to filing a plat or issuing a building permit, whichever occurs first. Escrow will not be collected for frontage along unimproved perimeter streets.

**H. Street Assessment**

The City of Arlington Street Assessment Policy allows the City to assess local and minor collector streets at the time of construction subject to City Council approval. Street assessments are collected by the City Secretary's Office.

**I. Abandonment Fee**

A non-refundable fee is charged for processing the application when abandoning right-of-way or easements by separate instrument. Additional costs may be associated with the abandonment including utility relocation fees.

**J. Flood Study Review Fee**

This fee is charged to the owner to recover the cost associated with the technical review of the flood studies. The fee is based on the creek length and varies based on the number of computer runs submitted and reviewed. The fee is adopted by City Council and is due prior to final acceptance of the study.

**K. Floodplain Development Permit Fee**

This fee is charged to the owner to recover the cost of reviewing development plans for earthwork within the floodplain. The fee is based on the type and complexity of the work being performed in the floodplain. The fee is adopted City Council and is due prior to acceptance of constructions plans.

**L. Corridor Development Certificate (CDC) Cost Recovery Fee**

This fee is charged to recover the costs associated with the technical review of the CDC permit by the U.S. Army Corps of Engineers (USACE). A portion of the fee is also used to fund the North Central Texas Council of Governments (NCTCOG) corridor-wide CDC administration. The fee is established by USACE and NCTCOG and shall be paid to the City with submittal of the CDC permit.

**M. Fire Department Permit Fees**

Fees for the items listed below are paid at the Fire Prevention Office.

- All blasting/explosive permits
- Authorized outdoor burning
- Installation or testing of underground flammable liquid storage tank systems
- Monitoring wells

- Installation of above ground waste oil tank
- Installation of above ground protected tank
- Removal of underground flammable liquid storage tanks
- Abandonment of underground tanks/lines
- Installation and testing of automatic halon, dry chemical, wet agent, carbon dioxide or other fire extinguishing systems including standpipe systems
- Installation of fire alarm systems – fee varies based on number of devices
- Special locking system
- Installation of any LPG container, except for portable containers of less than 120 gallons water capacity installed at properties where natural gas service is not available
- Installation and testing of automatic sprinkler systems – fee varies based on number of heads
- Installation of underground piping and private fire hydrants
- Residential automatic fire sprinkler system
- Installation of smoke control system

Permit fees shall be tripled if a contractor has begun work without a permit. The fees shall be quadrupled for the second and subsequent occurrences by the same contractor within two years.

**N. Electronic Scanning Fee**

This fee is charged to the applicant to recover the cost to Community Development and Planning to scan the final accepted public improvement plans and any other plans associated with these plans, if the applicant does not provide an electronic version. The fee is in the amount determined by city council resolution.

**Section 3.2 Easements**

**A. Public vs. Private**

Generally, public drainage features cross property lines, collect runoff from adjacent properties or are located in public street rights-of-way. The City of Arlington maintains public drainage features. Drainage features that do not meet these criteria may be considered private and maintained by the owner. Private drainage easements shall be dedicated on the plat for all private drainage features.

**B. Acquisition**

Easements not shown on a plat shall be procured by separate instrument. The procurement of any easement is the owner's responsibility. If the owner cannot obtain a required offsite easement, the owner may request assistance from the City. Prior to requesting assistance, the owner shall provide a written offer to the property owner based on fair market value. The City's assistance does not relieve the owner of the cost of purchasing the easement. In addition, the owner shall reimburse the City for all costs associated with the acquisition.

### **C. Filing**

The following is the process for filing an easement by separate instrument.

- The owner shall submit the written metes and bounds description and drawing of the easement sealed, signed and dated by a surveyor. This information along with the ownership information shall be submitted to the appropriate department.
- The description will be forwarded to the Real Estate Services Division, and prepared on City forms. A fee will be determined for preparing and filing the documents.
- Upon payment of the fee, the easement will be returned to the owner for signatures. The signed documents are then returned to the City.
- The City will file the easement at DRTCT.
- A copy of the filed easement will be forwarded to the owner.

### **Section 3.3 Water Utilities Engineering Department**

#### **A. Earthwork within Lake Arlington or Lake Arlington Flowage Easement**

The area below elevation 550 is designated as Lake Arlington and is owned by the City of Arlington. The City also has a “Lake Arlington Flowage Easement” in the area between elevations 550 and 560. For any earthwork proposed in Lake Arlington or the “Lake Arlington Flowage Easement,” the owner must obtain permission from the Director of Water Utilities and the Corps of Engineers. For work in the flowage easement, the owner may be required to abandon the flowage easement, depending on the type of work proposed.

The following items shall be submitted to the WUED for approval prior to beginning work within Lake Arlington or the flowage easement:

- A brief description of the work
- A vicinity map
- A plan view of the work area
- A cross-section of any proposed excavation
- Existing and proposed topographic plan prepared by a surveyor
- A copy of the Letter of Permission from the Corps of Engineers
- A copy of the executed abandonment documents (if applicable)

The topographic plan must show existing and proposed 550 and 560 contours in the area where the work will be performed. Excavated material may not be stockpiled in any area below elevation 560. Holes and abrupt changes in the lake bottom are not acceptable.

To remove property from the floodplain, see FEMA Designated Floodplain chapter. Site plans may be required for other improvements and structures within the flowage easement.

## **B. City Participation in Water and Sanitary Sewer Facilities**

The City may participate in the construction cost of offsite, perimeter and oversized water or sanitary sewer lines. Article IX of the Water Chapter of the City Code addresses facilities eligible for participation. The owner shall submit a written request for participation to the WUED prior to executing three party contracts. The request shall include:

- A plan drawing showing the water and sanitary sewer lines eligible for participation.
- An estimate of quantities and construction costs for the work involved in the participation request. For oversized lines, the difference in cost between the oversized line and the line required to serve the development shall be provided.

Once WUED concurs with the estimated construction cost, the participation request will be submitted to City Council for authorization. Once the request is approved by City Council, the WUED will notify the owner and provide standard forms required for reimbursement.

After construction is complete, the owner shall submit the following items to WUED for processing the participation reimbursement:

- Letter requesting payment for eligible offsite or oversized facilities
- Notarized Affidavit from contractor
- Notarized Affidavit from owner
- Notarized "Certification of Costs" from owner
- Copy of itemized reimbursables based on final cost and quantities

This process will be followed assuming participation funds are available. Should funds not be available for participation, the owner may proceed without City participation.

## **Section 3.4 Engineering Division/Department of Public Works & Transportation**

### **A. Abandonment**

Abandonment of rights-of-way or easements is processed by separate instrument or by plat. In either case, signatures sheets shall be required from the public utility companies and the adjacent affected property owners indicating either agreement or disagreement to the proposed abandonment. Right-of-way and easements proposed to be abandoned that do not contain improvements shall be processed administratively. If improvements are present, the abandonment request will be forwarded to the City Council for approval. Abandonments that are opposed by the affected property owners will also be forwarded to the City Council for approval. Right-of-way and easements granted to entities other than the City shall be abandoned by that entity.

A request for the abandonment of right-of-way or easements by separate instrument can be initiated by submitting the following to the PWT:

- An application form (available from PWT or on the website)
- Parcel drawing and written metes and bounds description

- Non-refundable application fee
- Utility relocation cost, if applicable
- Utility company signatures on standard forms
- Affected property owners signatures on standard forms

Right-of-way or easements can also be abandoned by Final Plat, Combination Plat, Replat, or Minor Plat (except an Amended Plat). The right-of-way or easement shall be shaded and labeled “Abandoned by the filing of this Plat.” There is no application fee specifically for the abandonment by plat. The following shall be submitted prior to filing the plat:

- Utility relocation cost, if applicable
- Utility company signatures on standard forms
- Affected property owners signatures on standard forms

If costs were incurred by the City to acquire the right-of-way or easement, funds shall be paid to the City for reimbursement.

**B. Participation**

**1. Street**

Subject to available funding, the City may participate in the cost of designing and constructing a street or roadway facilities included on the Thoroughfare Development Plan in excess of the owner’s responsibility to provide adequate roadway facilities as defined in the Subdivision Rules and Regulations. The City’s obligation to participate shall be limited to the cost of constructing a facility in accordance with standards specified in the Thoroughfare Development Plan. The City will not participate in any costs that exceed City standards.

Prior to beginning construction, the owner shall submit a written request to the City. The request shall include:

- A plan drawing showing the all facilities included in the request
- An estimate of quantities and costs for work involved in the participation request

Once City concurs with the estimate, the participation request will be submitted to City Council for authorization and approval to participate in the requested facilities.

After construction is complete, the owner shall submit a final cost summary to the City requesting reimbursement.

**2. Drainage**

The owner shall pay for the cost of all onsite and offsite drainage improvements.

**C. Monitoring Wells**

The installation of monitoring wells within City right-of-way shall only occur when there is no other alternative location. For approval of monitoring wells in right-of-way, the following shall be submitted to the City:

- Justification letter
- Water gradient profile
- Map showing the proposed location of the monitoring well

The request will be evaluated and a written response provided within ten working days. Upon approval of a request, the following additional criteria shall be required prior to installation:

- Right-of-Way Use Agreement
- Waiver Liability, Indemnification, Release and Hold Harmless Agreement
- Certificate of Insurance naming the City as additional insured
- Traffic control plan

A permit from the Fire Department is required for the installation of monitoring wells on private property.

**D. Texas Department of Transportation Submittal Process**

Any construction within State right-of-way shall be approved by TxDOT as well as the City. Three sets of plans to be forwarded to TxDOT for approval shall be submitted to the City.

**E. Floodplain Development Permits**

The floodplain development permit ensures that all development activities proposed within the floodplain will be in compliance with the Flood Damage Prevention Ordinance of the City Code. A plan shall be submitted showing proposed improvements within the floodplain, together with all necessary supporting technical documentation. A fee is charged for this permit.

**Section 3.5 Community Development and Planning Department - Easement and Right-of-Way Use Agreements**

The Construction Chapter of the City Code allows permitting of certain improvements within easements and right-of-way with the execution of an Easement Use Agreement. The agreement states that the City is not responsible for the maintenance or reconstruction of any improvements located in the easement or right-of-way and that the owner must remove the improvement at the request of the City. The Easement Use Agreement is processed by Building Inspections. Forms and instructions are available at the Development Services Desk or on the City’s website. The following table lists items routinely requested for placement within right-of-way and easements and the departments that review the agreement.

	<b>Reviewing Department</b>
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<b>Items Routinely Placed in Easements and Right-of-Way</b>	<b>Utility Easements</b>	<b>Drainage Easements</b>	<b>Street ROW</b>	<b>Slope or Temporary Construction Easement</b>
Driveways/Flatwork	N/A	PWT	PWT	PWT
Brick, Stone Fences	PWT/WUED	PWT	PWT/WUED	PWT
Retaining Walls > 3' or < 3' that support a structure	PWT/WUED	PWT	PWT/WUED	PWT
Private Storm Drains/Area Drains	PWT/WUED	PWT	PWT/WUED	PWT
Swimming Pools Decks	PWT/WUED	PWT	PWT/WUED	PWT
Wood Decks, Gazebos, Patios (covered/uncovered)	PWT/WUED	PWT	PWT/WUED	PWT
Buildings and Other Permanent Improvements	PWT/WUED	PWT	PWT/WUED	PWT

Other improvements including those listed below may be allowed without the execution of an Easement Use Agreement at the appropriate Director's discretion:

- Paving or flatwork
- Wooden or chain-link fences
- Retaining walls less than three feet in height that do not support a structure or infringe on the required visibility triangles.

A site plan shall be submitted and accepted prior to issuance of a permit for the construction of the improvements.

### **Section 3.6 Community Development and Planning Department - Transportation**

#### **A. Bikeway Plan**

The bikeway plan may require bike lane easements five feet wide along certain collector and arterial streets as reflected in the City of Arlington's Thoroughfare Development Plan.

The City has adopted the *Bicycle and Pedestrian Facilities Planning and Design Guidelines* developed by the North Central Texas Council of Governments (NCTCOG) Guide for the Development of Bicycle Facilities by the American Association of State Highway and Transportation Officials (AASHTO) for design of the bikeway lanes. Refer to Appendix A for the Bikeway Plan Map.

#### **B. Traffic Study**

##### **1. Purpose**

The purpose of a traffic study is to assess the effects of specific development activity on the existing and planned roadway system. It is the intent of these requirements to make traffic access and circulation planning an integral part of the development process.

## **2. Responsibility**

When required, the owner shall submit at the owner's expense a traffic study that assesses the traffic impacts associated with a proposed development. The study must be prepared under the direction of a licensed professional engineer with experience in Transportation Engineering sufficient to assess traffic impacts.

## **3. Determination of Need**

The City will determine the necessity of a traffic study within five working days after receiving the following information:

- Existing or proposed zoning categories
- Tract location map
- Tract size in acres
- Existing and proposed land use (if known)
- Proposed types and locations of new roadways
- Location of proposed access points and signalization, if applicable

Generally, a traffic study shall be required for any development expected to generate traffic volumes that will significantly impact the capacity or safety of the street system.

A Traffic Impact Analysis (TIA) is a comprehensive study of all aspects of a development's probable impacts on the transportation system. This study will analyze how traffic generated by a development relates to traffic on internal and adjacent roadways. The following provides specific situations where a traffic study may be required:

### **a. Zoning**

- A TIA shall be required for a zoning proposal when the expected vehicle trip generation is 5,000 trips per day (tpd) or greater and the current zoning trip generation is exceeded by 1,000 tpd or more.
- TIA may be required for zoning cases generating less than 5,000 tpd, but will not be required for zoning cases generating less than 500 tpd.
- The TIA requirement will be waived if increased traffic generation from the property being zoned has been previously considered in development of the Thoroughfare Development Plan.

### **b. Platting**

- A TIA shall be required for a development when the expected traffic generation is greater than 5,000 tpd.

- Developments expected to generate less than 5,000 tpd may be required to submit a TIA.
- A TIA will not be required for developments generating less than 500 tpd.

**c. Annexation**

A TIA shall be required when the trip generation of the fully developed land use scenario of the annexed land exceeds 5,000 tpd. This requirement will be waived if the Thoroughfare Development Plan has adequately considered this traffic generation or if the City has initiated the annexation.

**d. Thoroughfare Development Plan Amendment**

A TIA may be required to support a request for amendment to the Thoroughfare Development Plan. If the City initiates a Thoroughfare Development Plan amendment, the City will be responsible for the necessary traffic study.

**e. Building Permit, Driveway Permit or Development Plan**

A TIA may be required for any building permit, driveway permit or development plan. This requirement includes permits for sites with existing driveways.

**f. Certificate of Occupancy**

A TIA may be required prior to the issuance of a certificate of occupancy on an existing structure if the new use is expected to increase traffic by more than 500 tpd or if the site's existing driveways create operational or safety problems.

**g. Special Circumstances**

A traffic study may be required for a development if the City determines that one or more of the following conditions exist:

- Traffic generated from a non-residential development will significantly impact adjacent residential neighborhoods.
- Traffic operational impacts such as problems with driveways, left or right turns, signal timing, median openings or sight distance are anticipated. In such cases, the study will only be required to answer questions related to the specific impacts.
- Existing traffic problems on adjacent streets are expected to worsen due to traffic generated from the new development.

- Implementation of the Thoroughfare Development Plan in the area will not occur prior to development of the property.
- The proposed land use differs significantly from that contemplated in the adopted Comprehensive Plan.
- The internal street or access system is not anticipated to accommodate the expected traffic generation.
- A traffic study may be required at any stage of development at the discretion of the City staff, City Council or the Planning and Zoning Commission.

**h. Waiver**

A request for waiver of the traffic study may be submitted to the City. The waiver letter must include sufficient information documenting the justification for the waiver.

**i. Study Update**

Any previous traffic study relating to a development that is more than two years old shall be updated unless the City determines that conditions have not changed significantly. If an updated study is necessary, additional information will be required to:

- Update changes in the proposed development
- Update or refine assumptions made in a prior submittal
- Provide specific information not available at the time of previous submittal

**4. Study Requirements**

**a. Preliminary Meeting**

A meeting shall be held between the engineer and the City to discuss the development project prior to beginning the study. Topics for discussion at the meeting include:

- trip generation
- directional distribution of traffic
- trip assignment
- definition of the study area
- intersections requiring critical lane analysis
- methods for projecting future volumes and conditions to be analyzed
- special site related issues

**b. Study Submission and Review**

A study shall be submitted to the City in accordance with the following:

**1) Zoning cases**

The traffic study shall be submitted no later than the submission of the zoning case application.

**2) Subdivision plats**

The traffic study shall be submitted no later than the submission of the plat application.

**3) City Council agenda**

The traffic study shall be submitted 20 working days prior to the City Council meeting to approve the zoning case.

**4) Others**

For development proposals not involved in a formal hearing process, City will review a traffic study within ten working days of the submittal or will notify the applicant in writing if additional review time is required.

Longer review periods may be necessary if TxDOT is involved. The City will be responsible for processing the traffic study through TxDOT.

Revisions to the traffic study shall be provided to address comments required by the City. If study revisions are required, they will be reviewed within five working days of submittal.

**c. Traffic Impact Analysis Contents**

All TIAs shall be prepared under the direction of an engineer with experience in Transportation Engineering. In order to provide consistency and to facilitate staff review of traffic studies, the following format shall be used:

**1) Introduction**

**2) Land Use, Site and Study Area Boundaries**

A brief description of the size of the land parcel, general terrain features and the location within the City and the region shall be included in this section. In addition, roadways that provide site access and are in the study area shall be identified.

The limits of the study area shall be based on existing and future traffic conditions surrounding the site and will be determined at the preliminary meeting. A vicinity map that shows the site and the study area boundaries, in relation to the surrounding transportation system, shall be included.

**3) Existing and Proposed Site Uses**

The existing and proposed zoning of the site shall be identified. In addition, the specific use for the site shall be identified if known, since a variety of uses may be permitted under a zoning category. The traffic study shall address traffic impacts for the worst case allowed by zoning.

**4) Existing and Proposed Uses in Study Area**

A complete description and map of the existing land uses and zoning in the study area shall be included. In addition, a complete description and map of the assumed future land use shall be provided. Generally, this information can be obtained from the Community Development & Planning Department.

**5) Existing and Proposed Roadways and Intersections in Study Area**

A complete description and map of the existing roadways and intersections including geometrics, traffic signal control, and volumes shall be included. It shall also identify improvements contemplated by government agencies and provide the following details:

- The nature of the improvement project
- Limits
- Implementation schedule
- The agency or funding source responsible

**6) Trip Generation and Design Hour Volumes**

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

Trip generation shall be calculated for the maximum uses allowed under the existing and proposed zoning based on the latest edition of the ITE Trip Generation Manual. In the event that data is not available for the proposed land use, the City shall approve estimated rates. All sources must be cited in the report.

The calculation of design hour volumes used to determine study area impacts shall be based on:

- Peak hour trip generation rates as published in the ITE Trip Generation Guidelines and explained in the ITE publication, “Using the ITE Trip Generation Report.”
- “Site Impact Traffic Evaluation Handbook,” FHWA Report PL/85/004, U.S. DOT, June 1985.
- Traffic volume counts for similar existing uses, if no published rates are available.
- Additional sources from other jurisdictions or publications, if acceptable to the City. Possible sources include:
  - a) “Development and Application of Trip Generation Rates,” FHWA Report PL/85/003, U.S. DOT, January 1985.
  - b) “San Diego Traffic Generators,” San Diego Association of Governments.
  - c) ITE Journal articles.

Passerby factors are to be used to reduce the estimated additional total daily traffic to the street serving a proposed development. They are not to be applied directly to reduce trip generation and turning movement volumes at driveways serving the proposed development. The percentage rates for passerby traffic may be obtained from the latest ITE Trip Generation Manual.

Internal trip reductions and modal split assumptions will require analytical support to demonstrate how the figures were derived. Other documented rates to account for passerby traffic may be used upon approval by the City.

City studies indicate that daily trip generation from office/commercial mixed use developments can be accurately predicted by the application of ITE rates to each individual use. The City may allow reduction of the p.m. peak trip generation to eight to ten percent of the total daily generation.

## 7) **Trip Distribution**

The estimates of percentage distribution of trips from the proposed development to destinations in the metro region shall be clearly stated in the report using a compass rose. Market studies and information concerning origin of trips to the proposed development

may be used to support these assumptions. A map showing the percentage of trips on each street shall be provided.

**8) Trip Assignment**

The direction of approach for site-generated traffic via the area's street system shall be presented in this section. The technical analysis, basic methods, and assumptions used in this work shall be clearly stated. The assumed trip distribution and assignment shall represent the most logically traveled routes for drivers accessing the proposed development. These routes can be determined by observation of travel patterns to existing land uses in the study area.

**9) Existing and Projected Traffic Volumes**

The specific time frames to be studied will depend on the individual development. Near term analysis shall be based on the anticipated earliest completion of the development. The analysis must account for traffic growth from existing volumes and roadway system changes during development of the site. The near term impacts are intended to reveal expected impacts of the development when it is ready for occupancy.

The long-term impacts shall be analyzed when the area is fully developed or 20 years from present, depending on the development location and available information.

An interim condition may also be requested in areas where the roadway system is not fully developed or ultimate improvements are not scheduled. These time frames will be determined at the preliminary meeting.

Graphics shall be provided showing the following traffic impacts for private access points, intersections and streets:

- A.M. peak hour site traffic (in and out) including turning movements.
- P.M. peak hour site traffic (in and out) including turning movements.
- A.M. peak hour total traffic including site generated traffic (in and out). These volumes should include through and turning movement volumes for near term and long term conditions.
- P.M. peak hour total traffic including site generated traffic (in and out). These volumes shall include through and

turning movement volumes for near term and long term conditions.

- Any other peak hour which is critical to site traffic and the street system in the study area shall be included in the graphics and with the same information provided for the a.m./p.m. peak hours.
- Actual counts of existing total daily traffic for the street system in the study area at the time the study is prepared.
- Projected existing and long-term total daily traffic for the street system in the study area based on traffic from the proposed development and counts of existing daily traffic. The component of the existing daily traffic attributable to the existing uses shall be identified as well as the increase in total daily traffic from the proposed development.

All raw traffic count data (including average daily volumes and peak hour turning movements) and analysis worksheets shall be provided in the appendices of the report.

Volume projections for background traffic growth will be provided by the City, or a method for determining these volumes will be recommended by the City.

All total daily traffic counts shall be actual machine counts and not based on factored peak hour sampling. Latest available machine counts from TxDOT, the City and other agencies may be acceptable if less than two years old.

## **10) Capacity Analysis**

A capacity analysis for appropriate peak periods shall be conducted for all public street intersections impacted by the proposed development and for all private property access points to streets within the study area. Capacity calculations shall include both near term and long-term projections. At each location studied, storage requirements shall be calculated for each vehicular movement.

Capacity calculations for near term conditions must be based on the operational analysis techniques contained in the most current edition of the Highway Capacity Manual (HCM). Long-term capacity calculations may be based on the planning analysis techniques in the latest edition of the HCM or the planning and operations procedures included in Transportation Research Circular No. 212. The technique used to calculate capacity will be discussed at the preliminary meeting.

All capacity analysis work sheets or computer print outs shall be included in the appendices of the report.

**11) Traffic Signals**

The need for new traffic signals shall be based on warrants contained in the Texas Manual on Uniform Traffic Control Devices. A minimum spacing of one-half mile for all signalized intersections shall be maintained, except as allowed by the PWT. This spacing is desirable to achieve optimum speed, capacity, and signal progression.

To ensure optimum two-way signal progression, a traffic signal analysis shall be performed to properly locate all access points that may require signalization. The analysis shall include all current and future signalized intersections within the affected area.

The progression pattern calculations must use a cycle consistent with current signal timing policies of the City. A desirable bandwidth of 50% of the signal cycle must be used where existing conditions allow. Where intersections are expected to have signals in the future, a 60% mainline and 40% cross street cycle split should be assumed. Cycle split assumptions must relate to volume assumptions in the capacity analysis for the intersection. Adequate pedestrian clearance shall be provided in the signal cycle split assumptions. Where computerized progression analysis techniques are used, turning and pedestrian movement volume data shall be considered. The City may require proposed signalized intersections to remain unsignalized and have turning movements limited by access design or median islands if the optimum bandwidth is reduced.

**12) Traffic Accidents**

Traffic accident data may be required for affected street corridors. The study period is typically three years. Accident data summaries may be obtained from the PWT. Estimates of increased or decreased accident potential shall be evaluated for the proposed development.

**13) Level of Service Determination**

A table indicating the level of service for near-term and long-term traffic projections for all streets within the study area shall be included. Level of Service "C" is the design objective for all movements. Under no circumstances shall the Level of Service be less than "D" unless deemed acceptable for site and non-site traffic.

**14) Conclusions**

This chapter of the report must include a summary of the study findings regarding impacts of the proposed development on the existing and proposed street system.

**15) Recommendations**

In the event that the analysis indicates unsatisfactory levels of service or safety problems, a detailed description of proposed improvements to remedy deficiencies shall be included. Assumptions regarding future capacity recommendations shall be approved by the City. The recommendation section shall include a sketch of each improvement showing pertinent geometric features.

## **CHAPTER 4**

### **SUBDIVISIONS**

#### **Section 4.1 Introduction** (Amended Ord #10-008)

The purpose of these guidelines is to provide information required to prepare civil construction plans for subdivisions. Specific information required for plan submittal can be found in the following sections or in the checklists located in the Appendices. Additional resources have been included to assist in the design and plan preparation.

#### **Section 4.2 Public Improvements Submittal** (Amended Ord #10-008)

A Public Improvements application shall be submitted to the Community Development and Planning Department. The following is a list of the type of sheets or plans that may be required as part of the Public Improvements submittal:

- Cover Sheet
- Final Plat
- Dimension Control Plan
- Landscape/Tree Preservation Plans
- Drainage Area Map
- Site Grading Plan
- Street and Drainage Plan, Profile and Details
- Water and Sanitary Sewer Plan, Profile and Details
- Streetlights, street signs and pavement markings
- Storm Water Management Site Plans
- Storm Water Pollution Prevention Plans
- Gated Entries
- Deceleration Lanes
- Median Openings

After all reviews have been completed, the applicant will be notified regarding the final number of plans needed for acceptance. Final plans or other documents that will be archived must be submitted in an electronic format specified by the Director of Community Development and Planning (CDP Director) as a condition to issuance of any type of permit, approval, or other action related to the final plans or documents. The City may provide an electronic conversion service for a fee in the amount set forth by City Council resolution. The CDP Director shall provide a schedule indicating which documents must be provided electronically, at which point during the approval process, and other information as necessary to implement an electronic archiving program.

This chapter provides guidelines for designing public improvements, or civil construction plans for residential and commercial subdivisions.

Public Improvement applications that are not accepted for construction within twelve (12) months after the date of application may be voided unless an extension is requested in

writing prior to its expiration. One extension will be allowed for a period not to exceed six (6) months.

Public Improvement construction plans will expire if no construction has begun within 24 months from the date of public improvement approval. A new Public Improvement application must be submitted along with the construction plans. Plans must be in compliance with design standards in effect at the time of resubmittal.

In cases where a development is phased, the public improvement construction plans will expire 24 months from the date of approval if construction of the undeveloped phases has not begun after City acceptance of the public improvements of the previous phase. Construction plans for the undeveloped phases shall be resubmitted for review, along with a new Public Improvement application, and must be in compliance with design standards in effect at the time of resubmittal.

### **Section 4.3 Stormwater Management/Department of Public Works & Transportation**

#### **A. Stormwater Management Site Plan (SWMSP) – Permanent Controls**

##### **1. General Requirements**

A preliminary Stormwater Management Site Plan (SWMSP) shall be prepared for all developments of 12,000 SF or more. A site plan will be accepted in lieu of a preliminary SWMSP if the site plan shows development will create less than 5,000 SF of impervious surface.

A final SWMSP must be accepted by CDP prior to any site activity.

The SWMSP shall identify permanent site features and controls that will be included in the design and constructed with the project to minimize and mitigate the project's long-term effects on stormwater quality and quantity. The SWMSP shall be submitted to the CDP with the street and drainage plans.

The SWMSP shall be developed and coordinated with the site drainage plan and may be shown on the same sheet. It shall also be coordinated with the landscaping plan to prevent conflicts and assure compatible land use. The SWMSP shall meet all criteria of the SWMSP Checklist found in Appendix B and shall be sealed by a Professional Engineer or shall be signed and dated and contain a statement affirming the plan was prepared under the direction of the engineering signing the plan.

##### **2. Permanent Best Management Practices (BMPs)**

BMPs and design criteria to be used for the site will be discussed at the pre-application conference for platting and accepted by the City before the final plat is approved as required in the Subdivision Regulations. It is the responsibility of the engineer to design BMPs that address site specific conditions using

appropriate design criteria for the North Central Texas region. The source of the design criteria shall be referenced in the SWMSP.

To preserve the existing natural resources in Arlington and promote sustainable development, demonstration of compliance with the following Site Layout permanent BMP is required in the SWMSP for all developments.

- Site Layout – When the predevelopment grade at a site is steeper than five horizontal to one vertical or the site contains natural creeks or wetlands, the site layout shall be designed to require the least modification to the existing topography and drainage. Factors to be considered are lots oriented and designed to minimize change in grade, drainage systems designed to minimize change in time of concentration, and street layouts designed to minimize extent of pavement.

In addition to the Site Layout BMP, the following minimum number of BMPs shall be provided:

**BMP Requirements\***

	<b>No. of BMPs <u>(minimum)</u></b>
12,000 SF ≤ Disturbed Area < 5 acres	1
5 acres ≤ Disturbed Area < 20 acres	2
≥ 20 acres	3

\*Subdivisions with paved alleys in addition to streets shall provide one BMP above the minimum.

Examples of factors that shall be considered when evaluating and selecting BMPs for a development are as follow:

- Effect of the development on runoff volumes and rates
- Potential pollutants from the development
- Percent of site treated by the BMP
- Effectiveness of the BMP on potential pollutants from the development
- Natural resources on the site
- Configuration of site, including changes to existing waterways

Potential stormwater pollutants from development may consist of but are not limited to the following:

- Total suspended solids

- Increased temperature
- Oil and grease
- Floatables (trash)
- Nutrients (fertilizers)
- Bacteria
- Metals
- Pesticides
- Sediment (soils due to erosion)

The following items are acceptable permanent BMPs for subdivisions:

- Preservation of natural creeks – Refer to Article V, Drainage and Environmental Standards, in the Subdivision Regulations for requirements when preserving natural creeks.
- Vegetated swales – Vegetated swales may be used if drainage design criteria are met. Consideration will also be given for the use of vegetated bar ditches for local rural streets. Vegetated swales shall be designed with a trapezoidal cross section and a gentle slope that yields a maximum velocity of 2 fps for the 2-year storm event. The engineer shall evaluate flow depths to verify no upstream flooding is caused by the vegetated swale during larger events. Design capacity of the swales is as specified in the Drainage Requirements of this document.
- 100-year drainage easement – Dedication of the 100-year fully urbanized floodplain as a drainage easement with the creek left in its natural condition will receive one BMP credit. This BMP is only available when no credit is being given for the dedication of a linear park.
- Landscaping – A landscape plan sealed by a landscape architect shall be submitted with the SWMSP to receive BMP credit. Landscaping may be on individual and/or commonly owned lots and unpaved open space and must include canopy-type trees at least 3 inches of caliper at time of planting. Refer to Zoning Ordinance Section 14-300 for an acceptable tree list. Ornamental subdivision entry-way plantings are not eligible. The landscape plan shall identify the party responsible for the installation of planting and maintenance until the residence is purchased by an individual homeowner. A permanent or temporary irrigation system may be necessary to establish plantings.

- Cluster design – The subdivision shall concentrate residential density in one portion of the site in exchange for other areas permanently dedicated to open green space, passive or active recreational amenities, or similar use. Credit will not be given for drainage and utility easements or space set aside for future development. Depending on minimum lot size, this BMP may require a Planned Development (PD) as outline in the Zoning Ordinance.
- Low Impact Development Methods – The subdivision shall identify Low Impact Development (LID) Methods such as rain gardens, rain barrels, cisterns on individual lots and/or bio-retention or bio-detention facilities on common areas which treat all post-construction areas. The vegetated LID features should consist of native plantings or plantings consistent with Texas Smart-Scape recommendations. A provision (deed restriction or easement) ensuring long-term preservation and maintenance will be required.
- Detention - Detention may be achieved by surface ponds or subsurface structures. The first one inch of runoff from the drainage area shall be detained and slowly released over at least 24 hours but less than 48 hours. Detention ponds and structures shall be evaluated for the 5-, 25-, and 100-year storm events using post-development landuse to verify that no structure flooding will be caused by the detention. Outfalls for detention ponds shall be designed to prevent clogging of the intake. The pond shall also be designed in accordance with other criteria in this chapter.
- Retention ponds – Retention ponds may be used if the engineer can show that daily flows, ground water seeps, or other water sources are available to maintain a permanent pool with a healthy aquatic community. A water balance shall be submitted with the plan. Retention ponds shall be a minimum of 4 feet deep, have a 10H:1V slope for areas that are 1 foot deep or less, and be designed to prevent short-circuiting. Fountains, cascades, or other means of aeration shall be provided to prevent the pond from becoming stagnant. The pond shall be evaluated for its affect on the 5-, 25-, and 100-year storm events using post-development landuse to verify that the pond will not induce flooding.
- Preservation of existing tree canopy – This BMP is only available when the existing tree canopy covers more than 50% of the site. A minimum of 75% of the critical root zone shall be preserved at natural grade, with natural ground cover. The Stormwater Pollution Prevention Plan for construction activities must contain fencing requirements at the tree's drip line to ensure preservation of the trees. In addition, the grading and utility plans shall result in no soil disturbance or change of grade within the drip line edge of the preserved trees. BMP credits will be given in accordance with the following:

<u>Percent of Existing Canopy Preserved</u>	<u>No. of BMP Credits</u>
25% - 49.999%	1
50% - 65%	2
> 65%	3

- Dedication of a linear park - Refer to Article VII, Linear Parks, in the Subdivision Regulations for requirements related to dedication of a linear park. Dedication of a linear park will count for two BMP credits.
- Mixed use BMPs – For subdivisions that will support mixed use, refer to Chapter 5, Commercial Sites, of this manual for additional BMPs that may be used on the commercial lost in the subdivision.
- Other BMPs – Other BMPs and innovative designs will be considered when submitted to the CDP with supporting calculations and references.

**3. Construction and Maintenance**

The owner shall construct all permanent BMPs and is permanently responsible for maintenance of the BMPs. When the BMP falls within a drainage easement, the plat or separate instrument dedicating the easement shall include a statement of the owner’s responsibility for maintenance. The statement shall be identical to the one in Article V, Drainage and Environmental Standards, Section 5.03.B.4, of the Subdivision Regulations, with the words “stormwater treatment facility” substituted for “stormwater storage facility.”

**B. Stormwater Pollution Prevention Plan (SWPPP) – Temporary Controls During Construction**

**1. Applicable Regulations and Ordinances**

Construction activities shall comply with the SWPPP requirements in the effective TPDES General Permit relating to Stormwater Discharges from Construction Activities, of the Stormwater Pollution Control Ordinance and the appropriate federal (Environmental Protection Agency) and state (Texas Commission on Environmental Quality) regulations. When the ordinance and applicable regulations are in conflict, the most stringent requirements shall apply.

**2. General Requirements**

Projects that disturb less than 1 acre shall have a SWPPP that complies with the requirements in the Checklist for Small Projects. Projects that disturb 1 acre or more shall comply with the requirements in the Checklist for TCEQ Regulated Construction Projects. These checklists are in Appendices C and D, respectively. Residential projects that disturb less than 12,000 SF and are not part of a larger plan of development are exempt from these requirements.

The SWPPP for projects that disturb more than 5 acres shall be sealed by a Professional Engineer and submitted to CDP with the street and drainage plans for review and acceptance.

### 3. Best Management Practices (BMPs) During Construction

Structural BMPs shall comply with details and specifications in the latest edition of the NCTCOG BMP Manual titled “*Stormwater Quality Best Management Practices for Construction Activities*” and this manual. When the NCTCOG Manual and this manual are in conflict, this manual shall govern.

The SWPPP shall provide a series of changing BMPs that are appropriate for each phase of construction. The SWPPP shall also identify which owner/operator is responsible for installing, inspecting and maintaining each BMP during the different phases of construction. All temporary BMPs must be removed after final stabilization is achieved.

The following items are acceptable temporary BMPs for use during construction:

- Preservation of existing vegetation - This is a preferred BMP. When areas of existing vegetation are to be preserved, the areas shall be delineated on the plans, and the plans shall include notes stating that temporary chain-link fencing shall be installed to protect the vegetation.
- Vegetated buffer strips – Buffer strips may consist of preserved or planted vegetation. The strip shall be at least 15 feet wide, identified on the SWPPP, and flagged or otherwise designated in the field to prevent disturbance. Wider strips shall be specified when the slope is steeper than 10H:1V. If existing vegetation is used, it may be removed at the end of the project for establishment of permanent landscaping. The following design criteria shall be met when using vegetated buffer strips:
  1. The drainage area shall not exceed 0.25 acres per 100 feet length of vegetation.
  2. The maximum distance of flow to the vegetated buffer shall be 100 feet or less.
  3. The maximum up-slope grade perpendicular to the vegetated buffer shall not exceed 5H:1V.
- Soil retention blankets – Soil retention blankets shall be anchored per the manufacturer’s recommendations. On lots with slopes of 3H:1V or flatter, the blanketed area shall be at least 8 feet wide. Greater widths and additional BMPs shall be specified on steeper slopes. The blankets shall be seeded if used for temporary stabilization before start of home construction. Soil retention blankets used in channels shall meet TxDOT requirements for Type E-H blankets, as appropriate.
- Silt fence - Silt fences shall have wire mesh backing and be supported by metal posts. When used as a perimeter control, they shall only be placed

down-slope from the construction activity, with the ends turned up-slope, perpendicular to the contours, to form a sediment trap. Silt fences may be used for concentrated flows up to a maximum design flow rate of 0.5 cfs. The following design criteria shall be met when using silt fence:

1. The drainage area shall not exceed 0.25 acres per 100 feet of fence length.
  2. For slopes between 50H:1V and 3H:1V, the maximum distance of flow to the silt fence shall be 100 feet or less.
  3. For slopes of 3H:1V and steeper, the maximum distance of flow to the silt fence shall be 20 feet.
  4. The maximum up-slope grade perpendicular to the fence line shall not exceed 1H:1V.
- Curb inlet protection - Inlet protection is the least desirable BMP. It will only be accepted for use on private streets and on public streets when no other BMP is viable. Temporary inlet inserts shall be used unless a written request to use other measures is submitted to and approved by PWT. If other measures of protecting the inlet are requested, the engineer shall evaluate them for possible flooding in low areas and flow diversion on steep slopes.
  - Temporary detention structure - If 10 or more disturbed acres drain to a common drainage point, a temporary or permanent sedimentation basin shall be used. Storage volume may be calculated as the volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained. When calculating the volume of runoff from a 2-year, 24-hour storm event, it is not required to include the flows from offsite areas and flow from onsite areas that are either undisturbed or have already undergone permanent stabilization, if these flows are diverted around both the disturbed areas of the site and the sediment basin. Capacity calculations shall be included in the SWPPP. A sedimentation basin providing at least 3,600 cubic feet of storage per acre drained until final stabilization of the site may be used in lieu of calculating the runoff volume. This practice is advisable on smaller drainage areas where practicable.
  - Rock check dams - Rock check dams are appropriate for areas of concentrated flow such as swales and ditches and at the outfall for a subdivision. Rock shall be contained within wire mesh. Check dams shall be placed at a spacing that sets the top elevation of a dam at the toe elevation of the next upstream dam, with the top of the furthest upstream dam set at the invert of the last stabilized portion of the swale or ditch. When check dams are used as an outfall control, the first check dam shall be at least 10 feet from the outfall, but no further than 50 feet from the outfall.
  - Earthen berms - Earthen berms may be used as a perimeter control to divert runoff from adjacent sites away from the development or to retain runoff within the development. Earthen berms shall be stabilized within

14 days of their construction. The engineer shall analyze the impact of these diversion berms on adjacent sites.

- Fibrous mulch – Fibrous mulch may be used as an erosion control to limit the runoff from disturbed areas within the development. Mulch shall be at least 3 inches thick and cover all disturbed areas. When used on slopes of 3H:1V or steeper and in critical areas such as waterways, mulch matting must be anchored with netting to hold it in place.
- Hydromulch - Hydromulch stabilization may be used as an alternative to seeding for erosion control when all disturbed area is covered by the hydromulch. A strip of hydromulch is not acceptable unless additional structural controls are provided.
- Stabilized construction entrance - All construction entrances shall be stabilized with rock or other non-erodable material. If rock is used, the minimum effective diameter shall be 3 inches. Entrances shall be placed at high points or other areas where runoff from the construction site will not be directed to the entrance. The construction entrance shall not extend into the street or block flow in the gutter.
- Temporary inlet inserts – Commercially available or fabricated inserts shall be used when inlet protection is the only viable BMP. Inlet inserts must be configured to pass the inlet’s design flows without causing flooding.
- Other BMPs - It is the responsibility of the engineer to design appropriate BMPs for each site. If the most appropriate BMP is not in the NCTCOG BMP Manual, the engineer shall submit calculations and references for design of the BMP to PWT .

#### **4. Waste and Hazardous Material Controls**

Covered containers shall be provided for waste construction materials and daily trash. Hazardous materials shall be stored in a manner that prevents contact with rainfall and runoff. Onsite fuel tanks and other containers of motor vehicle fluids shall be placed in a bermed area with a liquid-tight liner or be provided with other secondary containment and spill prevention controls.

The SWPPP shall require federal, state and local reporting of any spills and releases of hazardous materials greater than the regulated Reportable Quantity (RQ) and reporting to the PWT’s Stormwater Management Division, Environmental Compliance Section of all spills and releases to the storm drainage system.

#### **5. Temporary Stabilization**

Portions of a site that have been disturbed but where no work will occur for more

than 21 days shall be temporarily stabilized as soon as possible, and no later than 14 days, except when precluded by seasonal arid conditions or prolonged drought.

Temporary stabilization shall consist of providing a protective cover, without large bare areas, that is designed to reduce erosion on disturbed areas. Temporary stabilization may be achieved using the following BMPs: temporary seeding, soil retention blankets, fibrous mulches, hydro-mulches and other techniques that cover 100 percent of the disturbed areas until either final stabilization can be achieved or until further construction activities take place.

Perimeter BMPs such as silt fence, vegetated buffer strips or other similar perimeter controls are intended to act as controls when stabilization has not occurred. Perimeter BMPs may remain in place during temporary stabilization, however, they are not acceptable as temporary stabilization.

## **6. Final Stabilization**

Final stabilization consists of soil cover such as vegetation, geotextiles, mulch, rock, chemical modification of the soil, or placement of pavement. For vegetative stabilization, perennial vegetation must cover all disturbed areas without large bare areas and with a density of 70 percent of the native background vegetative cover. Vegetated buffer strips are not allowed unless designed and credited as a permanent BMP. All non-vegetative stabilization must cover 100 percent of the disturbed area.

For stabilizing vegetated drainage ways, sod or seeded soil retention blankets shall be used. Hydromulch will not be allowed in vegetated swales, channels or other drainage ways. BMPs may remain in place during stabilization, however, BMPs shall be removed after stabilization is achieved.

The plan for final stabilization shall be coordinated with the permanent BMPs in the SWMSP and with the landscaping plan, if applicable.

## **7. Notice of Intent (NOI)**

On projects 5 acres in size or larger, the owner and each contractor, including each builder in a residential subdivision, shall submit a copy of the NOI to PWT's Stormwater Management Division, Environmental Compliance Section at least 2 days prior to construction. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor needs to submit a copy of the NOI.

## **8. TCEQ Site Notice**

On projects that are 1 acre and larger but smaller than 5 acres, the owner and each contractor shall complete the Construction Site Notice provided in the TCEQ's New General Permit for Construction and submit a copy of it to PWT's Stormwater Management Division, Environmental Compliance Section at least

two days prior to commencement of construction activities. A signed copy of each Construction Site Notice must be posted at the construction site in a location where it is readily viewed by the general public during all construction activity. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor must submit and post the Construction Site Notice.

**9. Notice of Termination (NOT)**

All parties that submitted a NOI shall submit a NOT within 30 days after final stabilization is established. When the owner of a residential subdivision transfers ownership of individual lots to builders before final stabilization is achieved, the SWPPP shall include controls for each individual lot in lieu of final stabilization. These controls shall consist of stabilization of the right-of-way and placement of structural BMPs at the low point of each individual lot or equivalent measures to retain soil on each lot during construction. Additionally, the builder must submit a valid NOI before an NOT can be submitted by the owner.

**10. Inspection and Maintenance during Construction**

The owner shall construct all BMPs and other controls required by the SWPPP. The owner shall have qualified personnel inspect the BMPs at least every two weeks during construction and within 24 hours after a storm event of 0.5 inches or greater. Alternately, inspections may be performed every 7 days with no additional inspections after rain events. Certified inspection reports shall be retained as part of the SWPPP. Within 7 days of the inspection, BMPs identified as damaged or deteriorated shall be repaired or replaced, as appropriate. BMPs shall also be cleaned to maintain adequate capacity.

If a discharge of soil or other pollutant occurs, the BMPs shall be evaluated. Changes or additions shall be made to the BMPs within 7 days to prevent future discharges. In addition, the owner shall implement procedures to remove discharged soil from all portions of the Municipal Separate Storm Sewer System (MS4) that received the discharge, including streets, gutters, inlets, storm drains, channels, creeks, and ponds.

Notes requiring the inspection and maintenance shall be placed on SWPPP drawings. The SWPPP shall identify the responsible party for inspecting and maintaining each BMP. If no party is identified, each owner and operator that submitted a NOI for the site shall be fully responsible for implementing all requirements of the SWPPP.

Inspectors for the City will not allow construction of public improvements to start, nor will they grant final acceptance of public improvements, until the SWPPP is implemented and maintained.

**Section 4.4. Water Utilities Engineering Department**

**A. Horizontal and Vertical Control**

**1. Horizontal Control**

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City’s web page.

**2. Vertical Control**

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City’s web page.

**B. Digital File Requirements**

Prior to acceptance of three-party contracts, the owner’s engineer shall furnish the City an electronic file of the water and sewer construction drawings in AutoCAD R14 or higher in .DXF or.DWG format. The information shall be provided to the City on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Water Lines	C-WTR-WL
Water Line Text	C-STR-WL-TXT
Water Line Valves	C-WTR-GV
Water Line Valve Text	C-WTR-GV-TXT
Water Line Fire Hydrants	C-WTR-FH
Water Line Fire Hydrant Text	C-STR-FH-TXT
Sewer Lines	C-SWR-SL
Sewer Line Text	C-SWR-SL-TX
Sewer Lines Cleanouts	C-SWR-CO
Sewer Lines Cleanout Text	C-SWR-CO-TXT
Sewer Lines Manholes	C-SWR-MH
Sewer Lines Manhole Text	C-SWR-MH-TXT

All files shall be in the same directory, including all construction documents with their dependencies (XREFS), plot files, and any support files needed. The electronic files shall use only standard AutoCAD fonts with “ROMANS” as the main font.

**C. Design Plan Information**

Plan review information is included in Appendix E. This information is used by the CDP when reviewing plans and provides guidance to the engineer as to the type of information that will be required for water and sewer plans.

Additional resources for water and sanitary sewer requirements are:

- The Water Chapter and the Subdivision Chapter of the City Code, and
- The Standard Details and Specifications for Water and Sewer Construction.
- The Texas Commission on Environmental Quality (TCEQ)
- The National Sanitation Foundations (NSF)
- The Texas Department of Insurance
- The Insurance Services Office

## **D. Design Requirements – Water**

### **1. Pipe Sizing**

- Water mains shall be sized for fully developed conditions based on the 2001 Water Distribution Analysis or latest revision. In addition, 12-inch water mains shall be installed on a ½ mile grid pattern and 8-inch water mains shall be installed on a ¼ mile grid pattern unless fire flow or domestic services require larger lines. Water lines shall be a minimum of 6 inches throughout the distribution system, except in industrial or manufacturing areas where the minimum size shall be 8 inches. Where the length of the line exceeds 800 feet, the minimum shall also be 8 inches.
- Water lines shall be designed based on 1 gpm for each unit or residence up to 100 and 0.60 gpm for each unit or residence over 100. This criteria shall be used to determine the size of the water lines required to serve a development and eligibility for oversized participation.
- Dead end systems shall be avoided where possible, but if necessary shall not exceed 2000 feet.

### **2. Line Placement**

If street improvements are proposed, the water line placement shall be coordinated with the street plans.

#### **a. Vertical**

- The following note shall appear on the water layout plan sheets: “There shall be a minimum cover of 42 inches over the water pipe as measured from the top of the pipe to the existing ground. Existing ground may be the flow line of the bar ditch, natural ground on the low side of a county-type road, or the proposed finished grade, whichever is lowest.”
- Lines shall be at least 2 feet below curb inlets.
- Water lines along unimproved streets shall have a minimum

depth of 5 feet below the lowest ditch elevation to the top of pipe to provide grade for future street improvements.

- A profile drawing shall also be provided for all water mains 12 inches and larger.

**b. Horizontal**

- Water lines shall be located 2 feet behind the proposed curb. Lines shall be located to clear the back of curb inlets by at least 2 feet by deflecting the pipe or using bends.
- The minimum radius to be used for PVC water pipe is as follows:

<u>Diameter (Inches)</u>	<u>Minimum Allowable Radius (Feet)</u>
6	150
8	200
10	250
12	300

For pipe sizes larger than 12 inches, the minimum radius shall be:  $300 \times D$  (where D = pipe diameter in feet).

**3. Gate Valves**

Gate valves shall be installed at pipe intersections to allow for the isolation of lines for repairs and the routing of poly pigs. Valves shall also be placed such that no more than 35 lots will be out of service when a line is out of service. When installed at street intersections, main line valves shall be installed 2 feet behind the back of the curb at the point of tangency for the curb return. Valves installed between intersections shall align with common lot lines. Gate valves are not to be used on fire hydrant leads when connected to water mains smaller than 12 inches in diameter.

**4. Fire Hydrants**

- For all single family detached and duplex residences, excluding townhouses and apartments, fire hydrants shall be spaced to have an effective radius of 500 feet or a fire hose laying distance of 600 feet, whichever results in the closer fire hydrant spacing, or as required in the current Fire Code. The fire hose laying distance is measured by the laying of fire apparatus hose lines along streets and right-of-way from the nearest water supply on a street to the most distant point on the exterior of the building.
- Fire hydrants for all other land uses shall be spaced to have an effective

radius of 300 feet or a fire hose laying distance of 500 feet, whichever gives the closer fire hydrant spacing, or as required in the current Fire Code.

- A fire hydrant shall be installed at the end of mains on cul-de-sacs and other locations where lines terminate. Other fire hydrants shall be located at street intersections and shall align with common lot lines. Additional fire hydrants may be required between intersections to meet the minimum spacing requirements.
- When the street is designated on the Thoroughfare Development Plan as an arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians shall have a fire hydrant on the same side of the street that the building is to be constructed.
- Fire hydrants shall be located in accessible protected areas. They shall be located a minimum of 3 feet and no more than 8 feet behind the back of curb.
- Fire hydrants shall be located outside curb returns and at least 4 feet from a driveway.
- A clear space of three feet shall be maintained around all fire hydrants.
- Fire hydrant mains shall be placed between 4 feet and 6 feet in depth. Offsets or bends shall be used to bring the fire hydrant up to allowable depths.
- Private fire protection systems and private fire hydrant locations shall be approved by the City of Arlington Fire Department prior to construction. A fire hydrant shall be installed no more than 200 feet from the fire department connection for an automatic sprinkler system.

## **5. Water Services**

- The minimum size water service line shall be 1-inch.
- Where water meter banks are installed, permanent metal tags with addresses shall be installed on the service line at the curb stop to link the service with the address. The meters shall be installed in a logical sequence.
- Water meters and boxes shall be located in accordance with the standard details.

## **6. Miscellaneous**

The City may install detector checks or water taps on lines greater than 2 inches at the owner's request. The owner may request a cost estimate for materials and installation by contacting the Water Utilities/Customer Services Office. A set of approved plans and a copy of the approval letter from the WUED shall accompany the request.

**E. Design Requirements – Sanitary Sewer**

**1. Pipe Sizing**

- Sanitary sewer mains shall be adequately sized to serve the development and upstream drainage basin. Sanitary sewer mains shall be extended through the development to serve abutting property as required. Sanitary sewer mains shall be a minimum of 8-inches in diameter.
- Sanitary sewer systems shall be designed based on 1 gpm of flow for up to 100 units or residences and 0.60 gpm for each unit or residence over 100. When the drainage area is larger than 100 acres and the proposed land use (zoning) is unknown, Harmon's Formula shall be used to determine peak dry weather flow.

Harmon's Formula:

$$M = 1 + \frac{14}{4 + \sqrt{P}}$$

M = Ratio of design load to average load

P = Population in thousands, assuming a density of 14 people per acre

- In addition, infiltration shall be estimated at 100 gpd per acre of drainage basin and shall be added to the peak dry weather flow to determine the total peak flow. The peak flow shall be 75 percent of the pipe capacity. Capacities shall be calculated using a Manning's (n) equal to 0.013. The engineer may be required to submit design calculations to the WUED for review.
- Other methods may be used with WUED approval. Line sizing is subject to the final approval of the Director of Utilities.
- A minimum velocity of 2 fps shall be maintained. Associated slopes are listed below:

<u>Diameter (inches)</u>	<u>Slope (ft/ft)</u> <u>n = 0.013</u>
8	0.0040
10	0.0028
12	0.0022
15	0.0015

18	0.0012
21	0.0010
24	0.0008
27	0.00067
30	0.00058
36	0.00046

**2. Line Placement**

If street improvements are proposed, the sanitary sewer line placement shall be coordinated with the street plans.

**a. Vertical**

- Sewer mains shall be installed on a uniform grade between manholes. Particular care shall be taken to avoid rapid grade changes or reduced velocities at the lower section of the sewer main.
- Sanitary sewer lines constructed along unimproved streets shall be a minimum of 8 feet below the level of the lowest part of the existing street or bar ditch to provide grade for future street improvements.
- Sanitary sewer mains and services shall be encased in Class ‘A’ concrete where:
  - 1) the cover is 3 feet or less in paved areas, measured from the top of subgrade
  - 2) the cover is 2 feet or less in parkways
  - 3) the line has 2 feet or less of clearance beneath proposed storm drains or conduits.
- A profile drawing shall be provided for all sanitary sewer mains.

**b. Horizontal**

- The minimum radius for PVC sewer pipe shall be determined using the following formula:

$$R = 300 \times D$$

R = minimum allowable radius of curvature

D = pipe diameter

R & D are in the same dimensional units

- Sanitary sewer lines shall be placed along the centerline of the street unless prohibited by topography.

### **3. Manholes and Cleanouts**

- Manholes shall be required at a maximum spacing of 500 feet on public sewer lines. Manholes are required at direction, pipe size, and grade changes.
- A standard manhole is 48 inches in diameter. A 60-inch diameter manhole is required when designed as a drop manhole, deeper than 12 feet, or the main is 15-inches or larger.
- Drop manholes shall only be used for depths greater than 12 feet.
- A manhole shall be installed at the end of mains on cul-de-sacs. A maximum of three sanitary sewer services may be installed at the end of a cul-de-sac.
- Where manholes and cleanouts are located within the 100-year floodplain, watertight rings and lids shall be used.
- The top of manholes shall be set at 1 foot below the top of the subgrade when located in future pavement and raised to grade with the pavement construction or 6 inches above existing natural ground outside paved areas.
- When tying to existing manholes, the invert must be reworked.
- Cleanouts may be installed at the end of main lines, except at the end of lines in cul-de-sacs.

### **4. Sanitary Sewer Services**

- Generally, sanitary sewer services are a minimum of 4-inches in diameter, shall be installed below water services and located 9 feet downstream of the center line of the lot. Exceptions will be considered on an individual basis.
- Where lot grades are lower than the street, located in the floodplain, or a storm drain crosses the sanitary sewer main, the flow line elevation of the sewer service line at the property line shall be provided.

### **5. Miscellaneous**

- When sanitary sewer lines are connected, the crown of each pipe shall be matched. Where a larger upstream line connects to a smaller downstream line, the flow lines shall be matched.
- Aerial crossings of open drainage features shall incorporate the use of trusses, wide flange beams, or the strapping of the line to bridge

structures or culverts to minimize the number of piers within the open drainage feature. Spread footings shall not be used in pier design.

- Ductile iron pipe shall generally be used for aerial crossings, trench spans, fill areas, bored and grouted pavement crossings, or where cover is minimal. All 12-inch and smaller sanitary sewer mains using poly-wrapped ductile iron pipe shall be a Class 350 or greater. A greater pipe class may be required to accommodate trench conditions.

**F. Submittals**

**1. Utility Companies**

The owner shall submit plans to the utility companies when new water and sanitary sewer lines will be installed along perimeter streets or as approach (offsite) mains to a development. A list of utility companies and contact names can be obtained from the WUED at the time of submittal.

**2. TxDOT**

A permit from TxDOT is required when constructing facilities within state right-of-way. The WUED will provide the forms that are to be completed by the owner. Five copies of the completed form and five additional sets of plans shall be submitted to the WUED. The WUED will forward the forms and the plans to TxDOT for approval. The permit must be approved prior to commencing construction.

**G. Utility Easements (Water & Sanitary Sewer)**

Utility easements are required for all public water and sanitary sewer lines installed outside of the street right-of-way. Generally, utility easements shall be a minimum of 15 feet wide except when a utility easement is adjacent to another easement or right-of-way where 10 feet is allowed. When both water and sanitary sewer lines are located in the same easement or other facilities are within the easement, the minimum width shall be 20 feet. Where water or sanitary sewer lines are constructed deeper than 10 feet, the easement width shall be a minimum of 20 feet. For deep lines, the width of the easement shall encompass the trench width and side slopes which are based on one horizontal to one vertical for each side of the trench unless otherwise approved by the WUED.

The owner shall submit the ownership information, metes and bounds description, and the exhibit of the utility easement to the WUED. The description and easement shall be sealed, signed, and dated by a surveyor.

The filing process for separate easements can be found in Chapter 3 of this manual.

**H. Construction Requirements**

**1. Water and Sanitary Sewer**

The owner shall construct all water and sanitary sewer facilities required for the development of the subdivision, including any necessary offsite facilities. The owner shall also acquire necessary offsite utility easements. All City participation requests for offsite and/or oversized facilities must be authorized by City Council before beginning construction. All water and sanitary sewer infrastructure shall be in place and accepted by the City prior to the issuance of a building permit.

In accordance with the Subdivision Regulations, the City will not allow construction of any public improvement or issue permits for any construction activity until the plat is approved and filed with the county. Upon written request from the owner, the Director may allow the construction of public improvements prior to the plat being filed with accepted plans and inspection. The owner must demonstrate that an inability to file the plat within a reasonable timeframe is the result of filing requirements that do not have a substantive impact upon the development of the land. Should the City allow the development of public improvements prior to plat filing, the improvements will not be accepted until a plat is filed of record. No grading, clearing or fill shall commence without a SWPPP and prior approval of CDP.

**2. Standard Specifications**

Water and sanitary sewer standard specifications may be obtained through the City's web site or by requesting a CD-ROM from the WUED.

**3. Typical Details (Water and Sanitary Sewer)**

Water and sanitary sewer details may be obtained through the City's web site or by requesting a CD-ROM from the WUED.

**I. Contractor Requirements**

**1. Pre-qualification**

A contractor employed by the owner must be pre-qualified by the City to construct all public water and sanitary sewer improvements. Pre-qualification shall be determined by the City. The contractor shall complete a pre-qualification form indicating the type of work for which the contractor desires to be pre-qualified. The contractor shall provide information regarding experience related to the construction of public projects similar to those for which the contractor is requesting pre-qualification. Pre-qualification forms for water and sanitary sewer projects are available in the WUED or on the City's website.

**2. Contract Requirements**

Standard Three-Party Contracts executed by the owner, contractor, and the City are required for construction of all public water and sanitary sewer

improvements. The contract shall provide for 100-percent performance, payment and maintenance bonds, except when the contract is less than \$25,000. When the contract is less than \$25,000, only a maintenance bond is required. The bonds shall not be executed prior to the date of execution of the contract. An insurance certificate with coverage approved by the City is also required with the contract documents. The expiration date of the insurance policy shall not be prior to the completion of the project. Additionally, an administration and inspection fee as established by the City (refer to Chapter 3 of this manual) shall be paid prior to commencing construction. A trench safety plan signed and sealed by an engineer shall also be submitted with the contract.

### **3. Inspection Requirements**

The contractor shall notify the PWT's Construction Inspection Division 48 hours prior to the start of any construction of public facilities. The contractor shall also ensure that, when applicable, proper authorities with TxDOT, franchised utility companies, railroads, or any other affected entities are notified.

### **J. Permits**

No Building permits will be issued until all water and sewer infrastructure is initially accepted.

## **Section 4.5 Transportation/Department of Public Works & Transportation**

### **A. Thoroughfare Development Plan (TDP)**

Included in Appendix F is a map illustrating the Thoroughfare Development Plan. Information on the back of the map explains designations and provides the guidelines used in developing the plan. All developments shall comply with the TDP. Contact CDP for the latest amendments to the TDP.

### **B. Gated Entry**

All gated entries must include turn around facilities to accommodate a type "SU" vehicle and provide ingress for a "design" fire truck. Placement of gate location and call box may vary based on trip generation for the development. All gated entries must be equipped with a Knox System Gate Access Key Switch and an Opticom Priority Control System as approved by the Fire Department.

Gated entries for apartment complexes must remain open during the hours of 7 to 9 a.m. and 4 to 6 p.m.

Any variation from the typical gated entries included in this section will require approval of the City. Refer to Appendix G for gated entry layout designs.

**C. Intersection Geometric Design**

Typical layouts of various street intersections are included in Appendix H.

**D. Sight Distance Criteria**

At controlled or uncontrolled intersections of any public street, the minimum intersection sight distance (visibility triangles) shall have the dimensions as illustrated in Figure 1 in Appendix I. Where a driveway intersects a public street, the minimum intersection sight distance shall have the dimensions as illustrated in Figure 2 in Appendix I. Additional sight distance may be required based on topography, roadway curvature, vegetation or other sight hindrance.

Deviations from the minimum intersection sight distance requirements may be allowed provided that the owner has demonstrated that the area proposed will provide adequate sight distance based on AASHTO standards. All deviations must be approved by the City.

**E. Residential Driveway Design Criteria**

**1. Design Standards**

The values in Table 1 represent minimum and/or maximum standards and shall be used for the design and construction of driveways:

**TABLE 1  
Driveway Design Criteria**

<u>Requirements</u>	<u>Street Class</u>	<u>Residential Driveway</u>
Driveway Throat Width	Local	10-28 feet
	Minor Collector	10-28 feet
	Major Collector	12-28 feet
	Arterial	12-28 feet
Driveway Curb Radius	Local	2.5-10 feet
	Minor Collector	2.5-10 feet
	Major Collector	10-20 feet
	Arterial	15-30 feet
Minimum Driveway Centerline Spacing	Local	15 feet
	Minor Collector	15 feet
	Major Collector <sup>1</sup>	100 feet
	Arterial	100 feet
Driveway Angle		70-90 degrees
Minimum Distance <sup>2</sup> from Driveway to Intersection	Local	30 feet
	Minor Collector	50 feet
	Major Collector	100 feet
	Arterial	100 feet
Max Approach Grade <sup>3</sup>	Local/Minor Collector	+9%
	All Others	+6%
Min Approach Length <sup>4,5</sup>	Local/Minor Collector	6 feet
	All Others	9 feet

Notes:

<sup>1</sup> 100 feet spacing applies to infill single family lots. New development requires 240 feet centerline spacing with shared driveways. Head out egress shall be provided.

<sup>2</sup> Distance measured from the intersection of the extended right-of-way lines to the centerline of the driveway. In no case shall the driveway centerline be closer than 100 feet to the curb return departure of the major street facility.

<sup>3</sup> The percent slope measured along the centerline of the driveway.

<sup>4</sup> The minimum distance over which the maximum approach grade must be maintained.

<sup>5</sup> The approach grade and length shall be altered to include a sidewalk section through the drive approach as applicable. See typical details for drive approaches.

## **2. General Design Criteria**

Driveway access to a residential lot from any major street facility shall not be permitted unless that lot has no other public access or meets the following criteria for access to a major collector:

- Lot depth has been increased in accordance with the Subdivision Regulations
- The lot width is a minimum of 120 feet
- Has a shared driveway and the separation is a minimum of 240 feet

A residential driveway shared by two or more properties shall have a minimum throat width of 12 feet. A joint-use private access easement shall be required. Shared residential driveways may be required for adjoining residential lots on major street facilities (arterials, minor and major collectors) to reduce the number of access points on those roadways.

To provide adequate vehicle storage and maneuvering area, a driveway space of 20 feet (minimum) shall be required between the street right-of-way and all garages or other structures served by the driveway. For side-yard driveways to local streets, a driveway space of 15 feet will be allowed. A maneuvering space of 24 feet (minimum) shall be required for all rear-entry garages that may extend into an adjacent access easement or alley.

A circular residential driveway may be allowed on any street type provided that the centerlines of the driveways are at least 50 feet apart and the other requirements in Table I are met. A circular residential driveway accessing two streets shall only be permitted for 28 feet wide residential streets.

If such a driveway is approved on a major street facility, an off-street maneuvering area shall be provided to ensure that vehicles will not back into the public street. Driveway access to a residential lot from a minor collector street may be denied if the lot has access to a local street and/or the proposed access would create a traffic flow or safety problem.

## **F. Pavement and Street Marking Installation**

The owner shall be responsible for the design and installation of pavement and street markings with the street improvements.

### **1. Standardization of Application**

All pavement markings within the City shall conform to the fundamental use and design requirements set forth in the Texas Manual on Uniform Traffic Control Devices (TMUTCD). Markings shall be visible during hours of darkness and be reflectorized.

## 2. **Materials and Application**

- a. Type I Marking Materials: Type I markings are thermoplastic type materials that require heating to elevated temperatures for application. Type I marking materials shall conform to current and appropriate TxDOT Standard Specifications for Construction of Highways, Streets and Bridges. Type I markings are used for all longitudinal and transverse markings, crosswalks and stop bars. The thickness of thermoplastic is applied at 60 to 90 mils for stop bars and crosswalks and at 30 to 60 mils for longitudinal markings. Reference AASHTO Thermoplastic Specification.
- b. Type II Marking Materials: Type II markings are paint-type materials that are applied at ambient or slightly elevated temperatures. Type II marking materials shall conform to current and appropriate TxDOT Materials Specifications. Type II may only be used in parking lots or as temporary pavement markings.

The two basic types of raised pavement markers used in the City are reflectorized and non-reflectorized traffic buttons. They are typically installed with epoxy. They can be used in addition to thermoplastic for longitudinal lines on highly traveled streets. Additionally, the City does not use any raised pavement markers greater than two inches in height. Marking configurations with raised pavement markers that may be used in the City with permission from PWT are shown in the Figures in Appendix Q.

Pavement arrows and words are installed using either thermoplastics or cold layed plastics. Cold layed plastic is applied at a thickness of 90 mils (min.).

## 3. **Color**

Pavement markings should be yellow, red or white and shall conform to fundamental use and design requirements listed in the TMUTCD.

## 4. **General Design Criteria**

Pavement markings, including both longitudinal and transverse, should be installed on all collectors and streets of a higher classification. High-speed (Speed Limit 40 or higher) rural roadways should also have center lines and edge line markings.

Longitudinal pavement markings on residential streets and most minor collector streets are typically not needed. However, when they are necessary, thermoplastic shall be used in order to reduce maintenance needs. The following table can be used as a reference to determine when pavement markings are installed.

Note: (1) A-No Markings; B-Center-Line; C-Center-Line and Lane Line Marking.  
 (2) Non-curbed and gutter streets serving as a collector or thoroughfare shall have center-line and edge line markings.

Street Width (ft)	Volume (trips)				
	0-1000	1000-2000	2000-5000	5000-10000	> 10000
< 30	A	A	B	B	B
30-39	A	A	B	B	B
40-49	B	B	B	C	C
49-60	B	B	C	C	C
> 60	B	B	C	C	C

The following guidelines for color and patterns of longitudinal lines are summarized from the TMUTCD:

- Yellow lines delineate the separation of traffic flows in opposing directions or mark the left edge of the pavement of divided highways and one-way roads and ramps.
- White lines delineate the separation of traffic flows in the same direction or mark the right edge of pavement.
- Red markings delineate roadways that shall not be entered.
- Broken lines are permissive in character.
- Solid lines are restrictive in character.
- Width of lines indicates the degree of emphasis.
- Double lines indicate maximum restrictions or prohibitions.

**5. Width and Patterns of Longitudinal Markings**

The width and patterns of longitudinal lines shall be as follows:

- Typical line widths are 4 inches
- Wide line widths are at least 8 inches

See figures in Appendix R for typical line patterns.

**6. Typical Applications of Longitudinal Markings**

The following describes specific applications of different types of longitudinal markings (see Appendix R for typical designs):

**a. Center Lines**

Yellow centerlines separate traffic traveling in opposite directions and do not need to be the geometrical center of the pavement. Double yellow centerlines consist of two normal solid yellow lines and delineate the separation between travel paths in opposite directions where overtaking and passing is prohibited in both directions.

**b. Lane Lines**

Lane lines are normally dashed white lines that permit lane changing with care. A solid white line is used to separate through traffic lanes from special secondary lanes and left or right turn lanes. Their length is determined based on the geometry of the intersection, length of queue, and speed (design or posted speed limit) of the street. Solid white lane lines (not edge lines) shall be eight inches in width when added emphasis on separation is desired.

**c. Lane Line Extensions**

Lane line extensions (puppy tracks) should be installed when conditions make it desirable to provide control or guide vehicles through an intersection. Such cases may include offset intersections, skewed intersections, and dual turning movements. All extensions should be 3 feet lines with 3 feet skips. They shall be the same color of the line that is to be extended.

**d. Other Types and Applications**

A single solid white line is used to delineate the edge of the travel path where travel in the same direction is permitted on both sides of the line but crossing the line is discouraged. It is also used to mark the right edge of the pavement (edge line).

A double solid white line is used to delineate a travel path where travel in the same direction is permitted on both sides of the line, but crossing the line is prohibited.

A double line consisting of a single broken yellow line and a single solid yellow line delineate a separation between travel paths in the opposite directions. Overtaking and passing is permitted with care for traffic adjacent to the broken line and is prohibited for traffic adjacent to the solid line (One Direction No-Passing Marking).

A double normal broken yellow line delineates the edge of a lane in which the direction of travel is changed from time to time in such a way that the line serves as the center line of the roadway during some periods (Reversible Lane Lines).

**e. Left Turn Channelization**

With the exception of continuous two-way left turn lanes and trapped lanes, most left turn lanes on undivided roadways will require a transition before left turn storage is provided. This transition or taper can be of a variety of designs and lengths. Refer to Appendix S and the following table.

NOTE: Where the street has been flared to provide a left turn lane, the storage length should be maximized and the taper length should be reduced. The typical taper length in this case is 150 feet for streets that with a speed limit of 40 or higher.

<b>TYPICAL TAPER RATIO PER FOOT OF LATERAL SHIFT</b>		
<b>SPEED LIMIT (mph)</b>	<b>APPROACH TAPER</b>	<b>BAY TAPER</b>
30	1:15	1:10
35	1:20	1:12
40	1:30	1:14
45	1:35	1:15
50	1:40	1:17

**f. Storage Length**

This is the distance from the end of the bay taper to the intersection nose or stop bar. This distance should be determined based upon left turn demand and the type of control at the intersection. The desirable distance is the length of the vehicle queue plus 100 feet for the deceleration that must take place before vehicles stop in queue. The desirable minimum storage length used in the City is 150 feet.

**g. Non-Longitudinal Markings**

The following are different types of non-longitudinal markings:

- Stop Bars
- Crosswalks
- Word and Symbol Markings
- Shoulder Markings
- Parking Space Markings
- Crosshatch Markings
- Median Markings

Non-longitudinal (or transverse) markings shall be white except transverse median markings applied at the median nose, which shall be yellow. Typical dimensions and patterns of some of the transverse markings are discussed below. Typical sketches are provided in Appendix T.

**(1) Stop Bars**

Stop Bars shall be 24 inches in width. The typical placement is 15 feet from the cross street curb line and shall be four feet in advance of any marked crosswalk. In some cases, that distance can be increased due to possible conflicts with left turn vehicles turning from the cross street and the proper design of crosswalks to accommodate pedestrian movements. However, in no case shall the stop bar be less than four feet or more than 30 feet from the cross street curb line.

Stop Bars should be installed across one or more approaches when any of the following conditions exists:

- When high pedestrian movements (greater than 50 in one hour) cross a stopped approach.
- When a multi-way stop exists involving a major collector street or a street of higher classification.
- At all signalized intersections.
- For stopped approaches at designated school crossings.
- At any location where a STOP sign cannot be placed where vehicles should come to a stop for safety purposes and field observations show a significant amount of traffic needs the extra delineation to enter the intersection safely. In these cases, the stop bar may be placed closer than 15 feet from the cross street if there are no significant pedestrian movements.
- In advance of any marked crosswalk.

**(2) Crosswalks**

Crosswalks shall be installed if any of the following conditions exists:

- For each approach at a signalized intersection unless pedestrians are prohibited from crossing a specific approach.
- For controlled approaches at a designated school crossing.
- At controlled approaches where pedestrian movements exceed 100 in any one hour.

Mid-block crosswalks shall not be allowed on city streets except at established school crossings controlled by school crossing guards.

All crosswalks should be installed using thermoplastic unless the pavement condition has a short life span, in which case paint should be used.

**(3) Word and Symbol Markings**

Pavement words and symbols shall be limited to no more than three lines of information. Pavement words and arrows shall be used in conjunction with Lane Use Control signs, railroad crossings, continuous left turn lanes, and where needed to provide proper guidance. The font size shall be a minimum of eight feet in height. "SCHOOL" markings are not normally used in the City but can be installed where special emphasis is needed.

**G. Traffic Signal Design Requirements**

The owner will be responsible for the design and installation of any traffic signal necessitated by the development. Location of proposed signals shall be based on an approved TIA or as directed by the City Traffic Engineer.

Pull boxes and conduits are required at all proposed or existing signalized intersections to accommodate future and existing signals. There shall be at least one pull box on every corner of the intersection plus one in each median nose and in any islands. All pull boxes shall be connected by 4-inch PVC, Schedule 40 conduits.

Refer to Chapter 6 Capital Improvements of this manual for signal design requirements if signals are required by the development.

**H. Fiber Optic Cables**

Fiber optic cables are typically along major roadway and at signalized intersection. When the development is required to construct the major roadway or signalized intersection, the owner will be responsible for installing conduits for the fiber optic cables along the public street and/or at the signalized intersection of the development. Locations of conduits shall be in accordance with the City's network fiber plan. Contact the Network Designer in the Information Technology Department to verify location of any existing signal fiber or City network fiber. Refer to Chapter 6 Capital Improvements of this manual for design requirements if fiber optic conduit installation is required by the development.

**I. Streetlight Design Requirements**

The owner will be responsible for the design and installation of streetlights on all internal streets and along the frontage of the development on perimeter public streets.

**1. Local and Minor Collector Streets**

**a. Placement Criteria**

- Streetlights shall be installed on streets 38 feet wide or less typically at a distance of 4 feet from the curb. They shall be 100 watt open bottom high pressure sodium type.
- Streetlights shall be installed at mid-block locations not less than 250 feet or greater than 500 feet from any adjacent streetlight and on the inside of each horizontal curve with a 200 feet centerline radius or less.
- Streetlights shall be installed at the end of each cul-de-sac which is 175 ft. or greater from the centerline of the intersecting street to the end of the cul-de-sac.
- Additional streetlights may be required whenever geometric conditions may create a traffic safety hazard that can be reduced by the installation of a streetlight.
- Placement of streetlights along existing roadway shall be coordinated with any existing streetlights along the roadway.

**b. Pole Type**

The standard for streetlight poles is 22 feet mounting height steel telescoping. The City may consider other options such as fiberglass, concrete or other decorative poles with a post top decorative fixture. Spacing of alternate poles will remain the same as standard steel poles. Only one pole type typically will be allowed.

If decorative streetlights are used, owner shall supply the City with 10% of the total light assemblies or a minimum of two poles, arms, and fixtures for future maintenance and damage. Spacing of decorative poles will be the same as standard streetlights when lighting levels on the street pavement meets or exceeds the standard lighting levels.

**2. Major Collector and Arterial Streetlight Design Standards**

**a. Placement Criteria**

- Type III refractors are required at all mid-block locations where intersection criteria does not control locations.

- Streetlights shall be 150 watt HPS cobra head
- Placement of streetlights along existing roadway shall be coordinated with any existing streetlights along the roadway.

**b. Lighting Configurations**

Median Lighting -- Light poles with twin arms and luminaries shall be installed at the center of the median of 4-lane and 6-lane boulevards. Lighting poles within the median of an initial four-lane boulevard planned for expansion to a six-lane boulevard shall be designed such that the poles will not need to be relocated when the roadway is expanded (i.e., at left turn lanes, and transitions for left turn lanes).

Staggered Lighting -- Light poles shall be installed in an alternating pattern within parkways along both sides of the roadway on undivided roadways.

One-side Lighting -- Light poles may be installed within the parkway on one side of the roadway along 4-lane undivided roadways only if staggered lighting is not feasible.

**c. Spacing Requirements**

The standard spacing distance between all poles in non-intersection areas shall be as shown below. Spacing less than standard can be used to clear obstructions and may be increased no more than 15 feet where necessary to avoid conflicts.

<b>Standard Spacing (feet)</b>			
	<b>One-Side Lighting</b>	<b>Median Lighting</b>	<b>Staggered Lighting</b>
<b>Major Collector</b>	160	210	160
<b>Minor Arterial</b>	N/A	210	130
<b>Major Arterial</b>	N/A	190	100

Any deviation requiring a tolerance of more than 15 feet. shall require submittal of calculated  $E_h$  (avg),  $E_h$  (avg)/Min., and Max./Min. values indicating compliance with the design criteria.

$E_h$  (avg) -- The average maintained horizontal illumination in ft. candles shall be a minimum of 0.90.

$E_h$  (avg)/Min. -- The average maintained horizontal illumination value divided by the lowest illumination point encountered within the area of roadway being lighted shall be 3.0 or less.

Max./Min. -- The highest illumination point divided by the lowest illumination point encountered within the area of roadway being lighted shall be 9.0 or less.

**d. Major Intersection Placement**

Type II four way refractors are required at intersections. For major collector and arterial intersections having geometric layouts that vary from those specified, streetlight poles shall be located to achieve the illumination values shown on the figure for the most comparable intersection layout. Alternate designs or intersection lighting locations which vary from those shown in the above referenced figures shall be reviewed by City upon submittal of calculations indicating conformance to lighting design criteria.

For intersection lighting layouts, the PWT shall be consulted to determine if traffic signal poles shall be required in the future at the intersection. If so, the lighting standards shall be integrated with the traffic signal pole and the pole type will be determined.

**e. Adjustment for Topographic Height Variations**

Where the base of the lighting standard is 5 feet higher or lower than the adjacent top of curb, a non-standard spacing between adjacent poles shall be specifically calculated to meet the required illumination values as specified.

**f. Lateral Clearances**

Poles shall be installed a maximum of 8 feet from the back of the curb for one-side or staggered lighting. If this is in conflict with existing or proposed facilities, an alternative location will be determined.

Streetlight poles shall not be installed within 4 feet of any street, fire hydrant, drainage flume, inlet, driveway or within the drip line of any established tree.

**g. Pole Type Determination**

The standard for streetlight poles is 40 feet mounting height, steel with breakaway base.

**h. Color Determination**

New streetlight pole installations shall be nmemec bronze.

**3. Streetlight Plan Layout**

At a minimum, the streetlight plans shall:

- be on 24" x 36" size sheets.
- have a title block located at the lower right-hand corner of the drawing, and the north representation shall be displayed in an up or right direction.
- show all service poles or transformer pads utilized for streetlight energy source. Include the electric delivery provider's electrical design. Connection to the power source shall be coordinated with the electric delivery service provider.
- be drawn using standard symbols and abbreviations.
- show all utilities and storm drain facilities, including their easements.

**4. Pole contacts**

Other agencies' facilities may not be utilized for installation of streetlights unless approved by PWT.

**5. Utility Easements**

Additional easements may be required depending on the location of the power source. A minimum width of 10 feet located along common lot lines is required for streetlights.

**6. Underground Service Standards**

- All underground connections shall be in accordance with the latest NEC guidelines.
- All underground streetlight services shall be placed in 2-inch PVC Schedule 40 conduit in a trench with a minimum depth of 30 inches.

**7. Overhead Service Standards**

Overhead Service Standard shall be in accordance with the latest NESC and NEC guidelines.

**8. Conductors/Insulation**

Cable and insulation shall be installed in accordance with the following table.

	LOCAL AND MINOR STREETS		MAJOR COLLECTOR AND ARTERIAL STREETS	
	Overhead	Underground	Overhead	Underground
Standard Practice	No	Yes	No	Yes

Stranded Aluminum	Duplex (XLP)	Triplex (XLP)	Duplex (XLP)	N/A
Annealed Copper	N/A	N/A	N/A	2 Insulated Plus One Bare Wire (THHN)
240 Volt	N/A	N/A	Standard	Standard
120 Volt	Standard	Standard	N/A	N/A

**9. Special District Standards**

All streetlights in the Entertainment District shall conform to the Entertainment District Design Standards. All streetlights in the Downtown District shall conform to the Downtown Neighborhood and Downtown Business Design Standards.

**J. Street Signs Design Requirement**

The owner is responsible for the design and installation of all street signs within the development. The street signs shall be fabricated and installed in accordance with TMUTCD’s standards and specifications. Any deviations shall be approved by PWT.

For the street marker blades, the sheeting and lettering shall be 3M Scotchlite High Intensity Series #3870 White and #3870 Blue, or equivalent. White lettering on a blue background shall be used to indicate public streets, whereas blue lettering on a white background shall be used to indicate private streets.

All signs in the Entertainment District shall conform to the Entertainment District Design Standards. All signs in the Downtown District shall conform to the Downtown Neighborhood and Downtown Business Design Standards.

**Section 4.6 Engineering Division/Department of Public Works & Transportation**

**A. Right-of-Way**

Right-of-way shall be in accordance with the Thoroughfare Development Plan, the Subdivision Regulations and Zoning Ordinance.

**B. Horizontal and Vertical Control**

**1. Horizontal Control**

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City’s web page.

**2. Vertical Control**

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City’s web page.

**C. Digital File Requirements**

Prior to acceptance of three-party contracts, the owner’s engineer shall furnish the City a digital graphics file of the street and drainage construction drawings in .DXF or .DWG format. The information shall be provided on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Closed storm sewer system	STORM
Back of curb	CURB
Right-of-way	ROW
Edge of sidewalk	SIDEWALK
Open storm sewer systems	CHANNEL

**D. Design Plan Checklist**

A plan review checklist is included in Appendix J. The checklist is used by the CDP when reviewing plans and provides guidance to the engineer as to the type of information that will be required for street and drainage plans.

**E. Street Plan Design Requirements**

**1. Design Speed**

All streets shall be designed and constructed to provide the following design speeds:

<u>Street Type</u>	<u>Design Speed</u>
Arterial	45 miles per hour
Major Collector	40 miles per hour
Minor Collector	35 miles per hour
Local Street	30 miles per hour

**2. Minimum Radius**

The required radius for curb returns at intersections shall be as follows:

Arterial/Arterial	80 feet*
Arterial/Collector (departure side)	80 feet*

Collector/Collector	30 feet
Arterial/All Others	35 feet
Collector/All Others	30 feet
All Others	20 Feet

\* The minimum allowable radius is 35 feet and 30 feet, respectively. See the Intersection Geometric Design in Appendix H.

The minimum radius for the back of curb on a cul-de-sac shall be 39 feet.

### 3. Vertical Alignment

All streets shall be designed and constructed to a minimum grade of 0.5%; however, if the required geotechnical report indicates the soil has a PI greater than or equal to 40, a minimum grade of 1% shall be required.

All streets shall have a maximum grade as follows:

<u>Street Type</u>	<u>Maximum Grade</u>
Arterial	6.0%
Major Collector	8.0%
Minor Collector	8.0%
Local	8.0%

In order to maintain adequate sight distance, all streets shall be designed and constructed to comply with the following minimum vertical curve length for each algebraic percent difference in grade.

<u>Street Type</u>	<u>Crest Curves</u>	<u>Sag Curves</u>
Arterial	120	90
Major Collector	80	70
Minor Collector	50	50
Local	30	40

The following maximum intersection grades involving arterial and major collector roadways shall be used at controlled intersections.

<u>Design Street Type</u>	<u>Intersecting With</u>	<u>Design Street Maximum Grade</u>	<u>Distance</u>
Arterial	Arterial	2%	300 feet
Arterial	Major Collector	3%	300 feet
Major Collector	Arterial	3%	200 feet
Major Collector	Major Collector	3%	200 feet
Minor Collector/Local	Arterial/Major Collector	4%	150 feet

**4. Horizontal Alignment**

The following minimum centerline radii shall be used in the design of all street construction:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	1000 feet
Major Collector	800 feet
Minor Collector	500 feet
Local	As approved by the Director of PWT
Cul-de-sacs and Loop Streets	50 feet radius to right-of-way line

Reverse curves shall be separated by a tangent section in accordance with the following table:

<u>Type Street</u>	<u>Minimum Tangent Length</u>
Arterial	200 feet
Major Collector	100 feet
Minor Collector	50 feet
Local	As approved by the Director of PWT

Collector or arterial roadways intersecting other collector/arterial roadways shall have the following minimum horizontal centerline approach tangent section length as measured from the nearest right-of-way line of the intersecting street, unless such requirement is waived by the Director of PWT:

<u>Type Street</u>	<u>Intersecting With</u>	<u>Minimum Approach Tangent</u>
Arterial	Arterial	200 feet
Collector	Arterial	150 feet
Collector	Collector	100 feet

**5. Paving Requirements (Amended Ord #09-030 6/23/09)**

Both public and private streets shall be designed in accordance with the requirements outlined below.

- Standard pavement widths and sections shall be constructed on prepared subgrade in accordance with the City of Arlington Standard Details and Specifications. Pavement widths shall be measured from back of curb except for local rural roadways where the width is measured from edge of pavement. The street classification shall be as shown in the Thoroughfare Development Plan. The widths and thicknesses shall be in accordance with the information provided on the typical section details and the following table.

<b>Street Type</b>	<b>Width</b>	<b>Thickness Concrete</b>	<b>Thickness HMAC</b>
Residential/Local Rural <sup>(1)</sup>	28 feet or less	7 inches concrete over 8 inches lime/cement subgrade	5 inches HMAC over 12 inches lime/cement subgrade
Collectors and Minor Arterial	38 feet, 45 feet, or as indicated in Thoroughfare Plan	9 inches concrete over 8 inches lime/cement subgrade	7 inches HMAC over 12 inches lime/cement subgrade
Major Arterial	As indicated in Thoroughfare Plan	9 inches concrete over 12 inches lime/cement subgrade	8 inches HMAC over 16 inches lime/cement subgrade
Private Access Easement	20 feet <sup>(2)</sup>	5 inches over 8" lime/cement subgrade	N/A

<sup>(1)</sup> The PWT has developed details for streets 28 feet wide and greater. Alternative street designs may be allowed with approval of CDP, PWT, and Fire if an adequate level of service is provided. It is the responsibility of the owner's engineer to develop details for constructing alternative roadways. The requirements shall be in accordance with the Subdivision Regulations and this manual. There shall be no waiver from construction specifications.

<sup>(2)</sup> The pavement width of a private access easement shall be increased to 24 feet when it functions as a required fire lane. The width may be reduced if used for a one way alley-way.

- All concrete shall have #4 bars on 24-inch centers.
- All streets shall be constructed with a lime/cement stabilized subgrade in accordance with the above table. The application rate shall be specified in the plans. With the approval from PWT, the owner may request a variance to the above table by submitting a geotechnical report prepared by an engineer indicating an alternate design.
- In small areas, such as the addition of median openings or auxiliary lanes to existing facilities, owner may submit a request to the City to allow alternate pavement sections to match existing and/or alternate subgrade treatment, such as 6-inch cement treated base or 4-inch additional pavement thickness on compacted base.

## **6. Median Openings**

Requests for median openings for private or public developments shall be submitted to the CDP for approval. The following shall be submitted with the request:

- A drawing showing the location and distance to the next median opening. The drawing shall also include any driveways, public streets and property lines within 600 feet of the requested opening.
- A letter from affected property owners on both sides of the street within 600 feet stating their concurrence of the proposed location of the median opening.

Generally, median openings shall be spaced 600 feet apart (measured nose to nose) on major arterials and 450 feet (600 feet from major intersections) on minor arterials. Median opening noses are typically 12-15 feet beyond the projection of the curb or driveway edge of the facility being served. Median openings may require the construction of left turn lanes. The typical storage length is 150 feet with 150 feet transition. The storage length may be altered based on projected traffic volumes.

If approved, all costs associated with the median opening shall be paid by the owner. The median opening shall be constructed or cost escrowed within 6 months of the date of approval, or the request shall be void.

**a. Existing Improved Streets**

The owner shall submit construction plans to the CDP for review. The plans shall be in accordance with the standard details. Upon acceptance of the plans, three-party contracts will be required for construction of the opening. All costs associated with the median opening shall be paid by the owner including construction and relocation of utilities and irrigation that may conflict with opening. If the remainder of the median is less than 8 feet wide it must be constructed in accordance with City standard median details. The request for a median opening shall be void if the median opening has not been constructed within 6 months of the date of approval.

**b. Unimproved Streets - Construction Plans Available**

Owner shall hire an engineer to modify the existing plans to include the median opening and prepare a construction cost estimate. The plans shall be in accordance with the standard details. The owner shall escrow the construction cost of the median opening with the City. The cost shall be escrowed within 6 months or the request shall be void.

**c. Proposed Street – No Construction Plans Available**

No median opening requests will be considered until an engineering services contract is initiated for the design of the street.

## **7. Sidewalks and Access Ramps**

Sidewalks and access ramps must be constructed in accordance with State and Federal regulations. The owner is responsible for submitting all pertinent information with regard to sidewalks and access ramps to the Texas Department of Licensing and Regulation (TDLR) prior to construction as required. The following describes general requirements for sidewalk and access ramp construction:

- Sidewalks shall be shown on the subdivision construction drawings. Generally, they shall be constructed by the homebuilder except where the sidewalks do not abut a residential lot or when the residential lot backs up to an existing street. In these cases, the sidewalks shall be constructed with the subdivision public street improvements. The construction drawings shall clearly identify which sidewalks are to be constructed with the public street improvements.
- Sidewalks shall be placed on both sides of the street within the right-of-way, shall be 4 feet wide and placed 1 foot off the right-of-way line. If necessary, sidewalks may be placed closer to the curb, but no closer than two feet except where site restrictions require the sidewalk to be placed closer to the curb. In these cases, the sidewalk shall be adjacent to the curb and shall be six feet in width.
- If obstructions are within the path of a proposed sidewalk, the sidewalk width and placement may be adjusted to allow the obstruction to remain. In these cases, a minimum sidewalk width of three feet shall be maintained.
- Access ramps shall be designed and constructed at all street intersections concurrent with the street construction. Mid-block ramps are required for local streets and at signalized locations.
- When required, sidewalks along TxDOT facilities shall be 5 feet wide and located 4 feet off the right-of-way line.
- The developer may request in writing a determination by the Director of PWT that construction is either not feasible at the time of development for engineering reasons or inappropriate due to the nature of the construction project.

## **F. Drainage Plan Design Requirements**

When a development requires the construction of drainage facilities, the following drainage plan requirements shall be used.

### **1. Peak Runoff**

The City may have flow rates available for watersheds. If so, these shall be used in the drainage calculations. Where no flow rates are available, a unit hydrograph technique (WinTR55, TR20, HEC1, etc.) is preferred and recommended. The Modified Rational Method ( $Q=CCaIA$ ) may be used for calculating peak runoff from watersheds of less than 20 acres. The Rational Method is not appropriate for designs other than small side ditches, median ditches, and driveway pipes..

**a. Runoff Coefficients**

Stormwater runoff shall be based on a fully urbanized watershed. The most intense land use or zoning shall be used to determine the runoff coefficient for the fully urbanized watershed. The following table gives values for runoff coefficients that shall be used in the determination of stormwater runoff if the Modified Rational Method is used.

**RUNOFF COEFFICIENT "C"**

Zoning or Land Use	Hydrologic Soil Groups			
	A	B	C	D
Parks and Permanent Open Space	.35	.37	.39	.41
"E" Zoning	.43	.45	.47	.50
"R" Zoning	.50	.52	.55	.58
"D" and "R1" Zoning	.60	.63	.66	.70
"R2" and "MH" Zoning	.65	.68	.72	.76
"TH" Zoning	.65	.70	.77	.80
Multi-family Zoning	.65	.71	.87	.90
Commercial, Schools & Churches	.95	.96	.98	1.00
Central Business District/Industrial	1.00	1.00	1.00	1.00

**SOIL GROUP CLASSIFICATION**

- Group A Deep sand, aggregated silts
- Group B Sandy loam
- Group C Clay loam, shallow sandy loam
- Group D Heavy plastic clays

**b. Rational Method Antecedent Precipitation Factor (C<sub>a</sub>)**

C<sub>a</sub> values to be used are shown in the following table:

**ANTECEDENT PRECIPITATION FACTOR "C<sub>a</sub>"**

Recurrence Interval (Years)	"C <sub>a</sub> "
5	1.00
25	1.10
100	1.25

NOTE: The product of  $CC_a$  shall not exceed 1.0.

**c. Intensity**

For times of concentration less than or equal to one hour, Hydro-35 shall be used to determine the rainfall intensity. For times of concentration greater than one hour, TP-40 shall be used to determine the rainfall intensity. Refer to Appendix K.

**d. Time of Concentration**

The time of concentration shall be based on fully urbanized conditions for the upstream watershed. The total time of concentration shall include overland and channelized flow. The maximum length allowed for the overland portion of the calculation is 50 feet. The remainder of the watershed shall be considered channelized flow. Refer to Appendix L to determine the velocity, which is used to calculate the time of concentration or utilize the WinTR55 tool to calculate the time of concentration.

**e. Storm Frequency**

The following table shows the minimum design frequency to be used when designing drainage facilities:

<u>Type Of Facility</u>	<u>Minimum Design Frequency</u>
On-grade inlets	5 years
Low point inlets	25 years
Storm sewers upstream of low points	5 years
Storm sewers downstream of low points	25 years
Street right-of-way	100 years*
Channels and creeks	25 years
Creek culverts and bridges	25 years
Permanent bar ditch and associated culverts	5 years

\*Depending on the amount of flow in the right-of-way, additional drainage infrastructure may be required to reduce the flow in order to protect the health, safety and welfare of the general public.

**f. Drainage Areas**

The drainage area shall be based on fully urbanized areas within and contributing to the development, shall follow natural drainage features, and shall not be diverted. Existing or anticipated features modified by the development shall be considered when outlining drainage areas. A

drainage area map shall be prepared that complies with the checklist in Appendix J.

**2. Roughness Coefficients and Permissible Velocities**

The following table provides roughness coefficients and permissible velocities:

Type of Section/Feature	Coefficient of Roughness “n”	Maximum Permissible Velocity, fps
I. Natural Creeks		
A. Creek Section		
1. Some grass and weeds; little or no brush	0.045	3.0 to 6.0
2. Dense growth of grass or brush	0.055	3.0 to 6.0
3. Dense brush and trees	0.065	3.0 to 6.0
B. Floodplain/Overbank Areas		
1. Grass, Weeds, Some Brush and Trees	0.045	3.0 to 6.0
2. Dense Grass, Weeds or Brush	0.055	3.0 to 6.0
3. Dense Brush and Trees	0.080	3.0 to 6.0
II. Constructed/Modified Open Channels		
A. Gabion Channels	0.035	Receiving stream limit
B. Pre-Cast Concrete Block Channels	0.035	Receiving stream limit
C. Natural Stone Channels	0.035	Receiving stream limit
D. Grass Vegetated Channels (maintained)	0.035	3.0 to 6.0
E. Concrete Channels	0.016	Receiving stream limit
F. Rock Rip-Rap Channels	0.035	5.0 to 10.0
III. Streets		
A. Concrete	0.015	N/A
B. Asphalt	0.015	N/A
IV. Pipe		
A. Reinforced Concrete Pipe	0.013	Receiving stream limit
B. Corrugated Metal Pipe <sup>1</sup>	0.022	Receiving stream limit
C. High Density Polyethylene Pipe <sup>1</sup>	0.011	Receiving stream limit

<sup>1</sup> If approved by PWT

**3. Street Capacity Design**

**a. Streets with Curb and Gutter**

Local and minor collector streets shall be designed to flow less than curb deep during a 5-year storm. For major collectors and minor arterials, ½ of the inside lane shall remain dry during the design storm. For major arterials, the full inside lane (5<sup>th</sup> and 6<sup>th</sup> lanes) shall remain dry for the design storm. The runoff from the 100-year storm shall be contained within the street right-of-way and shall not exceed 0.2 feet above the lowest top of curb.

**b. Local Rural Streets**

Local rural streets shall be constructed with bar ditches in lieu of curb and gutter. The 25-year storm shall be contained within the right-of-way and the flow shall not exceed the street crown elevation. Transitional materials may be required at driveway culverts to prevent erosion. Culverts under driveways shall be a minimum of 18 inches and designed to carry the 5 year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow. If a culvert is not feasible, the driveway shall be constructed with an invert.

**4. Closed System Design**

Closed systems are permitted only when the Director of PWT determines that they are appropriate based upon site constraints such as easements, utility infrastructures, etc., and hydraulic conditions. If permitted by PWT, the closed system shall be connected to an existing system or extended until it reaches an open channel or natural creek.

**a. Drainage Easements**

A drainage easement shall be dedicated for all closed systems. The minimum width of a drainage easement is 15 feet. When combined with other utilities, the minimum width is 20 feet. The easement may need to be larger to accommodate systems with pipe sizes larger than 60 inches or deep systems.

**b. Hydraulic Grade Line (HGL)**

The hydraulic grade line (HGL) shall be shown on the plans and shall be below the bottom of the subgrade for systems under pavement. For systems outside of the pavement, the HGL shall be lower than all inlet throats and shall not exceed one pipe size above the top of pipe. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher.

**c. Head Losses**

The design techniques and methods used in the determination of all head losses shall be approved by the PWT. The City of Fort Worth's Storm Drainage Criteria and Design Manual is an acceptable guide for calculating head losses.

**d. Entrance/Outfall Structures**

Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm sewer systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow.

The sloped end treatment shall be a 6H:1V end section. Storm sewer systems that outfall to a creek shall be extended to the centerline of the creek. Gabion mattresses shall be installed at the outfall structure to lower velocities and prevent erosion.

**e. Pipe**

Underground systems shall be constructed with Class III reinforced concrete pipe. The pipe size shall be a minimum of 18 inches. A higher class of pipe may be required when constructed shallow or deep. The City may allow plastic pipe for certain applications; however, plastic pipe is never allowed under street paving.

All pipe bends and fittings shall be prefabricated. Collar connections shall be in accordance with the City standards.

Radius pipe is allowed and shall be placed in accordance with the manufacturer's lay schedule.

Field connections may be allowed when the main pipe is twice the diameter of the lateral; however, field connections are not allowed when the lateral slope is greater than 10 percent.

**f. Access Points**

A manhole or inlet with a minimum 36-inch RCP lateral shall be constructed every 500 feet to provide access into the closed system.

**g. Inlets**

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all concrete streets except local streets. Grate inlets are not allowed on public systems. Drop/Y inlets may be utilized in rear yards to intercept multiple lot to lot drainage or intercept offsite drainage.

**5. Open System Design**

A development that includes, or is adjacent to a creek, shall submit a hydraulic analysis (flood study) to determine easements and minimum finished floor (MFF) elevations, or to modify existing floodplain or floodway. The requirements for each flood study differ according to the existing creek designation (i.e., within a FEMA designated floodplain) and whether improvements are proposed for the creek. This section will address the requirements for flood studies.

**a. Unimproved Creeks (Natural)**

For a creek in its natural undisturbed state, a flood study shall be submitted to determine the easement limits and MFF elevations for the

property. The requirements for this type of submittal are included in the Flood Study Matrix in this section.

A drainage easement based upon its natural undisturbed state shall be dedicated for the 25-year storm event for the fully urbanized watershed conditions.

The study shall also define the Erosion Clear Zone (ECZ). If the ECZ is outside the limits of the easement, this area shall be shown. No improvements will be allowed within this area. An additional 25 feet from the top of the bank shall be delineated for the Creek Buffer Zone (CBZ) in accordance with the Subdivision Regulations. Cross sections of the creek shall be provided to verify the limits of the ECZ and the CBZ.

Where natural creeks connect to improved systems, permanent transitional materials are required. Additionally, in areas along natural creeks where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be required to stabilize the creek. Stabilization materials shall be approved by PWT.

**b. Constructed/Modified Open Channels**

A flood study will be required for an existing or proposed constructed/modified open channel. The study shall define the easement limits, 100-year flood and MFF elevations. If the open channel is located in a FEMA designated floodplain (i.e., on the FIRM), then the study will be sent to FEMA. Additional hydraulic analyses are required and shall be in accordance with the information outlined in the Flood Study Matrix in this section.

If the modifications are located between the top of banks, then the plans shall be submitted to the Army Corps of Engineers for review and permitting.

A request for a constructed or modified open channel shall be evaluated by the Director of PWT, and permitted when appropriate based on site constraints and hydraulic conditions. If permitted, the constructed or modified open channel design may incorporate the following:

- Gabions
- Pre-cast concrete blocks
- Native stone
- Vegetation
- Bio-engineered materials

A drainage easement shall be dedicated to include a channel designed to convey the runoff from the 25-year storm for the fully urbanized watershed conditions plus one foot of freeboard. The drainage easement shall also contain 10 feet on each side of the channel for access. Additional easement may be needed at specific locations for access to the feature for maintenance.

A Channel Buffer Zone (CBZ) may also be required depending on the type of materials used to improve the creek. Refer to the Subdivision Regulations for details. Cross sections of the channel shall be provided to verify the limits of the CBZ

Where constructed or modified open channels connect to a closed system, natural creeks, or a channel of a different material, a transitional area shall be designed. Channels shall be designed with the following minimum criteria:

	Concrete	Vegetated	Other Material
Side slopes	2:1	4:1	*
Bottom width	6 feet	6 feet	6 feet

\* As specified by manufacturer or design.

For channels with vegetated bottoms, the design shall include a pilot channel with an invert which conveys low flows and allows for maintenance.

For earthen channels, see Protection and Restoration of Linear Park Land in this chapter for recommended plant and vegetation species.

## 6. FEMA Designated Floodplain

In order to remove all or portions of property from the floodplain, or to improve a creek and construct a channel (concrete, earthen or other approved material), owner shall submit the hydraulic analyses to the City for acceptance. Upon acceptance by the City, owner shall then forward the analyses to FEMA for approval. If the 100-year ultimate development floodplain is not dedicated as a drainage easement, any fill to be placed in a FEMA designated floodplain shall require 1:1 hydraulically equivalent compensatory storage. There are several types of map changes available through FEMA. The following lists the types of map changes available:

### a. CLOMA – Conditional Letter of Map Amendment

A CLOMA is FEMA’s concurrence that a proposed structure upon construction would be excluded from the Special Flood Hazard Area (SFHA) shown on the effective Flood Insurance Rate Map (FIRM). The letter becomes effective on the date approved by FEMA. The letter does

not revise an effective FIRM; it indicates whether the project, if built as proposed, will be recognized by FEMA.

**b. LOMA – Letter of Map Amendment**

A LOMA is an official amendment, by letter, to an effective FIRM. This is typically used to correct an error on the map and is based on current detailed topographic information. A LOMA establishes a property/structure's location in relation to the SFHA based on natural ground. The letter becomes effective on the date approved by FEMA.

**c. CLOMR-F – Conditional Letter of Map Revision Based on Fill**

A CLOMR-F is FEMA's concurrence that a proposed structure/property involving the placement of fill outside of the floodway would exclude an area from the SFHA shown on the FIRM. The letter becomes effective on the date approved by FEMA. This letter does not revise an effective FIRM, it indicates whether the project, if built as proposed, will be recognized by FEMA.

**d. LOMR-F – Letter of Map Revision Based on Fill**

A LOMR-F is an official revision, by letter, to an effective FIRM. A LOMR-F provides FEMA's determination concerning whether a structure or parcel has been elevated on fill above the Base Flood Elevation (BFE) and excluded from the SFHA. The letter becomes effective on the date specified on the LOMR-F.

**e. CLOMR – Conditional Letter of Map Revision**

A CLOMR is FEMA's concurrence that a proposed project that would affect the hydrologic and/or hydraulic characteristics of a channel/creek and thus result in the modification of the existing regulatory floodway or effective base flood elevations (BFEs). The letter becomes effective on the date approved by FEMA. This letter does not revise an effective FIRM; it indicates whether the project, if built as proposed, will be recognized by FEMA.

**f. LOMR – Letter of Map Revision**

A LOMR is an official revision, by letter, to an effective FIRM. A LOMR may change flood insurance risk zones, floodplain and/or floodway boundary delineations, and BFE. The letter becomes effective on the date specified on the LOMR.

**7. Flood Study Submittal Requirements**

**a. Structures and Property**

In order to remove any portion of a property from a FEMA designed floodplain, either a LOMA or LOMR-F must be submitted. The FEMA's MT-1 form is used for CLOMA, LOMA, CLOMR-F, and LOMR-F. To remove an entire lot and structure from the SFHA, both the lowest point on the lot and the lowest floor of the structure must be at or above the 100-year flood elevation. The community must determine that the land and any existing or proposed structures to be removed from the SFHA are "reasonably safe from flooding." Follow the directions for the MT-1 for submittal. The owner shall submit the information to the City. Upon acceptance by the City, owner shall forward the information to FEMA for approval.

New or substantially improved structures shall be placed 2 feet above the fully urbanized 100-year flood elevation.

**b. Unimproved Creeks and Constructed/Modified Open Channels**

The following information shall be submitted for all flood studies.

- 1) Letter/report from the Engineer that explains the purpose of the study, (i.e., to define easement limits, determine minimum finished floor elevations, revise the floodplain/floodway, etc.), describes the project and details all information submitted.
- 2) Hydrology
  - Provide a current drainage area map
  - Provide a proposed drainage area map – (include all offsite areas and adjacent subdivisions)
  - Provide all hydrology computations and describe the methods used
  - Provide channel cross sections showing the Erosion Clear Zone, Creek Buffer Zone, property lines, easement lines, 100 year floodplain, and floodway.
  - Any other calculations – including verification that the downstream systems (bridges, pipes, bar ditches, etc.) are designed to handle the increased runoff.
- 3) Hydraulics
  - Provide a site map showing existing topography and cross section locations
  - Provide a site map showing proposed contours and cross section locations
  - Provide the required HEC runs (see the following sections for details)
  - Provide corresponding maps for each HEC run submitted.

- 4) Submit the flood study in a bound notebook with all pertinent information included. In addition to the above information, an MT-2 form must be filled out and included in the report if the information will be submitted to FEMA.

**c. Flood Study Matrix**

Various HEC runs are required to establish criteria set by the City and FEMA. The matrix below is an attempt to clarify which HEC runs are required for the type of creek and improvements proposed. The matrix is divided into creek type (i.e., whether the creek is proposed to remain in its natural (unimproved) condition or constructed/modified open channel. For each type, the creek is further classified as mapped (FEMA designated Zones A and AE), or unmapped. For the specific type and classification of the creek, the following matrix indicates the HEC runs that are required with the Flood Study submittal. Additional HEC runs may be required depending on the analysis.

Flood Study Matrix							
	FEMA Class	City		FEMA			
		1	2	3	4	5	6
Unimproved Creeks	Mapped Zones A & AE	x	x				
	Unmapped	x	x				
Constructed/Modified Open Channels	Mapped Zone A	x	x			x	x
	Mapped Zone AE	x	x	x	x	x	x
	Unmapped	x	x				
<u>HEC Runs</u> Type 1: 25-year fully urbanized conditions model Type 2: 100-year fully urbanized conditions model Type 3: Duplicate effective model Type 4: Corrected effective model Type 5: Existing or pre-project conditions model Type 6: Revised or post-project conditions model							

Unimproved Creeks (Natural)

The following HEC runs are required when a natural creek is mapped or unmapped. The information will not be submitted to FEMA.

- HEC analysis based on the 25-year storm event for a fully urbanized watershed (used to define the minimum easement).

The 25-year storm event analysis is not required if the 100-year fully urbanized watershed drainage easement is granted.

- HEC analysis based on the 100-year storm event for a fully urbanized watershed (used to define the minimum finished floor (MFF) elevations).

#### Constructed/Modified Open Channels

The following HEC runs will be required when the development changes the FIRM or cross sections of the creek significantly. Some of the information will be submitted to FEMA (CLOMR/LOMR).

The following information is required by the City for all mapped or unmapped creeks. This information will not be submitted to FEMA.

- HEC analysis based on the 25-year storm event for a fully urbanized watershed (used to define the minimum easement). The 25-year storm event analysis is not required if the 100-year fully urbanized watershed drainage easement is granted.
- HEC analysis based on the 100-year storm event for a fully urbanized watershed (used to define the MFF elevations).

The following HEC models are required and will be sent to FEMA for review if the creek is within Zone A:

- HEC model based on existing or pre-project conditions – to reflect current conditions prior to the construction of the project using current cross sections and flows from development within the drainage area since the date of effective model.
- HEC model based on revised or post-project conditions – based on current flows plus additional flow caused by the development.

The following additional HEC models are required and will be sent to FEMA for review if the creek is within Zone AE:

- Duplicate Effective Model – model used in the effective Flood Insurance Study (can be obtained from FEMA).
- Corrected Effective Model - corrects any errors that occur in the duplicate effective model, adds cross sections, or incorporates more detailed topographic information.

It is the responsibility of the owner to obtain all required local, state and federal permits including, but not limited to the Corps of Engineers.

## **8. Drainage Easements**

**a. Unimproved Creeks**

The minimum easement is the 25-year fully urbanized floodplain. In addition, the Erosion Clear Zone and the Creek Buffer Zone must also be considered and may be outside the easement. Refer to the Subdivision Regulations and this manual for details.

**b. Constructed/Modified Open Channels**

The minimum easement is the width of the channel, which shall hold the runoff from the 25-year storm for fully urbanized conditions plus one foot of freeboard. An additional 10 feet shall be dedicated on either side of the channel for access and maintenance. When constructed with porous materials or when the channel is vegetated, the Creek Buffer Zone shall be included. Refer to the Subdivision Regulations and this manual for details.

**9. Storage (Detention/Retention)**

Stormwater storage shall be designed and constructed with any development when downstream structural flooding is known or anticipated or when the capacity of downstream drainage system is exceeded. The stormwater release rate from the proposed development shall not be greater than the pre-developed condition of the site.

For a detention facility, the following criteria shall apply:

- The release rate of this detention facility shall not exceed downstream capacity.
- In cases of structural flooding, the detention facility must detain the difference between the pre and post developed flows.

The storage and release rates from a post-construction landuse shall be evaluated for the 5, 25 and 100-year storm events. The release velocities shall be designed to minimize erosion downstream of the facility. A minimum of one foot of freeboard shall be provided.

All above ground facilities that store more than a total depth of four feet shall be designed to meet all state and federal criteria for small dams.

In lieu of the storage, the owner may employ a Professional Engineer to document that the excess flow will not:

- be detrimental or hazardous to structures (buildings),
- be detrimental or hazardous to vehicular or pedestrian traffic,
- increase the velocity of a receiving natural stream by more than 5.0%, or

- change flood heights on adjacent properties by 0.1 feet or more.

Acceptable design methods include computer model methods outlined in FEMA's approved Hydraulic Models: Determination of Water-Surface Elevation for Riverine Analysis list or manually using the Step Method.

#### **10. Positive Overflow**

Positive overflow shall be evaluated for the entire development. Positive overflow means conveying the difference between the 100-year flow and the design frequency flow in a secondary drainage feature without flooding structures. The secondary drainage feature may be a street, a concrete flume or other permanent facility. When positive overflow is conveyed between lots, it shall be contained within a concrete flume at least 4 feet wide (face to face) or a vegetated swale sized to carry the overflow and constructed in a drainage easement between lots.

#### **11. Concentrated Runoff from Development**

In areas where concentrated runoff leaves the development, the following information shall be provided:

- The 5, 25 and 100-year design discharges.
- The depth of inundation of these discharges.
- The impacts of the 100-year discharge on flooding, stream channel stability and water quality on existing and proposed off-site facilities from the point at which the runoff leaves the development downstream to the first hydraulic structure on a studied stream (either FEMA FIRM or previously accepted drainage study submitted to the City of Arlington).

Where drainage features such as storm sewer systems, ditches, channels, and natural creeks are available to receive concentrated runoff, the design storm shall be collected on-site and connected to the feature. Calculations shall be performed to demonstrate that each feature receiving runoff is an adequate facility (runoff from the development will not exceed the capacity of the feature), and presented during the Pre-Application Conference.

Upon analysis of the information submitted, the owner may be required to provide facilities to address negative impacts from the 100-year discharge. Mitigation plans shall be prepared and submitted as part of the Preliminary Drainage Plan which include, but not limited to, all necessary on-site and off-site improvements including storage designed in accordance with Section 9 above, storm drainage systems, channel modifications, driveway adjustments and culvert improvements.

When offsite grading is required or the development discharges concentrated

flow on an adjacent property, a Notarized Letter of Permission or a drainage easement from the affected property owner(s) will be required. The Notarized Letter of Permission shall be in a form approved by the City. Generally, if the purpose for the Notarized Letter of Permission is for a feature that requires maintenance by the affected property owner then the Notarized Letter of Permission shall be filed with DRTCT and shall be a covenant running with the land. Sample of letter is available at PWT.

## **12. Site Grading**

An engineered overall site grading plan shall be submitted with the subdivision's street and drainage plans. The plan shall be consistent with the drainage area map. The plan shall include flow arrows and Type A, B, or C drainage for each lot within the subdivision as described in HUD (FHA) Data Sheet 72, as amended. Type 1 or 2 block grading as shown in the HUD information is preferred. Type 3 and 4 block grading is allowed only if:

- a flume or channel is constructed at the rear of the lot to intercept runoff; or
- runoff from no more than 3 lots is accumulated prior to constructing an underground drainage system, flume or channel to intercept the runoff.

The engineer may utilize berms and swales to redirect flows. Grass swales shall have a minimum of 2 percent slope.

The engineer shall provide more detailed information in addition to the lot grading type (A, B, or C) by indicating spot elevations on each lot.

If the site is complex and an overall site grading plan cannot be developed in accordance with the HUD standards, an individual grading plan for each lot shall be submitted by an engineer prior to issuing the building permit. The individual grading plans shall be coordinated with surrounding lots. For these complex plans, an "as-built" letter shall be submitted by an engineer prior to final inspection.

Copies of the HUD figures are included in Appendix M.

## **13. Minimum Finished Floor Elevation**

The City reserves the right to require minimum finished floor elevations on any lot. Minimum finished floor elevations are required for all lots located in the floodplain or near open drainage features and shall be set 2 feet above the 100-year fully urbanized water surface elevation. MFF elevations may also be required at t-intersections, low points, or as required by the subdivision design. These elevations are typically set 1 foot above the top of curb on the high side of the lot. Elevation certificates will be required for lots located in the floodplain. Refer to the FEMA website for the most current version.

**14. Miscellaneous**

**a. Valley Gutters**

Transverse valley gutters are not allowed in lieu of an underground drainage system without approval from the PWT. Where approved, the valley gutter shall be a minimum of 8 feet in width for the full width of the street and constructed of reinforced concrete. The street crown transition shall be a minimum of 25 feet in both directions.

**b. Flumes**

Flumes constructed between lots and/or are visible from a street shall be constructed with alternative materials or finishes in lieu of traditional reinforced concrete to soften the appearance. Examples of acceptable alternatives are colored concrete, or concrete pavers. Other alternatives may be submitted with the construction plans and will be evaluated for acceptance.

Flumes are not allowed in lieu of an underground drainage system without approval of the PWT.

**c. Temporary Tie-ins to County-type Roadways**

Tie-ins to existing county-type roadways planned for future improvements are considered temporary. Culverts under driveways and roadways shall be a minimum of 18 inches and designed to carry the 5-year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow. If the driveway or roadway is located in an area of shallow bar ditches and a culvert is not feasible, the driveway or roadway shall be constructed with an invert. Other requirements are noted on the typical detail.

**d. Trinity River Corridor Development Certificate (CDC)**

The Corridor Development Certificate (CDC) process is a regional process used to stabilize flood risks along the Trinity River. The CDC process does not necessarily prohibit floodplain development, but ensures that any development that occurs in the floodplain will not raise flood water levels or reduce valley storage capacity.

While the City retains ultimate control over its floodplain permitting decisions, other cities along the Trinity River may review and comment on projects throughout the corridor.

The CDC permit is required for any development activities proposed within the Trinity River floodplain. A technical review of the application is conducted by the U.S. Army Corps of Engineers and a fee is charged

to the owner to recover review costs. The requirements for the CDC permit may be obtained from the PWT or the NCTCOG.

**G. Submittals**

**1. Utility Companies**

The owner shall submit construction plans to the utility companies when facilities are proposed along perimeter streets to determine any conflicts. A list of utility companies and contact names may be obtained from the CDP at the time of submittal.

**2. TxDOT**

A permit from TxDOT is required when constructing facilities within state right-of-way. Three sets of 11" x 17" plans shall be submitted to the CDP who will forward the plans to TxDOT for review. A permit from the TxDOT shall be obtained prior to beginning work.

**H. Construction Requirements**

**1. Release for Early Grading**

A. In accordance with the Subdivision Regulations, the City will not allow construction of any public improvement or issue permits for any construction activity until the plat is approved and filed with the county. Upon written request from the owner, the PWT Director may allow the construction of public improvements prior to the plat being filed with accepted plans and inspection. The owner must demonstrate that an inability to file the plat within a reasonable timeframe is the result of filing requirements that do not have a substantive impact upon the development of the land. Should the City allow the development of public improvements prior to plat filing, the improvements will not be accepted until a plat is filed of record. No grading, clearing or fill shall commence without a SWPPP and prior approval of CDP.

B Upon written request from the owner, the Director may allow early grading prior to the construction plans being accepted or plat being filed under the following conditions:

- No soil disturbance, including grading, clearing, fill or removal of concrete in the case of demolition shall commence without an approved and implemented SWPPP
- The site grading plan shall be substantially complete.
- Work is limited to grading activity only.
- Early grading has been approved by the Landscape Administrator
- The owner shall accept any responsibilities for subsequent revisions prior to final grading plans acceptance.

**2. Fill**

If fill has been placed on areas of proposed roadways without City inspection, the owner shall provide compaction testing reports to ensure proper compaction was attained and the quality of the fill is acceptable prior to proceeding with construction. The testing will be at the owner's expense and be performed by a geotechnical engineering company approved by the PWT.

**3. Construction Responsibility**

The owner shall be responsible for all improvements required for the development of the subdivision, including any necessary offsite facilities and construction staking. If construction is not feasible at the time of site development, the owner may request to escrow the costs with the City. The escrow amount shall be equivalent to the owner's share of the construction cost plus actual engineering cost. The City shall determine whether escrow will be accepted in lieu of construction. The escrow shall not be subject to refund.

**4. Brass Disks**

Brass disks shall be set within a subdivision when minimum finished floor elevations that specify an elevation are required. Brass disks shall be placed on drainage structures at locations shown on the construction plans. City inspectors will provide the disks to the contractor. A letter sealed, signed, and dated by a surveyor shall be submitted at the completion of construction establishing the location and elevation of all brass disks set within the subdivision. The letter shall be accepted by the City prior to initial acceptance of the public street improvements.

**5. As-built Plans**

The City shall require the engineer to document field changes by submitting certified as-built plans.

**I. Standard Specifications (Street and Drainage Facilities)**

Street and drainage facilities shall be constructed in accordance with the most recent City of Arlington Special Provisions and the Standard Specifications for Public Works Construction as issued by the North Central Texas Council of Governments (NCTCOG), which is commonly referred to as the standard specifications or NCTCOG specifications. Where any discrepancies occur between the Special Provisions and NCTCOG specifications, the Special Provisions shall govern.

**J. Typical Details (Street and Drainage Facilities)**

Street and drainage improvements shall be constructed in accordance with the City's typical details. These details may be obtained through the City's web site or by obtaining a CD-ROM from the PWT. The details are subject to change, and it is the responsibility

of the engineer to use the most current details. If a detail is not available, it is the responsibility of the design engineer to provide the detail in the plans.

## **K. Contractor Requirements – Public Improvements**

### **1. Pre-qualification**

All public paving and drainage improvements shall be constructed by a contractor employed by the owner and pre-qualified by the City. If the contractor has not been pre-qualified, the contractor shall complete a pre-qualification form indicating the type of work for which the contractor desires to be pre-qualified. The information will be reviewed by the PWT, and the contractor will be notified of pre-qualification status. Allow up to three weeks for this process. Should the contractor's pre-qualification be denied, the owner shall select a contractor that is pre-qualified or one that is able to obtain pre-qualification with the City. Pre-qualification forms for paving and drainage projects are available in the PWT or on the City's web site.

### **2. Contract Requirements**

Standard Three-Party Contracts executed by the owner, contractor, and the City are required for construction of all public improvements. The contract shall provide for 100-percent performance bond, payment, and maintenance bonds, except when the contract is less than \$25,000. When the contract is less than \$25,000, only a maintenance bond is required. If the stand-alone streetlight and/or street sign contract is less than \$5,000, the Director of PWT may waive the maintenance bond requirements. The bonds shall not be executed prior to the date of execution of the contract. An insurance certificate with coverage approved by the City is also required with the contract documents. The expiration date of the insurance policy shall not be prior to the completion of the project. Additionally, an administration and inspection fee established by the City (refer to Chapter 3 of this manual) shall be paid prior to commencing construction. A trench safety plan shall also be submitted with the contract.

### **3. Traffic Control Plan**

When construction impacts existing roadways, a detailed traffic control plan shall be submitted with the contract. All traffic control plans shall be in accordance with the City's Work Area Traffic Control Manual and the Texas Manual on Uniform Traffic Control Devices. The City's Work Area Traffic Control Manual is available at the PWT. The site specific plan shall be submitted to the CDP for approval 10 working days prior to beginning construction.

### **4. Inspection Requirements**

The contractor shall notify the PWT 48 hours prior to the start of any construction of public facilities. The contractor shall also ensure that, when

applicable, proper authorities with TXDOT, franchise utility companies, railroads, or any other affected entities are notified.

**L. Private Facilities (Street and Drainage Improvements)**

Private street and drainage improvements shall be designed in accordance with City standards and shall meet the minimum construction standards for public streets and drainage facilities. Street improvements shall include its appurtenances such as streetlights, street signs, and pavement markings. Where a private street intersects a public street, all street appurtenances shall conform to public standards.

A building permit will be required for installation of private streetlights.

Inspections of private facilities shall be performed by the City at the owner's expense or by a third party. If inspection is performed by a third party, the following shall be provided:

- An as-built plan set signed and sealed by the design engineer validating the inspection report and certifying that the facilities were constructed in accordance with the accepted plans.
- A report prepared by an individual or company experienced in public works construction and inspection. At a minimum the report shall include the following information. Additional information may be requested to substantiate the construction.

Paving

Survey data/cross sections  
Subgrade densities and thickness  
Lime application rate  
Steel size and placement  
Concrete thickness and strength

Street Appurtenances

Street signs specifications  
Street pavement markings specifications

Drainage

Survey data/cross sections  
Pipe embedment  
Pipe placement  
Pipe connections  
Pipe sizes  
Ditch backfill and densities  
Steel size and placement for structures  
Concrete thickness and strength for structures

The improvements will not be initially accepted by the City until the as-built letter and inspection report is received and accepted.

If inspected by the City, documentation of final inspections will be provided upon completion of the improvements.

**M. Permits**

No building permits will be issued until all public infrastructure improvements are initially accepted and/or until the as-built letter and inspections report is received and accepted by the City for private infrastructure improvements.

Building permits pertaining to retaining walls necessary for the overall site grading, perimeter screening walls or electrical permits for streetlights on private streets may be issued prior to acceptance of public infrastructure.

**Section 4.7 Parks Department**

A landscape architect, licensed in the State of Texas, shall seal all landscape plans.

**A. Protection and Restoration of Linear Park Land**

Unstable and disturbed areas shall be secured during the development process through installation of erosion control Best Management Practices as outlined in the Environmental Management Section of this chapter.

All areas dedicated to linear park land shall be protected during development of adjacent properties. Protecting linear park land means leaving creeks in their natural state whenever possible. This includes:

- Not removing or scraping sandbars;
- Whenever possible, limiting use of heavy maintenance equipment in sensitive riparian, stream bottom and wetland areas – ideally not entering or mowing or trimming during sensitive times such as breeding, migratory, or nesting seasons (Mid March to end of June);
- Having a policy of rotational cutting of woody vegetation that avoids leaving long bare reaches along the creek corridor;
- Mowing or cutting back should not occur on both sides of the stream at the same time;
- An un-mowed strip should be left along both banks of the creek that can serve both as wildlife cover and as a filter zone to help absorb fertilizers and other potential run-off contaminants;
- Only vegetation that absolutely needs to be cut to maintain flood flows should be cut and replanted with flood-compatible indigenous species.

**B. Recommended Plant and Vegetation Species**

**1. Woody Plants**

<u>Canopy Trees</u>	<u>Scientific Name</u>	<u>Understory Trees</u>	<u>Scientific Name</u>
Hackberry	<i>Celtis occidentalis</i>	Creek Plum	<i>Prunus rivularis</i>
Green Ash	<i>Fraxinus pennsylvanica</i>	Possumhaw	<i>Ilex deciduas</i>
Bur Oak	<i>Quercus macrocarpa</i>	Yaupon Holly	<i>Ilex vomitoria</i>
Red Oak	<i>Quercus shumardii</i>	Prairie Flame Leaf Sumac	<i>Rhus landeolata</i>
American Elm	<i>Ulmus americana</i>	Carolina Buckthorn	<i>Rhamnus caroliniana</i>
Cedar Elm	<i>Ulmus crassifolia</i>	Texas Redbud	<i>Cercis canadensis</i>
Pecan	<i>Carva Illinoensis</i>		

**2. Live Herbaceous Vegetation**

<u>In-Stream Wetland Plants</u>	<u>Scientific Name</u>	<u>Moist Swale/ Point Bar Plants</u>	<u>Scientific Name</u>
Smartweed	<i>Polygonum spp.</i>	Bushy Bluestem	<i>Andropogon glomeratus</i>
Umbrella Sedge	<i>Fuirena simplex</i>	Lowland Switchgrass	<i>Panicum virgatum</i>
Bulrush	<i>Scirpus validus</i>	Eastern Gamagrass	<i>Tripsacum dactyloides</i>
Silver Plumegrass	<i>Erianthus alopecuroides</i>	Lindheimer's Mulhly	<i>Muhlenbergia lindheimeri</i>
Prairie Cord Grass	<i>Spartina pectinata</i>		
Bottlebrush Sedge	<i>Carex comosa</i>		
Inland Sea Oats	<i>Chasmanthium latifolium</i> (shade tolerant)		
Sedge	<i>Carex spp.</i> (shade tolerant)		
Canada Wildrye	<i>Elymus Canadensis</i> (shade tolerant)		
Virginia Wildrye	<i>Elymus virginicus</i> (shade tolerant)		

<u>Detention Pond Wetland Plants</u>	<u>Scientific Name</u>
Bushy Bluestem	<i>Andropogon glomeratus</i>
Sedge	<i>Carex spp.</i>
Bulrush	<i>Scirpus validus</i>

**3. Seeded Vegetation**

**Riparian Buffer Seed Mixture**

Buffalo Grass  
Goldenwave Coreopsis  
Little Bluestem  
Cutleaf Daisy  
Sideoats Grama  
Green Sprangletop

**Scientific Name**

*Buchloe dactyloides*  
*Coreopsis lanceolata*  
*Schizachyrium scoparium*  
*Engelmannia pinnatifida*  
*Bouteloua curtipendula, gracilis*  
*Leptochloa dubia*

**Streambank Seed Mixture**

Virginia Wildrye  
Canada Wildrye  
Inland Sea Oats

**Scientific Name**

*Elymus virginicus*  
*Elymus Canadensis*  
*Chasmanthium latifolium*

**Streambed Seed Mixture**

Heath Aster  
Carolina Canarygrass  
Switchgrass  
Eastern Gamagrass  
Bushy Bluestem

**Scientific Name**

*Aster ericoides*  
*Phalaris caroliniana*  
*Panicum virgatum*  
*Tripsacum dactyloides*  
*Andropogon glomeratus*

**4. Bio-technical stabilization with Live Woody Plant Stakes**

**Streambed Stabilization**

Black Willow  
Cottonwood – (cottonless)

**Scientific Name**

*Salix nigra*  
*Populus deltoids*

**Vegetated Gabion Checkdam**

Black Willow  
Cottonwood – (cottonless)

**Scientific Name**

*Salix nigra*  
*Populus deltoids*

**5. Joint Plantings for Articulated Concrete Block**

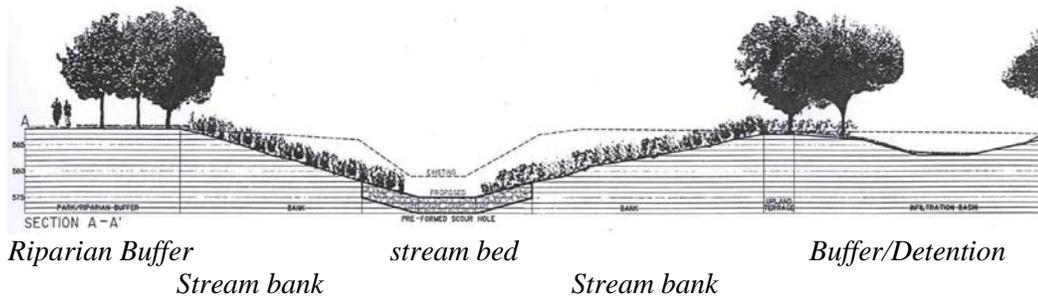
**Joint Planting**

Mexican Feathergrass

**Scientific Name**

*Stipa tenuissima*

**C. Typical Stream Cross Section**



**D. Trail Corridor Vegetation Management**

Except in the formal parks, the trail corridor should be primarily natural-appearing rather than groomed and formal. If turf grass areas are called for, they should be of minimal size. The illusion of a larger formal park can often be created by attractively grooming feature areas such as trail heads, picnic areas and other focal points. In general, linear parks should feature a low maintenance, natural landscape that is inviting to the user. This might be achieved over time using native grasses, wild flowers, selective weed removal, and, articulated mowing. Articulated mowing means shaping a natural landscape by grooming the trail shoulders and selectively creating mowed meadows and sweeps along the corridor.

Noxious and undesirable weeds should be identified and removed, ideally by cutting rather than chemical application. It is also important to manage vegetation for user security. Maintain good lines of sight, user surveillance, and escape routes. Avoid blind thickets close to the trail where a person could hide. These areas may pose, or appear to pose, a threat to users.

**Section 4.8 Fire Department**

**A. Fire Protection – Fire Flow**

An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are constructed in accordance with the Fire Code. Total fire flow requirements depend upon the type of construction and number of square feet. Fire flow for one-and two-family dwellings that do not exceed 3,600 square feet shall be 1,000 gallons per minute. Fire flow and flow duration for dwellings having a fire area in excess of 3,600 square feet shall be in accordance with the Fire Code.

**B. Fire Sprinkler Systems**

1. All underground piping, beginning at the point where water is used exclusively for sprinklers, shall be installed by a State certified fire sprinkler firm.

- Pipe depth shall be 42 inches minimum and 60 inches maximum to top of pipe.
  - In all cases, clean sand backfill shall be provided a minimum of six inches around the pipe.
  - Standard thrust blocks shall be provided at each change in direction and at all tees, hydrants, plugs, caps, and bends.
  - All underground mains shall have a clearance of two feet to any other utility or obstruction.
2. All plans shall have the registration number of a State certified firm and RME number with original signature.
  3. Underground sprinkler lines for residential sprinkler systems may share the domestic line in accordance with NFPA 13D.
  4. Fire Department Connection
    - All fire department connections shall be 4-inch Storz connections. The permanent Storz adapter shall be constructed of high strength, light weight, corrosion resistant aluminum alloy capable of being securely attached to standpipe/sprinkler outlets designed for fire department Storz connections. The Storz lug connection shall conform to industry standards. The hose sealing surface shall consist of a machined metal seat to eliminate rubber gaskets, coated to protect against long term exposure to the environment. The Storz connection shall connect to the pipe outlet using National Standard Thread. The connection shall be placed between 30 and 48 inches above grade and angled downward at a 30° angle. A semi-permanent ¼" mesh screen constructed of corrosion resistant metal shall be provided inside the Storz adapter.
    - A 4-inch Knox Storz aluminum cap with chain or cable shall be provided for the fire department connection.
    - For each additional 1500 gpm required or fraction thereof, an additional 4-inch Storz connection is required.

The fire department connection shall be within 50 feet of a fire lane or street.

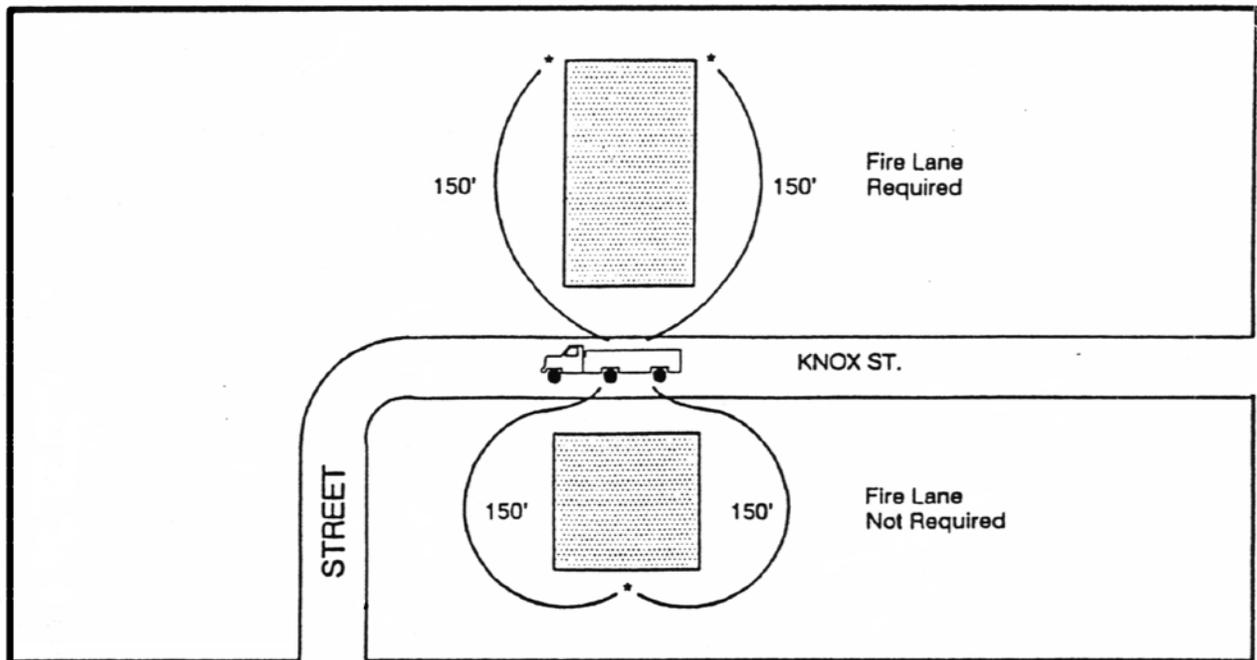
## **C. Fire Access Requirements**

### **1. Construction Requirements**

To provide adequate emergency vehicle access, all required fire lanes and public streets shall be installed and accepted before any construction occurs above the slab.

## 2. Hose Lay Distance

All buildings or structures shall be constructed such that all ground level, exterior sides of the building are within 150 feet of a dedicated street or fire lane. The 150 feet is measured along the route necessary to extend fire hose lines around the building. If the 150 feet cannot be reached from a public street, a fire lane will be required on site. This distance may be extended to 200 feet for single-family dwellings with approval of the Fire Department.



## 3. Unusual Conditions

When fire lanes cannot be installed due to topography, waterways, non-negotiable grades or other similar conditions, the Fire Department may require an additional fire protection system or systems.

## 4. Surface

Fire lanes shall be constructed of a concrete or asphalt surface to provide all-weather driving capabilities and shall support a 60,000 pound vehicle.

## 5. Vertical Clearance

All fire lanes shall have a minimum vertical clearance of 14 feet to allow a fire truck to pass under.

**6. Width**

The minimum unobstructed width of a fire lane shall be 24 feet to allow two fire trucks to pass in case of an emergency. For one single-family dwelling, this width may be reduced with approval of the Fire Department.

**7. Turning Radius**

All fire lanes shall have a minimum inside turning radius of 30 feet and an outside turning radius of 54 feet.

**8. Grade**

The maximum grade for a fire lane or street when serving a building not protected throughout by an automatic sprinkler system is 8 percent.

**9. Bridges**

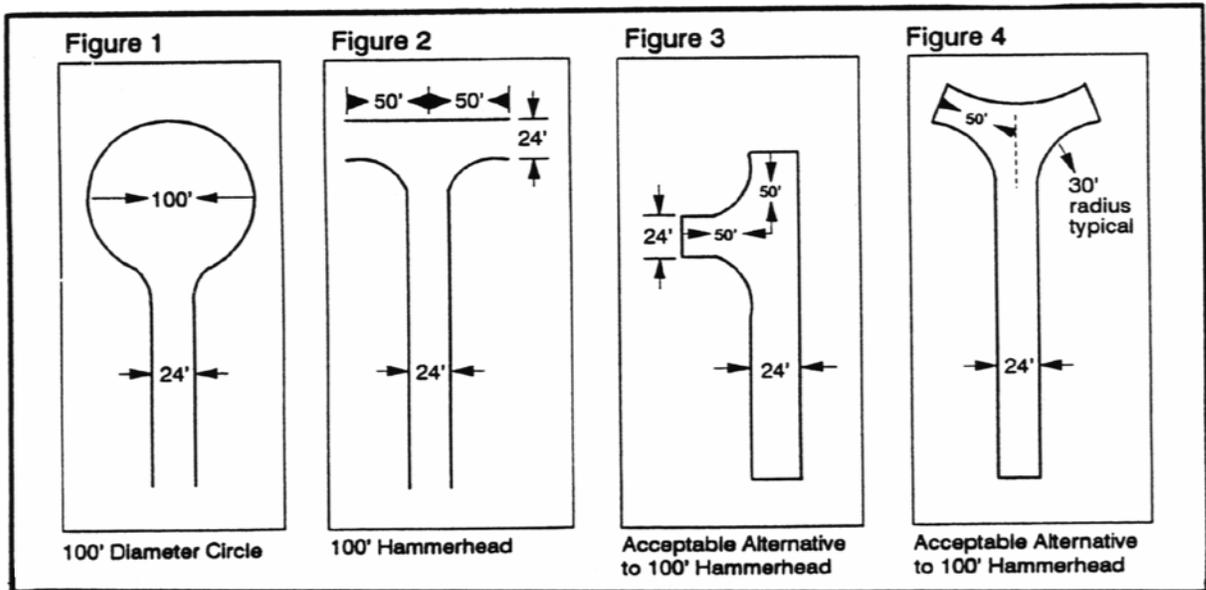
When a bridge is required to be used as access, it shall be constructed and maintained to carry a load of 60,000 pounds.

**10. Gates**

All gates across streets or fire lanes must be approved by the Fire Department and CDP. Plans shall be submitted to the Fire and CDP and approved prior to a permit being issued. Opticom receivers are required for all electric gates across fire lanes. A manual means of opening the gate shall also be provided. Refer to Chapter 4 of this manual for Gated entry details.

**11. Turn-Around Areas**

Dead-end fire lanes shall not exceed 150 feet in length without an approved turn around. Illustrations of approved turn-around arrangements are as follows:



**12. Obstruction**

The required fire lane width shall not be obstructed by parked vehicles or other obstructions. Speed bumps or similar obstacles that have the effect of slowing or impeding the response of fire apparatus shall be approved by the Fire Department prior to installation.

**13. Striping**

Fire lanes shall be maintained with fire lane striping that consists of 6 inch wide red background stripe with 4 inch high white letters stating "No Parking, Fire Lane" painted on the red stripe every 15 feet. Where a curb defines the fire lane, the markings shall be painted on the vertical surface of the curb. When repainting, additions to the existing fire lanes are not allowed without prior approval of the Fire Department. Only designated fire lanes shall be marked.

**14. Signs**

Signs may be substituted for fire lane striping in residential areas with approval of the Fire Department. If the Fire Department determines that striping is ineffective to designate a fire lane, signs may be required by written notice to the property owner.

**15. Maintenance**

All designated fire lanes shall be maintained at all times.

## CHAPTER 5

### COMMERCIAL SITES

#### **Section 5.1 Introduction**

The purpose of these guidelines is to provide information required to prepare construction plans for commercial developments. Specific information required for plan submittal can be found in the following sections or in the checklists located in the Appendices. Several departments have a checklist that may be used as a reference when preparing the plans. Some departments have included additional resources to assist in the design and plan preparation.

#### **Section 5.2 Building Inspections**

All plans for commercial sites shall be submitted to the Community Development and Planning Department (One Start) for review. Refer to the Commercial Site Plan Application for the type and number of required sets of plans.

#### **Section 5.3 Stormwater Management Division/Department of Public Works & Transportation**

##### **A. Stormwater Management Site Plan – Permanent Controls**

##### **1. General Requirements**

A preliminary Stormwater Management Site Plan (SWMSP) shall be prepared for all developments of 12,000 SF or more. A site plan will be accepted in lieu of a preliminary SWMSP if the site plan shows development will create less than 5,000 SF of impervious surface.

A final SWMSP must be accepted by PWT prior to any site activity.

The SWMSP shall identify permanent site features and controls that will be included in the design and constructed with the project to minimize and mitigate the project's long-term effects on stormwater quality and quantity. The SWMSP shall be submitted to CDP with the street and drainage plans.

The SWMSP shall be developed and coordinated with the site drainage plan and may be shown on the same sheet. It shall also be coordinated with the landscaping plan to prevent conflicts and assure compatible land use. The SWMSP shall meet all criteria of the SWMSP Checklist found in Appendix B and shall be sealed by a Professional Engineer or shall be signed and dated and contain a statement affirming the plan was prepared under the direction of the engineering signing the plan.

##### **2. Permanent Best Management Practices (BMPs)**

BMPs and design criteria to be used for the site will be discussed at the pre-application conference for platting and accepted by the City before the final plat is approved as required in the Subdivision Rules and Regulations. It is the responsibility of the engineer to design BMPs that address site-specific conditions using appropriate design criteria for the North Central Texas region. The source of the design criteria shall be referenced in the SWMSP.

To preserve the existing natural resources in Arlington and promote sustainable development, demonstration of compliance with the following Site Layout permanent BMP is required in the SWMSP of all developments.

- Site Layout – When the predevelopment grade at a site is steeper than five horizontal to one vertical or the site contains natural creeks or wetlands, the site layout shall be designed to require the least modification to existing topography and drainage. Factors to be considered are lots oriented and designed to minimize change in grade, drainage systems designed to minimize change in time of concentration, and street layouts designed to minimize extent of pavement.

In addition to the Site Layout BMP, the following minimum number of BMPs shall be provided:

**BMP Requirements**

	<b>No. of BMPs <u>(minimum)</u></b>
12,000 SF ≤ Disturbed Area < 5 acres	1
5 acres ≤ Disturbed Area < 10 acres	2
10 acres ≤ Disturbed Area < 20 acres	3
≥ 20 acres	4

Examples of factors that shall be considered when evaluating and selecting BMPs for a development are as follow:

- Effect of the development on runoff volumes and rates
- Potential pollutants from the development
- Percent of site treated by the BMP
- Effectiveness of the BMP on potential pollutants from the development
- Natural resources on the site
- Configuration of site, including changes to existing waterways

Potential stormwater pollutants from development may consist of but are not limited to the following:

- Total suspended solids
- Increased temperature
- Oil and grease
- Floatables (trash)
- Nutrients (fertilizers)
- Bacteria
- Metals
- Pesticides
- Sediment (soils due to erosion)

The following items are acceptable permanent BMPs for commercial sites:

- Preservation of natural creeks – Refer to Article V, Drainage and Environmental Standards, in the Subdivision Rules and Regulations for requirements when preserving natural creeks.
- Vegetated swales – Vegetated swales may be used if drainage design criteria are met. Vegetated swales shall be designed with a trapezoidal cross section and a gentle slope that yields a maximum velocity of 2 fps for the 2-year storm event. The engineer shall evaluate flow depths to verify no upstream flooding is caused by the vegetated swale during larger events. Design capacity of the swales is as specified in the Drainage Requirements of this document.
- 100-year drainage easement – Dedication of the 100-year fully urbanized floodplain as a drainage easement with the creel left in its natural condition will receive one BMP credit. This BMP is only available when no credit is being given for the dedication of a linear park.
- Vegetated strips – Vegetated strips may be used to separate impervious areas. Each strip shall be a minimum of 20 feet wide and flow spreaders or other measures must be provided to ensure sheet flow across the strip. Vegetation for the strip shall be included in the site’s landscaping plan.
- Floatables exclusion systems – Inlet inserts, trash racks on culverts, grates on curb inlets, and similar means of excluding trash are acceptable floatables exclusion systems when installed on private inlets and maintained by the property owner. BMP credit will not be given for grated surface inlets in parking lots.

- Permeable and semi-pervious pavement – Permeable and semi-pervious pavement may be used for spillover and excess parking areas. Permeable and semi-pervious pavement may also be used where pavement will only be subjected to foot traffic. The pavement design shall address life expectancy of the proposed material, load-bearing capacity, soil condition, and drainage to assure no standing water.
- Discharge of roof drains to pervious surface - Roof drains shall discharge to vegetated areas, infiltration trenches, or holding tanks for irrigation use to minimize the increase in runoff from the development.
- Low Impact Development Methods – The subdivision shall identify Low Impact Development (LID) Methods such as rain gardens, rain barrels, cisterns on individual lots and/or bio-retention or bio-detention facilities on common areas which treat all post-construction areas. The vegetated LID features should consist of native plantings or plantings consistent with Texas Smart-Scape recommendations. A provision (deed restriction or easement) ensuring long-term preservation and maintenance will be required.
- Detention – Detention may be achieved by surface ponds or subsurface structures. The first one-inch of runoff from the drainage area shall be detained and slowly released over at least 24 hours but less than 48 hours. Detention ponds and structures shall be evaluated for the 5-, 25-, and 100-year storm events using post-development landuse to verify that no structure flooding will be caused by the detention. Outfalls for detention ponds shall be designed to prevent clogging of the intake. The pond shall also be designed in accordance with other criteria in this chapter.
- Retention ponds – Retention ponds may be used if the engineer can show that daily flows, ground water seeps, or other water sources are available to maintain a permanent pool with a healthy aquatic community. A water balance shall be submitted with the plan. Retention ponds shall be a minimum of 4 feet deep, have a 10H:1V slope for areas that are 1 foot deep or less, and be designed to prevent short-circuiting. Fountains, cascades, or other means of aeration shall be provided to prevent the pond from becoming stagnant. The pond shall be evaluated for its affect on the 5-, 25-, and 100-year storm events using post-development landuse to verify that the pond will not induce flooding.
- Parking lot drainage – Parking lots may be designed to drain to vegetated areas or infiltration trenches instead of directly into storm drains or a paved channel. The design shall ensure that standing water does not occur. Sheet flow or the use of flow spreaders to disperse flow from a parking lot is preferred when draining to an adjacent vegetated area. Parking lots may also drain to sunken medians when implemented with appropriate landscaping.

- Subsurface treatment devices – Oil/water separators, centrifugal treatment devices, and other commercially available devices may be installed as part of the private drainage system. The devices shall be able to treat or pass the 100-year storm event without causing structure flooding.
- Rainwater harvesting – Runoff from roofs and other impervious areas that is collected for landscape watering or other uses shall be stored in tanks or covered containers that are not accessible to mosquitoes.
- Other BMPs – Other BMPs and innovative designs will be considered when submitted to the CDP with supporting calculations and references.

### **3. Construction and Maintenance**

The owner shall construct all permanent BMPs and is permanently responsible for maintenance of the BMPs. When the BMP falls within a drainage easement, the plat or separate instrument dedicating the easement shall include a statement of the owner’s responsibility for maintenance. The statement shall be identical to the one in Article V, Drainage and Environmental Standards, Section 5.03.B.4, of the Subdivision Rules and Regulations with the words “stormwater treatment facility” substituted for “stormwater storage facility.”

### **B. Stormwater Permit Required for Industrial Operations**

The SWMSP shall identify if the planned facility operations, after completion of construction, will be classified by a Standard Industrial Classification (SIC) code that requires an industrial stormwater permit. If the operations will require a permit, the drainage design shall provide for point discharges from the property and access to the discharge points for required stormwater sampling. Stormwater controls shall be included for outside storage areas.

### **C. Stormwater Pollution Prevention Plan (SWPPP) – Temporary Controls During Construction**

#### **1. Applicable Regulations and Ordinances**

Construction activities shall comply with the SWPPP requirements in the effective TPDES General Permit relating to Stormwater Discharges from Construction Activities, of the Stormwater Pollution Control Ordinance and the appropriate federal (Environmental Protection Agency) and state (Texas Commission on Environmental Quality) regulations. When the ordinance and applicable regulations are in conflict, the most stringent requirements shall apply.

#### **2. General Requirements**

Projects that disturb less than 1 acre shall have a SWPPP that complies with the requirements in the Checklist for Small Projects. Projects that disturb 1 acre or more shall comply with the requirements in the Checklist for TCEQ Regulated Construction Projects. These checklists are in Appendices C and D, respectively.

The SWPPP for projects that disturb more than 5 acres shall be sealed by a Professional Engineer and submitted to CDP with the street and drainage plans for review and acceptance.

### **3. Best Management Practices (BMPs) During Construction**

Structural BMPs shall comply with details and specifications in the latest edition of the NCTCOG BMP Manual titled “*Stormwater Quality Best Management Practices for Construction Activities*” and this manual. When the NCTCOG Manual and this manual are in conflict, this manual shall govern.

The SWPPP shall provide a series of changing BMPs that are appropriate for each phase of construction. The SWPPP shall also identify which owner/operator is responsible for installing, inspecting and maintaining each BMP during the different phases of construction. All temporary BMPs must be removed after final stabilization is achieved.

The following items are acceptable temporary BMPs for use during construction:

- Preservation of existing vegetation - This is a preferred BMP. When areas of existing vegetation are to be preserved, the areas shall be delineated on the plans, and the plans shall include notes stating that temporary chain-link fencing shall be installed to protect the vegetation.
- Vegetated buffer strips – Buffer strips may consist of preserved or planted vegetation. The strip shall be at least 15 feet wide, identified on the SWPPP, and flagged or otherwise designated in the field to prevent disturbance. Wider strips shall be specified when the slope is steeper than 10H:1V. If existing vegetation is used, it may be removed at the end of the project for establishment of permanent landscaping. The following design criteria shall be met when using vegetated buffer strips:
  - 1 The drainage area shall not exceed 0.25 acres per 100 feet length of vegetation.
  - 2 The maximum distance of flow to the vegetated buffer shall be 100 feet or less.
  - 3 The maximum up-slope grade perpendicular to the vegetated buffer shall not exceed 5H:1V.
- Soil retention blankets – Soil retention blankets shall be anchored per the manufacturer’s recommendations. On lots with slopes of 3H:1V or flatter, the blanketed area shall be at least 8 feet wide. Greater widths and additional BMPs shall be specified on steeper slopes. The blankets shall be seeded if used for temporary stabilization before start of home

construction. Soil retention blankets used in channels shall meet TxDOT requirements for Type E-H blankets, as appropriate.

- Silt fence - Silt fences shall have wire mesh backing and be supported by metal posts. When used as a perimeter control, they shall only be placed down-slope from the construction activity, with the ends turned up-slope, perpendicular to the contours, to form a sediment trap. Silt fences may be used for concentrated flows up to a maximum design flow rate of 0.5 cfs. The following design criteria shall be met when using silt fence:
  - 1 The drainage area shall not exceed 0.25 acres per 100 feet of fence length.
  - 2 For slopes between 50H:1V and 3H:1V, the maximum distance of flow to the silt fence shall be 100 feet or less.
  - 3 For slopes of 3H:1V and steeper, the maximum distance of flow to the silt fence shall be 20 feet.
  - 4 The maximum up-slope grade perpendicular to the fence line shall not exceed 1H:1V.
- Curb inlet protection - Inlet protection is the least desirable BMP. It will only be accepted for use on private streets and on public streets when no other BMP is viable. Temporary inlet inserts shall be used unless a written request to use other measures is submitted to and approved by PWT. If other measures of protecting the inlet are requested, the engineer shall evaluate them for possible flooding in low areas and flow diversion on steep slopes
- Temporary detention structure - If 10 or more disturbed acres drain to a common drainage point, a temporary or permanent sedimentation basin shall be used. Storage volume may be calculated as the volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained. When calculating the volume of runoff from a 2-year, 24-hour storm event, it is not required to include the flows from offsite areas and flow from onsite areas that are either undisturbed or have already undergone permanent stabilization, if these flows are diverted around both the disturbed areas of the site and the sediment basin. Capacity calculations shall be included in the SWPPP. A sedimentation basin providing at least 3,600 cubic feet of storage per acre drained until final stabilization of the site may be used in lieu of calculating the runoff volume. This practice is advisable on smaller drainage areas where practicable.
- Rock check dams - Rock check dams are appropriate for areas of concentrated flow such as swales, ditches, and outfalls. Rock shall be contained within a wire mesh. Check dams shall be placed at a spacing that sets the top elevation of a dam at the toe elevation of the next upstream dam, with the top of the furthest upstream dam set at the invert of the last stabilized portion of the swale or ditch. When check dams are used as an outfall control, the first check dam shall be at least 10 feet from the outfall, but no further than 50 feet from the outfall.

- Earthen berms - Earthen berms may be used as a perimeter control to divert runoff from adjacent sites away from the development or to retain runoff within the development. Earthen berms shall be stabilized within 14 days of their construction. The engineer shall analyze the impact of these diversion berms on adjacent sites.
- Fibrous mulch - Fibrous mulch may be used as an erosion control to limit the runoff from disturbed areas within the development. Mulch shall be at least 3 inches thick and cover all disturbed areas. When used on steep slopes of 3H:1V or steeper and in critical areas such as waterways, mulch matting must be anchored with netting to hold it in place.
- Hydromulch - Hydromulch stabilization may be used as an alternative to seeding for erosion control when all disturbed area is covered by the hydromulch. A strip of hydromulch is not acceptable unless additional structural controls are provided.
- Stabilized construction entrance - All construction entrances shall be stabilized with rock or other non-erodable material. If rock is used, the minimum effective diameter shall be 3 inches. Entrances shall be placed at high points or other areas where runoff from the construction site will not be directed to the entrance. The construction entrance shall not extend into the street or block flow in the gutter.
- Temporary inlet inserts - Commercially available or fabricated inserts may be used when inlet protection is the only viable BMP. Inlet inserts must be configured to pass the inlet's design flow without causing flooding.
- Other BMPs - It is the responsibility of the engineer to design appropriate BMPs for each site. If the most appropriate BMP is not in the NCTCOG BMP Manual, the engineer shall submit calculations and references for design of the BMP to PWT.

#### **4. Waste and Hazardous Material Controls**

Covered containers shall be provided for waste construction materials and daily trash. Hazardous materials shall be stored in a manner that prevents contact with rainfall and runoff. On-site fuel tanks and other containers of motor vehicle fluids shall be placed in a bermed area with a liquid-tight liner or be provided with secondary containment and spill prevention controls.

The SWPPP shall require federal, state and local reporting of any spills and releases of hazardous materials greater than the regulated Reportable Quantity (RQ) and reporting to the PWT's Stormwater Management Division, Environmental Compliance Section of all spills and releases to the storm drainage system.

**5. Temporary Stabilization**

Portions of a site that have been disturbed but where no work will occur for more than 21 days shall be temporarily stabilized as soon as possible, and no later than 14 days, except when precluded by seasonal arid conditions or prolonged drought.

Temporary stabilization shall consist of providing a protective cover, without large bare areas, that is designed to reduce erosion on disturbed areas. Temporary stabilization may be achieved using the following BMPs: temporary seeding, soil retention blankets, fibrous mulches, hydro-mulches and other techniques that cover 100 percent of the disturbed areas until either final stabilization can be achieved or until further construction activities take place.

Perimeter BMPs such as silt fence, vegetated buffer strips or other similar perimeter controls are intended to act as controls when stabilization has not occurred. Perimeter BMPs may remain in place during temporary stabilization, however, they are not acceptable as temporary stabilization.

**6. Final Stabilization**

Final stabilization consists of soil cover such as vegetation, geotextiles, mulch, rock, chemical modification of the soil, or placement of pavement. For vegetative stabilization, perennial vegetation must cover all disturbed areas without large bare areas and with a density of 70 percent of the native background vegetative cover. Vegetated buffer strips are not allowed unless designed and credited as a permanent BMP. All other forms of stabilization must cover 100 percent of the disturbed area.

For stabilizing vegetated drainage ways, sod or seeded soil retention blankets shall be used. Hydromulch will not be allowed in vegetated swales, channels or other drainage ways. BMPs may remain in place during stabilization, however, BMPs shall be removed after stabilization is achieved.

The plan for final stabilization shall be coordinated with the permanent BMPs in the SWMSP and with the landscaping plan, if applicable.

**7. Notice of Intent (NOI)**

On projects 5 acres in size or larger, the owner and each contractor shall submit a copy of the NOI to the PWT's Stormwater Management Division, Environmental Compliance Section at least 2 days prior to construction. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor needs to submit a copy of the NOI.

**8. TCEQ Construction Site Notice**

On projects that are 1 acre and larger but smaller than 5 acres, the owner and each contractor shall complete the Construction Site Notice provided in the TCEQ's New General Permit for Construction and submit a copy of it to the PWT's Stormwater Management Division, Environmental Compliance Section at least two days prior to commencement of construction activities. A signed copy of each Construction Site Notice must be posted at the construction site in a location where it is readily viewed by the general public during all construction activity. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor must submit and post the Construction Site Notice.

**9. Notice of Termination (NOT)**

All parties that submitted a NOI shall submit a NOT within 30 days after final stabilization is established.

**10. Inspection and Maintenance during Construction**

The owner shall construct all BMPs and other controls required by the SWPPP. The owner shall have qualified personnel inspect the BMPs at least every two weeks during construction and within 24 hours after a storm event of 0.5 inches or greater. Alternately, inspections may be performed every 7 days with no additional inspections after rain events. Certified inspection reports shall be retained as part of the SWPPP. Within 7 days of the inspection, BMPs identified as damaged or deteriorated shall be repaired or replaced, as appropriate. BMPs shall also be cleaned to maintain adequate capacity.

If a discharge of soil or other pollutant has occurs, the BMPs shall be evaluated. Changes or additions shall be made to the BMPs to prevent future discharges. In addition, the owner shall implement procedures to remove discharged soil from all portions of the Municipal Separate Storm Sewer System (MS4) that received the discharge, including streets, gutters, inlets, storm drains, channels, creeks, and ponds.

Notes requiring the inspection and maintenance shall be placed on SWPPP drawings. The SWPPP shall identify the responsible party for inspecting and maintaining each BMP. If no party is identified, each owner and operator that submitted a NOI for the site shall be fully responsible for implementing all requirements of the SWPPP.

Inspectors for the City will not allow construction of public improvements to start, nor will they grant final acceptance of public improvements, until the SWPPP is implemented and maintained.

**Section 5.4 Water Utilities Engineering Department**

**A. Horizontal and Vertical Control**

**1. Horizontal Control**

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City’s web page.

**2. Vertical Control**

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City’s web page.

**B. Digital File Requirements**

Prior to acceptance of three-party contracts, the owner’s engineer shall furnish the City an electronic file of the water and sewer construction drawings in AutoCAD R14 or higher in .DXF or.DWG format. The information shall be provided to the City on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Water Lines	C-WTR-WL
Water Line Text	C-STR-WL-TXT
Water Line Valves	C-WTR-GV
Water Line Valve Text	C-WTR-GV-TXT
Water Line Fire Hydrants	C-WTR-FH
Water Line Fire Hydrant Text	C-STR-FH-TXT
Sewer Lines	C-SWR-SL
Sewer Line Text	C-SWR-SL-TX
Sewer Lines Cleanouts	C-SWR-CO
Sewer Lines Cleanout Text	C-SWR-CO-TXT
Sewer Lines Manholes	C-SWR-MH
Sewer Lines Manhole Text	C-SWR-MH-TXT

All files shall be in the same directory, including all construction documents with their dependencies (XREFS), plot files, and any support files needed. The electronic files shall use only standard AutoCAD fonts with “ROMANS” as the main font.

**C. Design Plan Information**

Plan review information is included in Appendix E. This information is used by the CDP when reviewing plans, and provides guidance to the engineer as to the type of information that will be required for water and sewer plans.

Additional resources for water and sanitary sewer requirements are:

- The Water Chapter and the Subdivision Chapter of the City Code, and
- The Standard Details and Specifications for Water and Sewer Construction.

- The Texas Commission on Environmental Quality (TCEQ)
- The National Sanitation Foundations (NSF)
- The Texas Department of Insurance
- The Insurance Services Office

**D. Design Requirements – Water**

**1. Pipe Sizing**

- Water mains shall be sized for fully developed conditions based on the 2001 Water Distribution Analysis or latest revision. In addition, 12-inch water mains shall be installed on a ½ mile grid pattern and 8-inch water mains shall be installed on a ¼ mile grid pattern. Water lines shall be a minimum of 6 inches throughout the distribution system except in industrial or manufacturing areas where the minimum size shall be 8 inches. Where the length of the line exceeds 800 feet, the minimum shall also be 8 inches.
- Water lines shall be designed based on 1 gpm for each unit or residence up to 100 and 0.60 gpm for each unit or residence over 100. This criteria shall be used to determine the size of the water lines required to serve a development and eligibility for oversized participation.
- Dead end systems shall be avoided where possible, but if necessary shall not exceed 2000 feet.

**2. Line Placement**

If street improvements are proposed, the water line placement shall be coordinated with the street plans.

**a. Vertical**

- The following note shall appear on the water layout plan sheets: “There shall be a minimum cover of 42 inches over the water pipe as measured from the top of the pipe to the existing ground. Existing ground may be the flow line of the bar ditch, natural ground on the low side of a county-type road, or the proposed finished grade, whichever is lowest.”
- Lines shall be at least 2 feet below curb inlets.
- Water lines along unimproved streets shall have a minimum depth of 5 feet from the lowest ditch elevation to the top of pipe to provide grade for future street improvements.
- A profile drawing shall also be provided for all water mains 12 inches and larger.

**b. Horizontal**

- Water lines shall be located 2 feet behind the proposed curb for new developments. Lines shall be located to clear the back of curb inlets by at least 2 feet by deflecting the pipe or using offset bends.
- The minimum radius to be used for PVC water pipe is as follows:

<u>Pipe Size (Inches)</u>	<u>Minimum Allowable Radius (Feet)</u>
6	150
8	200
10	250
12	300

For pipe sizes larger than 12 inches, the minimum radius shall be: 300 x D (where D = pipe diameter in feet).

**3. Gate Valves**

Gate valves shall be installed at pipe intersections to allow for the isolation of lines for repairs and the routing of poly pigs. Valves shall also be placed such that no more than 35 lots will be out of service when a line is out of service. When installed at street intersections, main line valves shall be installed 2 feet behind the back of the curb at the point of tangency for the curb return. Valves installed between intersections shall align with common lot lines. Gate valves are not to be used on fire hydrant leads when connected to water mains smaller than 12 inches in diameter.

**4. Fire Hydrants**

- For all single family detached and duplex residences, excluding townhouses and apartments, fire hydrants shall be spaced to have an effective radius of 500 feet or a fire hose laying distance of 600 feet, whichever results in the closer fire hydrant spacing, or as required in the current Fire Code. The fire hose laying distance is measured by the laying of fire apparatus hose lines along streets and right-of-way from the nearest water supply on a street to the most distant point on the exterior of the building.
- Fire hydrants for all other land uses shall be spaced to have an effective radius of 300 feet or a fire hose laying distance of 500 feet, whichever gives the closer fire hydrant spacing, or as required in the current Fire Code.
- A fire hydrant shall be installed at the end of mains on cul-de-sacs and other locations where lines terminate. Other fire hydrants shall be located at street intersections and shall align with common lot lines.

Additional fire hydrants may be required between intersections to meet the minimum spacing requirements.

- When the street is designated on the Thoroughfare Development Plan as an arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians shall have a fire hydrant on the same side of the street that the building is to be constructed.
- Fire hydrants shall be located in accessible protected areas. They shall be located a minimum of 3 feet and no more than 8 feet behind the back of curb.
- Fire hydrants shall be located outside curb returns and at least 4 feet from a driveway.
- A clear space of three feet shall be maintained around all fire hydrants.
- Fire hydrant mains shall be placed between 4 feet and 6 feet in depth. Offsets or bends shall be used to bring the fire hydrant up to allowable depths.
- Private fire protection systems and private fire hydrant locations shall be approved by the City of Arlington Fire Department prior to construction. A fire hydrant shall be installed no more than 200 feet from the fire department connection for an automatic sprinkler system.

## **5. Water Services**

- The minimum size water service shall be 1 inch.
- Where water meter banks are installed, permanent metal tags with addresses shall be installed on the service line at the curb stop to link the service with the address. The meters shall be installed in a logical sequence.
- Water meters shall be located in accordance with the standard details.

## **6. Miscellaneous**

The City may install detector checks or water taps on lines greater than 2 inches at the owner's request. The owner may request a cost estimate for materials and installation by contacting the Water Utilities/Customer Services Office. A set of approved plans and a copy of the approval letter from the WUED shall accompany the request.

**E. Design Requirements – Sanitary Sewer**

**1. Pipe Sizing**

- Sanitary sewer mains shall be adequately sized to serve the development and upstream drainage basin. Sanitary sewer mains shall be extended through the development to serve abutting property as required. Sanitary sewer mains shall be a minimum of 8 inches in diameter.
- Sanitary sewer systems shall be designed based on 1 gpm of flow for up to 100 units or residences and 0.60 gpm for each unit or residence over 100. When the drainage area is larger than 100 acres and the proposed land use (zoning) is unknown, Harmon’s Formula shall be used to determine peak dry weather flow.

Harmon’s Formula:

$$M = 1 + \frac{14}{4 + \sqrt{P}}$$

M = Ratio of design load to average load

P = Population in thousands, assuming a density of 14 people per acre

- In addition, infiltration shall be estimated at 100 gpd per acre of drainage basin and shall be added to the peak dry weather flow to determine the total peak flow. The peak flow shall be 75 percent of the pipe capacity. Capacities shall be calculated using a Manning’s (n) equal to 0.013. The Engineer may be required to submit design calculations to the WUED for review.
- Other methods may be used with WUED approval. Line sizing is subject to the final approval of the Director of Utilities.
- A minimum velocity of 2 fps shall be maintained. Associated slopes are listed below:

<u>Diameter (inches)</u>	<u>Slope (ft/ft)</u> <u>n = 0.013</u>
8	0.0040
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010
24	0.0008
27	0.00067
30	0.00058
36	0.00046

## 2. Line Placement

If street improvements are proposed, the sanitary sewer line placement shall be coordinated with the street plans.

### a. Vertical

- Sewer mains shall be installed on a uniform grade between manholes. Particular care shall be taken to avoid rapid grade changes or reduced velocities at the lower section of the sewer main.
- Sanitary sewer lines constructed along unimproved streets shall be a minimum of 8 feet below the level of the lowest part of the existing street or bar ditch to provide grade for future street improvements.
- Sanitary sewer mains and services shall be encased in Class 'A' concrete where:
  - 1) the cover is 3 feet or less in paved areas, measured from the top of subgrade
  - 2) the cover is 2 feet or less in parkways
  - 3) the line has 2 feet or less of clearance beneath proposed storm drains or conduits.
- A profile drawing shall be provided for all sanitary sewer mains.

### b. Horizontal

- The minimum radius for PVC sewer pipe shall be determined using the following formula:
$$R = 300 \times D$$

R = minimum allowable radius of curvature  
D = pipe diameter  
R & D are in the same dimensional units
- Sanitary sewer lines shall be placed along the centerline of the street unless prohibited by topography.

### c. Manholes and Cleanouts

- Manholes shall be required at a maximum spacing of 500 feet on public sewer lines. Manholes are required at direction, pipe size, and grade changes.

- A standard manhole is 48 inches in diameter. A 60 inch diameter manhole is required when designed as a drop manhole, deeper than 12 feet, or the main is 15 inches or larger.
- Drop manholes shall only be used for depths greater than 12 feet.
- A manhole shall be installed at the end of mains on cul-de-sacs. A maximum of three sanitary sewer services may be installed at a manhole at the end of a cul-de-sac.
- Where manholes and cleanouts are located within the 100-year floodplain, watertight rings and lids shall be used.
- The top of manholes shall be set at 1 foot below the top of the subgrade when located in future pavement and raised to grade with the pavement construction, or 6 inches above existing natural ground outside paved areas.
- When tying to existing manholes, the invert must be reworked.
- Cleanouts may be installed at the end of main lines, except at the end of lines in cul-de-sacs.

**d. Sanitary Sewer Services**

- Generally, sanitary sewer services are a minimum of 4-inches in diameter, shall be below water services and located 9 feet downstream of the centerline of the lot. Exceptions will be considered on an individual basis.
- Where lot grades are lower than the street, located in the floodplain, or a storm drain crosses the sanitary sewer main, the flow line elevation of the sewer service line at the property line shall be provided.

**e. Miscellaneous**

- When sanitary lines are connected, the crown of each pipe shall be matched. Where a larger upstream line connects to a smaller downstream line, the flow lines shall be matched.
- Aerial crossings of open drainage features shall incorporate the use of trusses, wide flange beams, or strapping of the line to bridge structures or culverts to minimize the number of piers within the open drainage feature. Spread footings shall not be used in pier design.
- Ductile iron pipe shall generally be used for aerial crossings, trench spans, fill areas, bored and grouted pavement crossings, or

where cover is minimal. All 12-inch and smaller sanitary sewer mains using poly-wrapped ductile iron pipe shall be Class 350 or greater. A greater pipe class may be required to accommodate trench conditions.

**F. Submittals**

**1. Utility Companies**

The owner shall submit plans to the utility companies when new water and sanitary sewer lines will be installed along perimeter streets or as approach (offsite) mains to a development. A list of utility companies and contact names can be obtained from the WUED at the time of submittal.

**2. TxDOT**

A permit from TxDOT is required when constructing facilities within state right-of-way. The WUED will provide the forms that are to be completed by the owner. Five copies of the completed form and five additional sets of plans shall be submitted to the WUED. The WUED will forward the forms and the plans to TxDOT for approval. The permit must be approved prior to commencing construction.

**G. Utility Easements (Water & Sanitary Sewer)**

Utility easements are required for all public water and sanitary sewer lines installed outside of the street right-of-way. Generally, utility easements shall be a minimum of 15 feet wide except when a utility easement is adjacent to another easement or right-of-way where 10 feet is allowed. When both water and sanitary sewer lines are located in the same easement or other facilities are within the easement, the minimum width shall be 20 feet. Where water or sanitary sewer lines are constructed deeper than 10 feet, the easement width shall be a minimum of 20 feet. For deep lines, the width of the easement shall encompass the trench width and side slopes that are based on one horizontal to one vertical for each side of the trench unless otherwise approved by the WUED.

The owner shall submit the ownership information, metes and bounds description, and the exhibit of the utility easement to the WUED. The description and easement shall be sealed, signed, and dated by a surveyor.

The filing process for separate easements can be found in Chapter 3 of this manual.

**H. Construction Requirements**

**1. Water and Sanitary Sewer**

The owner shall construct all water and sanitary sewer facilities required for the development of the subdivision, including any necessary offsite facilities. The owner shall also acquire necessary offsite utility easements. All City participation requests for offsite and/or oversized facilities must be authorized by City Council before beginning construction. All water and sanitary sewer

infrastructure shall be in place and accepted by the City prior to issuance of a building permit.

In accordance with the Subdivision Rules and Regulations, the City will not allow construction of any public improvement or issue permits for any construction activity until the plat is approved and filed with the county. Upon written request from the owner, the Director may allow the construction of public improvements prior to the plat being filed with accepted plans and inspection. The owner must demonstrate that an inability to file the plat within a reasonable timeframe is the result of filing requirements that do not have a substantive impact upon the development of the land. Should the City allow the development of public improvements prior to plat filing, the improvements will not be accepted until a plat is filed of record. No grading, clearing or fill shall commence without a SWPPP and prior approval of CDP.

**2. Standard Specifications**

Water and sanitary sewer standard specifications may be obtained through the City's web site or by requesting a CD-ROM from the WUED.

**3. Typical Details (Water and Sanitary Sewer)**

Water and sanitary sewer details may be obtained through the City's web site or by requesting a CD-ROM from the WUED.

**I. Contractor Requirements**

**1. Pre-qualification**

A contractor employed by the owner must be pre-qualified by the City to construct all public water and sanitary sewer improvements. Pre-qualification shall be determined by the City. The contractor shall complete a pre-qualification form indicating the type of work for which the contractor desires to be pre-qualified. The contractor shall provide information regarding experience related to the construction of public projects similar to those for which the contractor is requesting pre-qualification. Pre-qualification forms for water and sanitary sewer projects are available in the WUED or on the City's website.

**2. Contract Requirements**

Standard Three-Party Contracts executed by the owner, contractor, and the City are required for construction of all public water and sanitary sewer improvements. The contract shall provide for 100-percent performance, payment and maintenance bonds, except when the contract is less than \$25,000. When the contract is less than \$25,000, only a maintenance bond is required. An insurance certificate with coverage approved by the City is also required with the contract documents. The expiration date of the insurance policy shall not be prior to the completion of the project. Additionally, an administration and inspection fee as established by the City (refer to Chapter 3 of this manual) shall be paid prior to

commencing construction. A trench safety plan shall also be submitted with the contract.

**3. Inspection Requirements**

The contractor shall notify the PWT's Construction Inspection Division 48 hours prior to the start of any construction of public facilities. The contractor shall also ensure that, when applicable, proper authorities with TxDOT, franchised utility companies, railroads, or any other affected entities are notified.

**J. Permits**

No building permits will be issued until all water and sewer infrastructure is initially accepted.

**Section 5.5 Transportation/Department of Public Works and Transportation**

**A. Thoroughfare Development Plan (TDP)**

Included in Appendix F is a map illustrating the Thoroughfare Development Plan. Information on the back of the map explains designations and provides the guidelines used in developing the plan. All developments shall comply with the TDP. Contact CDP for the latest amendments to the TDP.

**B. Intersection Geometric Design**

Typical layouts of various street intersections are included in Appendix H.

**C. Sight Distance Criteria**

At controlled or uncontrolled intersections of any public street, the minimum intersection sight distance (visibility triangles) shall have the dimensions as illustrated in Figure 1 in Appendix I. Where a driveway intersects a public street, the minimum intersection sight distance shall have the dimensions as illustrated in Figure 2 in Appendix I. Additional sight distance may be required based on topography, roadway curvature, vegetation or other sight hindrance.

Deviations from the minimum intersection sight distance requirements may be allowed provided that the owner has demonstrated that the area proposed will provide adequate sight distance as required based on AASHTO standards. All deviations from the above requirements must be approved by CDP.

**D. Parking Lot/Site Layout Design Criteria**

Parking lots shall be designed in accordance with the standards as shown in Figure N. The site shall be designed such that all vehicle maneuvers are accomplished on site.

**E. Commercial Driveway Design Criteria**

A site plan showing the following shall be submitted for review:

- All existing and future right-of-way and easements
- Curbs, storm drain, inlets and flumes
- Utilities
- Trees
- Sidewalks
- Driveway grade profile (15 feet beyond right-of-way)
- Existing driveways on both sides of the street and median openings (within 150 feet)

**1. Design Standards**

The values in Table 1 represent minimum and/or maximum standards and shall be used for the design and construction of driveways. For each driveway, CDP may require a specific combination of dimensions within these ranges based on the anticipated traffic flow and safety characteristics of the driveway and public street.

**TABLE I  
Driveway Design Criteria**

<u>Requirements</u>	<u>Street Class</u>	<u>Apartment- Commercial Driveway</u>	<u>Industrial Driveway</u>
Driveway Throat Width	Local	24-36 feet	24-45 feet
	Minor Col.	24-36 feet	30-45 feet
	Major Col.	24-36 feet	30-45 feet
	Arterial	30-36 feet	30-45 feet
Driveway Curb Radius	Local	10-20 feet	15-30 feet
	Minor Col.	15-20 feet	15-30 feet
	Major Col.	15-30 feet	20-30 feet
	Arterial	20-30 feet	20-30 feet
Minimum Driveway Centerline Spacing	Local	100 feet	100 feet
	Minor Col.	150 feet	150 feet
	Major Col.	200 feet	200 feet
	Arterial	250 feet <sup>1</sup>	250 feet <sup>1</sup>
Driveway Angle		90 degrees	90 degrees
Minimum Distance <sup>2</sup> from Driveway to Intersection	Local	75 feet	75 feet
	Minor Col.	100 feet	100 feet
	Major Col.	150 feet	150 feet
	Arterial	180 feet	180 feet

Max Approach Grade <sup>3,5</sup>	Local/Minor	+6%	+6%
	All Others	+3%	+3%
Min Approach Length <sup>4,5</sup>	Local/Minor	9 feet	9 feet
	All Others	20 feet	20 feet

Notes:

<sup>1</sup> Driveways on arterials served by deceleration lanes may be spaced at 200 feet intervals.

<sup>2</sup> Distance measured from the intersection of the extended right-of-way lines to the centerline of the driveway. In no case shall the driveway centerline be closer than 100 feet to the curb return departure of the major street facility.

<sup>3</sup> The percent slope measured along the centerline of the driveway.

<sup>4</sup> The minimum distance over which the maximum approach grade must be maintained.

<sup>5</sup> The approach grade and length shall be altered to include a sidewalk section through the drive approach as applicable. See typical details for drive approaches.

## 2. General Design Criteria

The driveway for any apartment, commercial or industrial property that connects to a major collector or arterial shall extend onto private property a minimum distance of 20 feet before intersecting any internal driveway.

Driveways having a projected design volume of 5,000 or more vehicles per day shall have a minimum of 100 feet continuous approach length without adjacent parking or vehicular cross flow.

All vehicle maneuvering on apartment, commercial and industrial properties into a parking space, up to a loading dock, or into any other area shall be accomplished by off-street maneuvering areas and internal driveways. No back-in or back-out vehicle maneuvering from a driveway shall be allowed to occur on any public street or right-of-way.

Shared driveways shall require the dedication of a private access easement on each affected property and execution of a private maintenance agreement. If the dedication is not shown on the final plat, it shall be filed by separate instrument. The combined size of the access easement must be a minimum of 24 feet wide and 48 feet deep. The easement width shall encompass the entire width of the driveway and shall extend at least one foot onto each property.

The curb return shall not extend beyond the property line, except as provided in shared driveway agreements, or as approved by CDP.

Driveways shall not be located within 4 feet of a fire hydrant, utility pole or other above ground utility and within 6 feet up or downstream of an inlet. The owner may have the above ground utility moved at the owner's expense if the utility company agrees.

### **3. Auxiliary Lanes**

As a condition of a driveway permit, the City may require the applicant to provide a deceleration lane for any driveway located on a major street facility or interstate frontage road where the right-turn ingress volume exceeds 40 right turns in the design hour of the street or if the use of driveway is determined to cause excessive delay on the roadway (i.e., heavy truck traffic). Such calculation shall be made by the City unless a traffic study is provided by the applicant. The design of such a deceleration lane shall conform to the dimensions shown on the Figure in Appendix O, unless otherwise authorized by the City.

When a driveway is approved within a right-turn lane or deceleration lane, the lane shall be extended a minimum of 50 feet in advance of the driveway. No driveway shall be permitted within the transition area of a right-turn or deceleration lane. If the owner is allowed to locate a driveway requiring a deceleration lane within 180 feet of an intersection, the deceleration lane shall be extended to the intersection.

A continuous deceleration lane may be required as a condition of a driveway permit when two or more deceleration lanes are planned, and their proximity necessitates that they be combined for proper traffic flow and safety. The transition taper for a continuous deceleration lane shall not extend into or beyond a public street intersection.

On undivided arterial and collector roadways, a left-turn lane may be required as a condition of a driveway permit when the projected product of the left-turn ingress volume (50 minimum) and the opposing volume per lane exceeds 420 trips in any design hour. In such cases, the City will analyze the present and future traffic volumes to verify that the left-turn lane is necessary to maintain minimum levels of traffic flow and safety.

A left turn lane shall be constructed to serve the driveway if it aligns with an existing median opening. An existing left turn lane may require lengthening to provide adequate storage.

Auxiliary lanes may be required on existing county-type roadways proposed as arterials if capacity issues exist.

The owner shall be responsible for the design, right-of-way acquisition, adjustment of utilities and construction costs of any auxiliary lane required.

### **4. Signalized Driveways**

On major collectors or arterials, if a traffic study indicates traffic signal warrants are met to require a signal at a driveway, the owner shall pay for the traffic signal installation costs. The owner may also be required to construct onsite and offsite improvements necessary to provide proper alignment, adequate signal capacity, smooth traffic flow and safety for the public street/driveway intersection.

A traffic signal access easement (minimum 20 feet wide by 60 feet deep) must be provided along the driveway to allow the City to install and/or maintain the signal detectors placed in the concrete.

If a driveway is permitted and installed at an existing signalized intersection, the applicant shall pay any costs and dedicate easements necessary to modify the existing signal and intersection to accommodate the new driveway.

## **5. Special Driveway Designs**

The City may require internal driveway improvements, turning movement prohibitions, auxiliary lanes and traffic control devices to address safety and/or capacity problems within the property that will have a detrimental effect on the adjacent public street system.

All driveways on undivided arterial roadways having a projected exiting left-turn volume that will operate at a level of service "D" or worse may be required to be constructed with a left-turn egress control median. In addition, any driveway having a projected ingress left-turn volume that will have a level of service "D" or worse may be required to have a left-turn ingress control median. If both conditions exist, a right-in/right-out driveway design may be required.

Driveways may be prohibited where adequate sight distance is not available for the established speed limit or the design speed of a future street improvement. Sight distances shall be calculated in accordance with the latest edition of the AASHTO Handbook. If an inspection indicates that driveway sight distance may be insufficient, the applicant will be required to submit vertical and horizontal information to the City that verifies adequate sight distance is available for the proposed driveway location. The City may deny access or a specific driveway location to any abutting public street if said access cannot be provided in a reasonable and safe manner. The City shall not deny reasonable access without compensation.

## **F. Pavement and Street Marking Installation**

When the development of a commercial site requires construction of a public street, the owner shall be responsible for the design and installation of pavement and street markings with the street improvements. The following design requirements shall be used.

### **1. Standardization of Application**

All pavement markings within the City shall conform to the fundamental use and design requirements set forth in the Texas Manual on Uniform Traffic Control Devices (TMUTCD). Markings shall be visible during hours of darkness and be reflectorized.

### **2. Materials and Application**

- a. Type I Marking Materials: Type I markings are thermoplastic type materials

that require heating to elevated temperatures for application. Type I marking materials shall conform to current and appropriate TxDOT Standard Specifications for Construction of Highways, Streets and Bridges. Type I markings are used for all longitudinal and transverse markings, crosswalks and stop bars. The thickness of thermoplastic is applied at 60 to 90 mils for stop bars and crosswalks and at 30 to 60 mils for longitudinal markings. Reference AASHTO Thermoplastic Specification.

- b. Type II Marking Materials: Type II markings are paint-type materials that are applied at ambient or slightly elevated temperatures. Type II marking materials shall conform to current and appropriate TxDOT Materials Specifications. Type II may only be used in parking lots or as temporary pavement markings.

The two basic types of raised pavement markers used in the City are reflectorized and non-reflectorized traffic buttons. They are typically installed with epoxy. They can be used in addition to thermoplastic for longitudinal lines on highly traveled streets. Additionally, the City does not use any raised pavement markers greater than two inches in height. Marking configurations with raised pavement markers that may be used in the City with permission from PWT are shown in the Figures in Appendix Q.

Pavement arrows and words are installed using either thermoplastics or cold layed plastics. Cold layed plastic is applied at a thickness of 90 mils (min.).

**3. Color**

Pavement markings should be yellow, red or white and shall conform to fundamental use and design requirements listed in the TMUTCD.

**4. General Design Criteria**

Pavement markings, including both longitudinal and transverse, should be installed on all collectors and streets of a higher classification. High-speed (Speed Limit 40 or higher) rural roadways should also have center lines and edge line markings.

Longitudinal pavement markings on residential streets and most minor collector streets are typically not needed. However, when they are necessary, thermoplastic shall be used in order to reduce maintenance needs. The following table can be used as a reference to determine when pavement markings are installed.

Note: (1) A-No Markings; B-Center-Line; C-Center-Line and Lane Line Marking.  
 (2) Non-curbed and gutter streets serving as a collector or thoroughfare shall have center -line and edge line markings.

Volume (trips)					
Street Width (ft)	0-1000	1000-2000	2000-5000	5000-1000	> 10000
< 30	A	A	B	B	B
30-39	A	A	B	B	B

40-49	B	B	B	C	C
49-60	B	B	C	C	C
> 60	B	B	C	C	C

The following guidelines for color and patterns of longitudinal lines are summarized from the TMUTCD:

- Yellow lines delineate the separation of traffic flows in opposing directions or mark the left edge of the pavement of divided highways and one-way roads and ramps.
- White lines delineate the separation of traffic flows in the same direction or mark the right edge of pavement.
- Red markings delineate roadways that shall not be entered.
- Broken lines are permissive in character.
- Solid lines are restrictive in character.
- Width of lines indicates the degree of emphasis.
- Double lines indicate maximum restrictions or prohibitions.

**5. Width and Patterns of Longitudinal Markings**

The width and patterns of longitudinal lines shall be as follows:

- Typical line widths are 4 inches
- Wide line widths are at least 8 inches

See figures in Appendix R for typical line patterns.

**6. Typical Applications of Longitudinal Markings**

The following describes specific applications of different types of longitudinal markings (see Appendix R for typical designs):

**a. Center Lines**

Yellow centerlines separate traffic traveling in opposite directions and do not need to be the geometrical center of the pavement. Double yellow centerlines consist of two normal solid yellow lines and delineate the separation between travel paths in opposite directions where overtaking and passing is prohibited in both directions.

**b. Lane Lines**

Lane lines are normally dashed white lines that permit lane changing with care. A solid white line is used to separate through traffic lanes from special secondary lanes and left or right turn lanes. Their length is determined based on the geometry of the intersection, length of queue, and speed (design or posted speed limit) of the street. Solid white lane lines (not edge lines) shall be eight inches in width when added emphasis on separation is desired.

**c. Lane Line Extensions**

Lane line extensions (puppy tracks) should be installed when conditions make it desirable to provide control or guide vehicles through an intersection. Such cases may include offset intersections, skewed intersections, and dual turning movements. All extensions should be 3 feet lines with 3 feet skips. They shall be the same color of the line that is to be extended.

**d. Other Types and Applications**

A single solid white line is used to delineate the edge of the travel path where travel in the same direction is permitted on both sides of the line but crossing the line is discouraged. It is also used to mark the right edge of the pavement (edge line).

A double solid white line is used to delineate a travel path where travel in the same direction is permitted on both sides of the line, but crossing the line is prohibited.

A double line consisting of a single broken yellow line and a single solid yellow line delineate a separation between travel paths in the opposite directions. Overtaking and passing is permitted with care for traffic adjacent to the broken line and is prohibited for traffic adjacent to the solid line (One Direction No-Passing Marking).

A double normal broken yellow line delineates the edge of a lane in which the direction of travel is changed from time to time in such a way that the line serves as the center line of the roadway during some periods (Reversible Lane Lines).

**e. Left Turn Channelization**

With the exception of continuous two-way left turn lanes and trapped lanes, most left turn lanes on undivided roadways will require a transition before left turn storage is provided. This transition or taper can be of a variety of designs and lengths. Refer to Appendix S and the following table.

NOTE: Where the street has been flared to provide a left turn lane, the storage length should be maximized and the taper length should be reduced. The typical taper length in this case is 150 feet for streets that with a speed limit of 40 or higher.

<b>TYPICAL TAPER RATIO PER FOOT OF LATERAL SHIFT</b>		
<b>SPEED LIMIT (mph)</b>	<b>APPROACH TAPER</b>	<b>BAY TAPER</b>
30	1:15	1:10
35	1:20	1:12
40	1:30	1:14
45	1:35	1:15
50	1:40	1:17

**f. Storage Length**

This is the distance from the end of the bay taper to the intersection nose or stop bar. This distance should be determined based upon left turn demand and the type of control at the intersection. The desirable distance is the length of the vehicle queue plus 100 feet for the deceleration that must take place before vehicles stop in queue. The desirable minimum storage length used in the City is 150 feet.

**g. Non-Longitudinal Markings**

The following are different types of non-longitudinal markings:

- Stop Bars
- Crosswalks
- Word and Symbol Markings
- Shoulder Markings
- Parking Space Markings
- Crosshatch Markings
- Median Markings

Non-longitudinal (or transverse) markings shall be white except transverse median markings applied at the median nose, which shall be yellow. Typical dimensions and patterns of some of the transverse markings are discussed below. Typical sketches are provided in Appendix T.

**(1) Stop Bars**

Stop Bars shall be 24 inches in width. The typical placement is 15 feet from the cross street curb line and shall be four feet in advance of any marked crosswalk. In some cases, that distance can be increased due to possible conflicts with left turn vehicles turning from the cross street and the proper design of crosswalks to accommodate pedestrian movements. However, in no case shall the stop bar be less than four feet or more than 30 feet from the cross street curb line.

Stop Bars should be installed across one or more approaches when any of the following conditions exists:

- When high pedestrian movements (greater than 50 in one hour) cross a stopped approach.
- When a multi-way stop exists involving a major collector street or a street of higher classification.
- At all signalized intersections.
- For stopped approaches at designated school crossings.
- At any location where a STOP sign cannot be placed where vehicles should come to a stop for safety purposes and field observations show a significant amount of traffic needs the extra delineation to enter the intersection safely. In these cases, the stop bar may be placed closer than 15 feet from the cross street if there are no significant pedestrian movements.
- In advance of any marked crosswalk.

**(2) Crosswalks**

Crosswalks shall be installed if any of the following conditions exists:

- For each approach at a signalized intersection unless pedestrians are prohibited from crossing a specific approach.
- For controlled approaches at a designated school crossing.
- At controlled approaches where pedestrian movements exceed 100 in any one hour.

Mid-block crosswalks shall not be allowed on city streets except at established school crossings controlled by school crossing guards.

All crosswalks should be installed using thermoplastic unless the pavement condition has a short life span, in which case paint should be used.

**(3) Word and Symbol Markings**

Pavement words and symbols shall be limited to no more than three lines of information. Pavement words and arrows shall be

used in conjunction with Lane Use Control signs, railroad crossings, continuous left turn lanes, and where needed to provide proper guidance. The font size shall be a minimum of eight feet in height. "SCHOOL" markings are not normally used in the City but can be installed where special emphasis is needed.

#### **G. Traffic Signal Design Requirements**

The owner will be responsible for the design and installation of any traffic signal necessitated by the development. Location of proposed signals shall be based on an approved TIA or as directed by the City Traffic Engineer.

Pull boxes and conduits are required at all proposed or existing signalized intersections to accommodate future and existing signals. There shall be at least one pull box on every corner of the intersection plus one in each median nose and in any islands. All pull boxes shall be connected by 4-inch PVC, Schedule 40 conduits.

Refer to Chapter 6 Capital Improvements of this manual for signal design requirements if signals are required by the development.

#### **H. Fiber Optic Cables**

Fiber optic cables are typically along major roadway and at signalized intersection. When the development is required to construct the major roadway or signalized intersection, the owner will be responsible for installing conduits for the fiber optic cables along the public street and/or at the signalized intersection of the development. Locations of conduits shall be in accordance with the City's network fiber plan. Contact the Network Designer in the Information Technology Department to verify location of any existing signal fiber or City network fiber. Refer to Chapter 6 Capital Improvements of this manual for design requirements if fiber optic conduit installation is required by the development.

#### **I. Streetlight Design Requirements**

When the development of a commercial site requires construction of a public street, the owner will be responsible for the design and construction of the streetlights on the public street. Owner shall also be responsible for the design and construction of streetlights along the perimeter of existing public streets where no streetlights exist.

##### **1. Local and Minor Collector Streets**

###### **a. Placement Criteria**

- Streetlights shall be installed on streets 38 feet wide or less typically at a distance of 4 feet from the curb. They shall be 100 watt open bottom high pressure sodium type.
- Streetlights shall be installed at mid-block locations not less than 250 feet or greater than 500 feet from any adjacent streetlight and on the

inside of each horizontal curve with a 200 feet centerline radius or less.

- Streetlights shall be installed at the end of each cul-de-sac which is 175 ft. or greater from the centerline of the intersecting street to the end of the cul-de-sac.
- Additional streetlights may be required whenever geometric conditions may create a traffic safety hazard that can be reduced by the installation of a streetlight.
- Placement of streetlights along existing roadway shall be coordinated with any existing streetlights along the roadway.

**b. Pole Type**

The standard for streetlight poles is 22 feet mounting height steel telescoping. The City may consider other options such as fiberglass, concrete or other decorative poles with a post top decorative fixture. Spacing of alternate poles will remain the same as standard steel poles. Only one pole type typically will be allowed.

If decorative streetlights are used, owner shall supply the City with 10% of the total light assemblies or a minimum of two poles, arms, and fixtures for future maintenance and damage. Spacing of decorative poles will be the same as standard streetlights when lighting levels on the street pavement meets or exceeds the standard lighting levels.

**2. Major Collector and Arterial Streetlight Design Standards**

**a. Placement Criteria**

- Type III refractors are required at all mid-block locations where intersection criteria does not control locations.
- Streetlights shall be 150 watt HPS cobra head
- Placement of streetlights along existing roadway shall be coordinated with any existing streetlights along the roadway.

**b. Lighting Configurations**

Median Lighting -- Light poles with twin arms and luminaries shall be installed at the center of the median of 4-lane and 6-lane boulevards. Lighting poles within the median of an initial four-lane boulevard planned for expansion to a six-lane boulevard shall be designed such that the poles will not need to be relocated when the roadway is expanded (i.e., at left turn lanes, and transitions for left turn lanes).

Staggered Lighting -- Light poles shall be installed in an alternating pattern within parkways along both sides of the roadway on undivided roadways.

One-side Lighting -- Light poles may be installed within the parkway on one side of the roadway along 4-lane undivided roadways only if staggered lighting is not feasible.

**c. Spacing Requirements**

The standard spacing distance between all poles in non-intersection areas shall be as shown below. Spacing less than standard can be used to clear obstructions and may be increased no more than 15 feet where necessary to avoid conflicts.

<b>Standard Spacing (feet)</b>			
	<b>One-Side Lighting</b>	<b>Median Lighting</b>	<b>Staggered Lighting</b>
<b>Major Collector</b>	160	210	160
<b>Minor Arterial</b>	N/A	210	130
<b>Major Arterial</b>	N/A	190	100

Any deviation requiring a tolerance of more than 15 feet. shall require submittal of calculated  $E_h$  (avg),  $E_h$  (avg)/Min., and Max./Min. values indicating compliance with the design criteria.

$E_h$  (avg) -- The average maintained horizontal illumination in ft. candles shall be a minimum of 0.90.

$E_h$  (avg)/Min. -- The average maintained horizontal illumination value divided by the lowest illumination point encountered within the area of roadway being lighted shall be 3.0 or less.

Max./Min. -- The highest illumination point divided by the lowest illumination point encountered within the area of roadway being lighted shall be 9.0 or less.

**d. Major Intersection Placement**

Type II four way refractors are required at intersections. For major collector and arterial intersections having geometric layouts that vary from those specified, streetlight poles shall be located to achieve the illumination values shown on the figure for the most comparable intersection layout. Alternate designs or intersection lighting locations which vary from those shown in the above referenced figures shall be reviewed by City upon submittal of calculations indicating conformance to lighting design criteria.

For intersection lighting layouts, the PWT shall be consulted to determine if traffic signal poles shall be required in the future at the intersection. If so,

the lighting standards shall be integrated with the traffic signal pole and the pole type will be determined.

**e. Adjustment for Topographic Height Variations**

Where the base of the lighting standard is 5 feet higher or lower than the adjacent top of curb, a non-standard spacing between adjacent poles shall be specifically calculated to meet the required illumination values as specified.

**f. Lateral Clearances**

Poles shall be installed a maximum of 8 feet from the back of the curb for one-side or staggered lighting. If this is in conflict with existing or proposed facilities, an alternative location will be determined.

Streetlight poles shall not be installed within 4 feet of any street, fire hydrant, drainage flume, inlet, driveway or within the drip line of any established tree.

**g. Pole Type Determination**

The standard for streetlight poles is 40 feet mounting height, steel with breakaway base.

**h. Color Determination**

New streetlight pole installation shall be tmemec bronze.

**3. Streetlight Plan Layout**

At a minimum, the streetlight plans shall:

- be on 24" x 36" size sheets.
- have a title block located at the lower right-hand corner of the drawing, and the north representation shall be displayed in an up or right direction.
- show all service poles or transformer pads utilized for streetlight energy source. Include the electric delivery provider's electrical design. Connection to the power source shall be coordinated with the electric delivery service provider.
- be drawn using standard symbols and abbreviations.
- show all utilities and storm drain facilities, including their easements.

**4. Pole contacts**

Other agencies' facilities may not be utilized for installation of streetlights unless approved by PWT.

**5. Utility Easements**

Additional easements may be required depending on the location of the power source. A minimum width of 10 feet located along common lot lines is required for streetlights.

**6. Underground Service Standards**

- All underground connections shall be in accordance with the latest NEC guidelines.
- All underground streetlight services shall be placed in 2-inch PVC Schedule 40 conduit in a trench with a minimum depth of 30 inches.

**7. Overhead Service Standards**

Overhead Service Standard shall be in accordance with the latest NESC and NEC guidelines.

**8. Conductors/Insulation**

Cable and insulation shall be installed in accordance with the following table.

	LOCAL AND MINOR STREETS		MAJOR COLLECTOR AND ARTERIAL STREETS	
	Overhead	Underground	Overhead	Underground
Standard Practice	No	Yes	No	Yes
Stranded Aluminum	Duplex (XLP)	Triplex (XLP)	Duplex (XLP)	N/A
Annealed Copper	N/A	N/A	N/A	2 Insulated Plus One Bare Wire (THHN)
240 Volt	N/A	N/A	Standard	Standard
120 Volt	Standard	Standard	N/A	N/A

**9. Special District Standards**

All streetlights in the Entertainment District shall conform to the Entertainment District Design Standards. All streetlights in the Downtown District shall conform to the Downtown Neighborhood and Downtown Business Design Standards.

**J. Street Signs Design Requirement**

When the development of a commercial site requires construction of a public street, the owner will be responsible for the design and installation of all street signs associated with the street improvements. The owner is will also be responsible for the design and installation of all public street signs necessitated by the development. The street signs shall be fabricated

and installed in accordance with TMUTCD's standards and specifications. Any deviations shall be approved by PWT.

For the street marker blades, the sheeting and lettering shall be 3M Scotchlite High Intensity Series #3870 White and #3870 Blue, or equivalent. White lettering on a blue background shall be used to indicate public streets, whereas blue lettering on a white background shall be used to indicate private streets.

All signs in the Entertainment District shall conform to the Entertainment District Design Standards. All signs in the Downtown District shall conform to the Downtown Neighborhood and Downtown Business Design Standards.

## **Section 5.6 Engineering Division/Department of Public Works & Transportation**

### **A. Right-of-Way**

Right-of-way shall be required in accordance with the Thoroughfare Development Plan, Subdivision Rules and Regulations and Zoning Ordinance.

### **B. Horizontal and Vertical Control**

#### **1. Horizontal Control**

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

#### **2. Vertical Control**

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City's web page.

### **C. Digital File Requirements**

Prior to acceptance of three-party contracts, the owner's engineer shall furnish the City a digital graphics file of the street and drainage construction drawings in .DXF or .DWG format. The information shall be provided on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Closed Storm Sewer System	STORM
Back of Curb	CURB
Right-of-way	ROW
Edge of Sidewalk	SIDEWALK
Open Storm Sewer Systems	CHANNEL

**D. Design Plan Checklist**

A plan review checklist is included in Appendix P. The checklist is used by CDP when reviewing plans, and provides guidance to the engineer as to the type of information that will be required for street and drainage plans.

**E. Street Plan Design Requirements**

When the development of a commercial site requires construction of a public street, the following street plan design requirements shall be used.

**1. Design Speed**

All streets shall be designed and constructed to provide the following design speeds:

<u>Street Type</u>	<u>Design Speed</u>
Arterial	45 miles per hour
Major Collector	40 miles per hour
Minor Collector	35 miles per hour
Local Street	30 miles per hour

**2. Minimum Radius**

The required radius for curb returns at intersections shall be as follows:

Arterial/Arterial	80 feet*
Arterial/Collector (departure side)	80 feet*
Collector/Collector	30 feet
Arterial/All Others	30 feet
Collector/All Others	30 feet
All Others	20 Feet

\*The minimum allowable radius is 35 feet and 30 feet, respectively. See Intersection Geometric Standards in Appendix H.

The minimum radius for the back of curb on a cul-de-sac shall be 39 feet.

**3. Vertical Alignment**

All streets shall be designed and constructed to a minimum grade of 0.5%; however, if the required geotechnical report indicates the soil has a PI greater than or equal to 40, a minimum grade of 1% shall be required.

All streets shall have a maximum grade as follows:

<u>Street Type</u>	<u>Maximum Grade</u>
Arterial	6.0%

Major Collector	8.0%
Minor Collector	8.0%
Local	8.0%

In order to maintain adequate sight distance, all streets shall be designed and constructed to comply with the following minimum vertical curve length for each algebraic percent difference in grade.

<u>Street Type</u>	<u>Crest Curves</u>	<u>Sag Curves</u>
Arterial	120	90
Major Collector	80	70
Minor Collector	50	50
Local	30	40

The following maximum intersection grades involving arterial and major collector roadways shall be used at controlled intersections.

<u>Design Street Type</u>	<u>Intersecting With</u>	<u>Design Street Maximum Grade</u>	<u>Distance</u>
Arterial	Arterial	2%	300 feet
Arterial	Major Collector	3%	300 feet
Major Collector	Arterial	3%	200 feet
Major Collector	Major Collector	3%	200 feet
Minor Collector/Local	Arterial/Major Collector	4%	150 feet

#### 4. Horizontal Alignment

The following minimum centerline radii shall be used in the design of all street construction:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	1000 feet
Major Collector	800 feet
Minor Collector	500 feet
Local	As approved by the Director of PWT
Cul-de-sacs and Loop Streets	50 feet radius to right-of-way line

Reverse curves shall be separated by a tangent section in accordance with the following table:

<u>Type Street</u>	<u>Minimum Tangent Length</u>
Arterial	200 feet
Major Collector	100 feet
Minor Collector	50 feet
Local	As approved by the Director of PWT

Collector or arterial roadways intersecting other collector/arterial roadways shall have the following minimum horizontal centerline approach tangent section length as measured from the nearest right-of-way line of the intersecting street, unless such requirement is waived by the Director of PWT:

<u>Type Street</u>	<u>Intersecting With</u>	<u>Minimum Approach Tangent</u>
Arterial	Arterial	200 feet
Collector	Arterial	150 feet
Collector	Collector	100 feet

**5. Paving Requirements** (Amended Ord #09-030 6/23/09)

Both public and private streets shall be designed in accordance with the requirements outlined below:

- Standard pavement widths and sections shall be constructed on prepared subgrade in accordance with the City of Arlington Standard Details and Specifications. Pavement widths shall be measured from back of curb except for local rural roadways where the width is measured from edge of pavement. The street classification shall be as shown in the Thoroughfare Development Plan. The widths and thicknesses shall be in accordance with the information provided on the typical section details and the following table:

<b>Street Type</b>	<b>Width</b>	<b>Thickness Concrete</b>	<b>Thickness HMAC</b>
Residential/Local Rural <sup>(1)</sup>	28 feet or less	7 inches concrete over 8 inches lime/cement subgrade	5 inches HMAC over 12 inches lime/cement subgrade
Collectors and Minor Arterial	38 feet, 45 feet, or as indicated in Thoroughfare Plan	9 inches concrete over 8 inches lime/cement subgrade	7 inches HMAC over 12 inches lime/cement subgrade
Major Arterial	As indicated in Thoroughfare Plan	9 inches concrete over 12 inches lime/cement subgrade	8 inches HMAC over 16 inches lime/cement subgrade
Private Access Easement	20 feet <sup>(2)</sup>	5 inches over 8" lime/cement subgrade	N/A

<sup>(1)</sup> The PWT has developed details for streets 28 feet wide and greater. Alternative street designs may be allowed with approval of CDP, PWT, and Fire if an adequate level of service is provided. It is the responsibility of the owner's engineer to develop details for constructing alternative roadways. The requirements shall be in accordance with the Subdivision Regulations and this manual. <sup>(2)</sup> The

pavement width of a private access easement shall be increased to 24 feet when it functions as a required fire lane. The width may be reduced if used for a one way alley-way.

- All concrete shall have #4 bars on 24-inch centers.
- All streets shall be constructed with a lime/cement stabilized subgrade in accordance with the above table. The application rate shall be specified in the plans. With the approval from PWT, the owner may request a variance to the above table by submitting a geotechnical report prepared by an engineer indicating an alternate design.
- In small areas, such as the addition of median openings or auxiliary lanes to existing facilities, owner may submit a request to the City to allow alternate pavement sections to match existing and/or alternate subgrade treatment, such as 6-inch cement treated base or 4-inch additional pavement thickness on compacted base.

## **6. Median Openings**

Requests for median openings shall be submitted to the CDP for approval. The following shall be submitted with the request:

- A drawing showing the location and distance to the next median opening. The drawing shall also include any driveways, public streets, and property lines within 600 feet of the requested opening.
- A letter from affected property owners on both sides of the street within 600 feet stating their concurrence of the proposed location of the median opening.

Generally, median openings shall be spaced 600 feet apart (measured nose to nose) on major arterials and 450 feet (600 feet from major intersections) on minor arterials. Median opening noses are typically 12-15 feet beyond the projection of the curb or driveway edge of the facility being served. Median openings may require the construction of left turn lanes. The typical storage length is 150 feet with 150 feet transition. The storage length may be altered based on projected traffic volumes.

If approved, all costs associated with the median opening shall be paid by the owner. The median opening shall be constructed or cost escrowed within 6 months of the date of approval, or the request shall be void.

### **a. Existing Improved Streets**

The owner shall submit construction plans to the CDP for review. The plans shall be in accordance with the standard details. Upon acceptance of the plans, three-party contracts will be required for construction of the opening. All costs associated with the median opening shall be paid by the owner including construction and relocation of utilities and irrigation that may conflict with the opening. If the remainder of the median is less than 8 feet

wide it must be constructed in accordance with City standard median details. The request for a median opening shall be void if the median opening has not been constructed within 6 month of the date of approval.

**b. Unimproved Streets with Construction Drawings Available**

Owner shall hire an engineer to modify the existing plans to include the median opening and prepare a construction cost estimate. The plans shall be in accordance with the standard details. The owner shall escrow the construction cost of the median opening with the City. The cost shall be escrowed within 6 months or the request shall be void.

**c. Proposed Street – No Construction Plans Available**

No median opening requests will be considered until an engineering services contract is initiated for the design of the street.

**7. Sidewalks and Access Ramps**

Sidewalks and access ramps must be constructed in accordance with State and Federal regulations. The owner is responsible for submitting all pertinent information with regard to sidewalks and access ramps to the Texas Department of Licensing and Regulation (TDLR) prior to construction as required. The following describes general requirements for sidewalk and access ramp construction:

- Sidewalks shall be shown on the site construction drawings and shall be constructed by the owner.
- Sidewalks shall be placed within the right-of-way, shall be 4 feet wide and placed 1 foot off the right-of-way line. If necessary, sidewalks may be placed closer to the curb, but no closer than two feet except where site restrictions require the sidewalk to be placed closer to the curb. In these cases, the sidewalk shall be adjacent to the curb and shall be six feet in width.
- If obstructions are within the path of a proposed sidewalk, the sidewalk width and placement may be adjusted to allow the obstruction to remain. In these cases, a minimum sidewalk width of three feet shall be maintained.
- Access ramps shall be designed and constructed at all street intersections.
- When required, sidewalks along TxDOT facilities shall be 5 feet wide and located 4 feet off the right-of-way line.

**F. Drainage Plan Design Requirements**

When the development of a commercial site requires the construction of drainage facilities, the following drainage plan design requirements shall be used.

**1. Peak Runoff**

The City may have flow rates available for watersheds. If so, these shall be used in the drainage calculations. Where no flow rates are available, a unit hydrograph technique (WinTR55, TR20, HEC1, etc.) is preferred and recommended. The Modified Rational Method (Q=CCaIA) may be used for calculating peak runoff from watersheds of less than 20 acres. The Rational Method is not appropriate for designs other than small side ditches, median ditches, and driveway pipes.

**a. Runoff Coefficients**

Stormwater runoff shall be based on a fully urbanized watershed. The most intense land use zoning shall be used to determine the runoff coefficient for the fully urbanized watershed. The following table gives values for runoff coefficients that shall be used in the determination of stormwater runoff if the Modified Method is used.

**RUNOFF COEFFICIENT "C"**

Zoning or Land Use	Hydrologic Soil Groups			
	A	B	C	D
Parks and Permanent Open Space	.35	.37	.39	.41
"E" Zoning	.43	.45	.47	.50
"R" Zoning	.50	.52	.55	.58
"D" and "R1" Zoning	.60	.63	.66	.70
"R2" and "MH" Zoning	.65	.68	.72	.76
"TH" Zoning	.65	.70	.77	.80
Multi-family Zoning	.65	.71	.87	.90
Commercial, Schools & Churches	.95	.96	.98	1.00
Central Business District/Industrial	1.00	1.00	1.00	1.00

**SOIL GROUP CLASSIFICATION**

- Group A Deep sand, aggregated silts
- Group B Sandy loam
- Group C Clay loam, shallow sandy loam
- Group D Heavy plastic clays

**b. Rational Method Antecedent Precipitation Factor (C<sub>a</sub>)**

C<sub>a</sub> values to be used are shown in the following table:

**ANTECEDENT PRECIPITATION FACTOR "C<sub>a</sub>"**

Recurrence Interval (Years)	"C <sub>a</sub> "
5	1.00
25	1.10
100	1.25

NOTE: The product of CC<sub>a</sub> shall not exceed 1.0.

**c. Intensity**

For times of concentration less than or equal to one hour, Hydro-35 shall be used to determine the rainfall intensity. For times of concentration greater than one hour, TP-40 shall be used to determine the rainfall intensity. Refer to Appendix K.

**d. Time of Concentration**

The time of concentration shall be based on fully urbanized conditions for the upstream watershed. The total time of concentration shall include overland and channelized flow. The maximum length allowed for the overland portion of the calculation is 50 feet. The remainder of the watershed shall be considered channelized flow. Refer to Appendix L to determine the velocity, which is used to calculate the time of concentration or utilize the WinTR55 tool to calculate the time of concentration.

**e. Storm Frequency**

The following table shows the minimum design frequency to be used when designing drainage facilities:

<b><u>Type Of Facility</u></b>	<b><u>Minimum Design Frequency</u></b>
On-grade inlets	5 years
Low point inlets	25 years
Storm sewers upstream of low points	5 years
Storm sewers downstream of low points	25 years
Street right-of-way	100 years
Channels and creeks	25 years
Creek culverts and bridges	25 years
Permanent bar ditch and associated culverts	5 years

\*Depending on the amount of flow in the right-of-way, additional drainage infrastructure may be required to reduce the flow in order to protect the health, safety and welfare of the general public.

**f. Drainage Areas**

The drainage area shall be based on fully urbanized areas within and contributing to the development and shall follow natural drainage features and shall not be diverted. Existing or anticipated features modified by the development shall be considered when outlining drainage areas. A drainage area map shall be prepared that complies with the checklist in Appendix P.

**2. Roughness Coefficients and Permissible Velocities**

The following table provides roughness coefficients and permissible velocities:

Type of Section/Feature	Coefficient of Roughness “n”	Maximum Permissible Velocity fps <sup>1</sup>
I. Natural Creeks		
A. Creek Section		
1. Some grass and weeds; little or no brush	0.045	3.0 to 6.0
2. Dense growth of grass or brush	0.055	3.0 to 6.0
3. Dense brush and trees	0.065	3.0 to 6.0
B. Floodplain/Overbank Areas		
1. Grass, Weeds, Some Brush and Trees	0.045	3.0 to 6.0
2. Dense Grass, Weeds or Brush	0.055	3.0 to 6.0
3. Dense Brush and Trees	0.080	3.0 to 6.0
II. Constructed/Modified Open Channels		
A. Gabion Channels	0.035	Receiving stream limit
B. Pre-Cast Concrete Block Channels	0.035	Receiving stream limit
C. Natural Stone Channels	0.035	Receiving stream limit
D. Grass Vegetated Channels (maintained)	0.035	3.0 to 6.0
E. Concrete Channels	0.016	Receiving stream limit
F. Rock Rip-Rap Channels	0.035	5.0 to 10.0
III. Streets		
A. Concrete	0.015	N/A
B. Asphalt	0.015	N/A
IV. Pipe		
A. Reinforced Concrete Pipe	0.013	Receiving stream limit
B. Corrugated Metal Pipe <sup>1</sup>	0.022	Receiving stream limit
C. High Density Polyethylene Pipe <sup>1</sup>	0.011	Receiving stream limit

<sup>1</sup> If approved by PWT

### 3. Street Capacity Design

Local and minor collector streets shall be designed to flow less than curb deep during a 5-year storm. For major collectors and minor arterials, ½ of the inside lane shall remain dry during the design storm. For major arterials, the full inside lane (5<sup>th</sup> and 6<sup>th</sup> lanes) shall remain dry for the design storm. The runoff from the 100-year storm shall be contained within the right-of-way and shall not exceed 0.2 feet above the lowest top of curb.

### 4. Closed System Design

Closed systems are permitted only when the Director of PWT determines that they are appropriate based upon site constraints such as easements, utility infrastructures, etc., and hydraulic conditions. If permitted by PWT, the closed system shall be connected to an existing system or extended until it reaches an open channel or natural creek.

**a. Drainage Easements**

A drainage easement shall be dedicated for all closed systems. The minimum width of a drainage easement is 15 feet. When combined with other utilities, the minimum width is 20 feet. The easement may need to be larger to accommodate systems with pipe sizes larger than 60 inches or deep systems.

**b. Hydraulic Grade Line (HGL)**

The hydraulic grade line (HGL) shall be shown on the plans and shall be below the bottom of the subgrade for systems under pavement. For systems outside of the pavement, the HGL shall be lower than all inlet throats and shall not exceed one pipe size above the top of pipe. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher.

**c. Head Losses**

The design techniques and methods used in the determination of all head losses shall be approved by the PWT. The City of Fort Worth's Storm Drainage Criteria and Design Manual is an acceptable guide for calculating head losses.

**d. Entrance/Outfall Structures**

Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm sewer systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow. The sloped end treatment shall be a 6H:1V end section. Storm sewer systems that outfall to a creek shall be extended to the centerline of the creek. Gabion mattresses shall be installed at the outfall structure to lower velocities and prevent erosion.

**e. Pipe**

Underground systems shall be constructed with Class III reinforced concrete pipe. The pipe size shall be a minimum of 18 inches. A higher class of pipe may be required when constructed shallow or deep. The City may allow plastic pipe for certain applications; however, plastic pipe is never allowed under street paving.

All pipe bends and fittings shall be prefabricated. Collar connections shall be in accordance with the City standards.

Radius pipe is allowed and shall be placed in accordance with the manufacturer's lay schedule.

Field connections may be allowed when the main pipe is twice the diameter of the lateral; however, field connections are not allowed when the lateral slope is greater than 10 percent.

**f. Access Points**

A manhole or inlet with minimum 36-inch RCP lateral shall be constructed every 500 feet to provide access into the closed system.

**g. Inlets**

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all concrete streets except local streets. Grate inlets are not allowed on public systems. Drop/Y inlets may be utilized to intercept offsite drainage.

**5. Open System Design**

A development that includes, or is adjacent to a creek, shall submit a hydraulic analysis (flood study) to determine easements and minimum finished floor (MFF) elevations, or to modify existing floodplain or floodway. The requirements for each flood study differ according to the existing creek designation (i.e., within a FEMA designated floodplain) and whether improvements are proposed for the creek. This section will address the requirements for flood studies.

**a. Unimproved Creeks (Natural)**

For a creek in its natural undisturbed state, a flood study shall be submitted to determine the easement limits and MFF elevations for the property. The requirements for this type of submittal are included in the Flood Study Matrix in this section.

A drainage easement based upon its natural undisturbed state shall be dedicated for the 25-year storm event for the fully urbanized watershed conditions. The study shall also define the Erosion Clear Zone (ECZ). If the ECZ is outside the limits of the easement, this area shall be shown. No improvements will be allowed within this area. An additional 25 feet from the top of the bank shall be delineated for the Creek Buffer Zone (CBZ) in accordance with the Subdivision Regulations. Cross sections of the creek shall be provided to verify the limits of the ECZ and the CBZ.

Where natural creeks connect to improved systems, permanent transitional materials are required. Additionally, in areas along natural creeks where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be required to stabilize the creek. Stabilization materials shall be approved by PWT.

**b. Constructed/Modified Open Channels**

A flood study will be required for an existing or proposed constructed/modified open channel. The study shall define the easement limits, 100-year flood and MFF elevations. If the open channel is located in a FEMA designated floodplain (i.e., on the FIRM), then the study will be sent to FEMA. Additional hydraulic analyses are required and shall be in accordance with the information outlined in Flood Study Matrix in this section.

If the modifications are located between the top of banks, then the plans shall be submitted to the Army Corps of Engineers for review and permitting.

A request for a constructed or modified open channel shall be evaluated by the Director of the PWT, and permitted when appropriate based on site constraints and hydraulic conditions. If permitted, the constructed or modified open channel design may incorporate the following:

- Gabions
- Pre-cast concrete blocks
- Native stone
- Vegetation
- Bio-engineered materials

A drainage easement shall be dedicated to include a channel designed to convey the runoff from the 25-year storm for the fully urbanized watershed conditions plus one foot of freeboard. The drainage easement shall also contain 10 feet on each side of the channel for access. Additional easement may be needed at specific locations for access to the feature for maintenance.

A Channel Buffer Zone (CBZ) may also be required depending on the type of materials used to improve the creek. Refer to the Subdivision Regulations for details. Cross sections of the channel shall be provided to verify the limits of the CBZ

Where constructed or modified open channels connect to a closed system, natural creeks, or a channel of a different material, a transitional area shall be designed. Channels shall be designed with the following minimum criteria:

	Concrete	Vegetated	Other Material
Side slopes	2:1	4:1	*
Bottom width	6 feet	6 feet	6 feet

\* As specified by manufacturer or design.

For channels with vegetated bottoms, the design shall include a pilot channel with an invert which conveys low flows and allows for maintenance. .

For earthen channels, see Protection and Restoration of Linear Park Land in this chapter for recommended plant and vegetation species.

## **6. FEMA Designated Floodplain**

In order to remove all or portions of property from the floodplain, or to improve a creek and construct a channel (concrete, earthen or other approved material), owner shall submit the hydraulic analyses to the City for acceptance. Upon acceptance by the City, owner shall then forward the analyses to FEMA for approval. If the 100-year ultimate development floodplain is not dedicated as a drainage easement, any fill to be placed in a FEMA designated floodplain shall require 1:1 hydraulically equivalent compensatory storage. There are several types of map changes available through FEMA. The following lists the types of map changes available:

### **a. CLOMA – Conditional Letter of Map Amendment**

A CLOMA is FEMA’s concurrence that a proposed structure upon construction would be excluded from the Special Flood Hazard Area (SFHA) shown on the effective Flood Insurance rate Map (FIRM). The letter becomes effective on the date approved by FEMA. The letter does not revise an effective FIRM; it indicates whether the project, if built as proposed, will be recognized by FEMA.

### **b. LOMA – Letter of Map Amendment**

A LOMA is an official amendment, by letter, to an effective FIRM. This is typically used to correct an error on the map and is based on current detailed topographic information. A LOMA establishes a property/structure’s location in relation to the SFHA based on natural ground. The letter becomes effective on the date approved by FEMA.

### **c. CLOMR-F – Conditional Letter of Map Revision Based on Fill**

A CLOMR-F is FEMA’s concurrence that a proposed structure/property involving the placement of fill outside of the floodway would exclude an area from the SFHA shown on the FIRM. The letter becomes effective on the date approved by FEMA. This letter does not revise an effective FIRM, it indicates whether the project, if built as proposed, will be recognized by FEMA.

### **d. LOMR-F – Letter of Map Revision Based on Fill**

A LOMR-F is an official revision, by letter, to an effective FIRM. A LOMR-F provides FEMA’s determination concerning whether a structure or parcel has been elevated on fill above the Base Flood Elevation (BFE) and

excluded from the SFHA. The letter becomes effective on the date specified on the LOMR-F.

**e. CLOMR – Conditional Letter of Map Revision**

A CLOMR is FEMA’s concurrence that a proposed project that would affect the hydrologic and/or hydraulic characteristics of a channel/creek and thus result in the modification of the existing regulatory floodway or effective base flood elevations (BFEs). The letter becomes effective on the date approved by FEMA. This letter does not revise an effective FIRM; it indicates whether the project, if built as proposed, will be recognized by FEMA.

**f. LOMR – Letter of Map Revision**

A LOMR is an official revision, by letter, to an effective FIRM. A LOMR may change flood insurance risk zones, floodplain and/or floodway boundary delineations, and BFE. The letter becomes effective on the date specified on the LOMR.

**7. Flood Study Submittal Requirements**

**a. Structures and Property**

In order to remove any portion of a property from a FEMA designed floodplain, either a LOMA or LOMR-F must be submitted. The FEMA’s MT-1 form is used for CLOMA, LOMA, CLOMR-F, and LOMR-F. To remove an entire lot and structure from the SFHA, both the lowest point on the lot and the lowest floor of the structure must be at or above the 100-year flood elevation. The community must determine that the land and any existing or proposed structures to be removed from the SFHA are “reasonably safe from flooding.” Follow the directions for the MT-1 for submittal. The owner shall submit the information to the City. Upon acceptance by the City, owner shall forward the information to FEMA for approval.

New or substantially improved structures shall be placed 2 feet above the fully urbanized 100-year flood elevation.

**b. Unimproved Creeks and Constructed/Modified Open Channels**

The following information shall be submitted for all flood studies.

- 1) Letter/report from the Engineer that explains the purpose of the study, (i.e., to define easement limits, determine minimum finished floor elevations, revise the floodplain/floodway, etc.), describes the project and details all information submitted.
- 2) Hydrology

- Provide a current drainage area map
- Provide a proposed drainage area map – (include all offsite areas and adjacent subdivisions)
- Provide all hydrology computations and describe the methods used
- Provide channel cross sections showing the Erosion Clear Zone, Creek Buffer Zone, property lines, easement lines, 100 year floodplain, and floodway.
- Any other calculations – including verification that the downstream systems (bridges, pipes, bar ditches, etc.) are designed to handle the increased runoff.

3) Hydraulics

- Provide a site map showing existing topography and cross section locations
- Provide a site map showing proposed contours and cross section locations
- Provide the required HEC runs (see the following sections for details)
- Provide corresponding maps for each HEC run submitted.

4) Submit the flood study in a bound notebook with all pertinent information included. In addition to the above information, an MT-2 form must be filled out and included in the report if the information will be submitted to FEMA.

**c. Flood Study Matrix**

Various HEC runs are required to establish criteria set by the City and FEMA. The matrix below is an attempt to clarify which HEC runs are required for the type of creek and improvements proposed. The matrix is divided into creek type (i.e., whether the creek is proposed to remain in its natural (unimproved) condition or constructed/modified open channel. For each type, the creek is further classified as mapped (FEMA designated Zones A and AE), or unmapped. For the specific type and classification of the creek, the following matrix indicates the HEC runs that are required with the Flood Study submittal. Additional HEC runs may be required depending on the analysis.

Flood Study Matrix							
	FEMA Class	City		FEMA			
		1	2	3	4	5	6
Unimproved Creeks	Mapped Zones A & AE	x	x				
	Unmapped	x	x				

Constructed/Modified Open Channels	Mapped Zone A	x	x			x	x
	Mapped Zone AE	x	X	x	x	x	x
	Unmapped	x	X				
<u>HEC Runs</u>							
Type 1: 25-year fully urbanized conditions model							
Type 2: 100-year fully urbanized conditions model							
Type 3: Duplicate effective model							
Type 4: Corrected effective model							
Type 5: Existing or pre-project conditions model							
Type 6: Revised or post-project conditions model							

1) Unimproved Creeks (Natural)

The following HEC runs are required when a natural creek is mapped or unmapped. The information will not be submitted to FEMA.

- HEC analysis based on the 25-year storm event for a fully urbanized watershed (used to define the minimum easement). The 25-year storm event analysis is not required if the 100-year fully urbanized watershed drainage easement is granted.
- HEC analysis based on the 100-year storm event for a fully urbanized watershed (used to define the minimum finished floor (MFF) elevations).

2) Constructed/Modified Open Channels

The following HEC runs will be required when the development changes the FIRM or cross sections of the creek significantly. Some of the information will be submitted to FEMA (CLOMR/LOMR).

The following information is required by the City for all mapped or unmapped creeks. This information will not be submitted to FEMA.

- HEC analysis based on the 25-year storm event for a fully urbanized watershed (used to define the minimum easement). The 25-year storm event analysis is not required if the 100-year fully urbanized watershed drainage easement is granted.
- HEC analysis based on the 100-year storm event for a fully urbanized watershed (used to define the MFF elevations).

The following HEC models are required and will be sent to FEMA for review if the creek is within Zone A:

- HEC model based on existing or pre-project conditions – to reflect current conditions prior to the construction of the project using current cross sections and flows from development within the drainage area since the date of effective model.
- HEC model based on revised or post-project conditions – based on current flows plus additional flow caused by the development.

The following additional HEC models are required and will be sent to FEMA for review if the creek is within Zone AE:

- Duplicate Effective Model – model used in the effective Flood Insurance Study (can be obtained from FEMA).
- Corrected Effective Model - corrects any errors that occur in the duplicate effective model, adds cross sections, or incorporates more detailed topographic information.

It is the responsibility of the owner to obtain all required local, state and federal permits including, but not limited to the Corps of Engineers.

## **8. Drainage Easements**

### **a. Unimproved Creeks**

The minimum easement is the 25-year fully urbanized floodplain. In addition, the Erosion Clear Zone and the Creek Buffer Zone must also be considered and may be outside the easement. Refer to the Subdivision Regulations and this manual for details.

### **b. Constructed/Modified Open Channels**

The minimum easement is the width of the channel, which shall hold the runoff from the 25-year storm for fully urbanized conditions plus one foot of freeboard. An additional 10 feet shall be dedicated on either side of the channel for access and maintenance. When constructed with porous materials or when the channel is vegetated, the Creek Buffer Zone shall be included. Refer to the Subdivision Regulations and this manual for details.

## **9. Storage (Detention/Retention)**

Stormwater storage shall be designed and constructed with any development when downstream structural flooding is known or anticipated or when the capacity of downstream drainage system is exceeded. The stormwater release rate from the proposed development shall not be greater than the pre-developed condition of the site.

For a detention facility, the following criteria shall apply:

- The release rate of this detention facility shall not exceed downstream capacity.
- In cases of structural flooding, the detention facility must detain the difference between the pre and post developed flows.

The storage and release rates from a post-construction landuse shall be evaluated for the 5, 25 and 100-year storm events. The release velocities shall be designed to minimize erosion downstream of the facility. A minimum of one foot of freeboard shall be provided.

All above ground facilities that store more than a total depth of 4 feet shall be designed to meet all state and federal criteria for small dams.

In lieu of the storage, the owner may employ a Professional Engineer to document that the excess flow will not:

- be detrimental or hazardous to structures (buildings),
- be detrimental or hazardous to vehicular or pedestrian traffic,
- increase the velocity of a receiving natural stream by more than 5.0%, or
- change flood heights on adjacent properties by 0.1 feet or more.

Acceptable design methods include computer model methods outlined in FEMA's approved Hydraulic Models: Determination of Water-Surface Elevation for Riverine Analysis list or manually using the Step Method.

## **10. Positive Overflow**

Positive overflow shall be evaluated for the entire development. Positive overflow means conveying the difference between the 100-year flow and the design frequency flow in a secondary drainage feature without flooding structures. The secondary drainage feature may be a street, a concrete flume or other permanent facility. When positive overflow is conveyed between lots, it shall be contained within a concrete flume at least 4 feet wide (face to face) or a vegetated swale sized to carry the overflow and constructed in a drainage easement between lots.

## **11. Concentrated Runoff from Development**

In areas where concentrated runoff leaves the development, the following information shall be provided:

- The 5, 25 and 100-year design discharges.
- The depth of inundation of these discharges.
- The impacts of the 100-year discharge on flooding, stream channel stability and water quality on existing and proposed off-site facilities from the point at which the runoff leaves the development downstream to the first hydraulic structure on a studied stream (either FEMA FIRM or previously accepted drainage study submitted to the City of Arlington).

Where drainage features such as storm sewer systems, ditches, channels, and natural creeks are available to receive concentrated runoff, the design storm shall be collected on-site and connected to the feature. Calculations shall be performed to demonstrate that each feature receiving runoff is an adequate facility (runoff from the development will not exceed the capacity of the feature), and presented during the Pre-Application Conference.

Upon analysis of the information submitted, the owner may be required to provide facilities to address negative impacts from the 100-year discharge. Mitigation plans shall be prepared and submitted as part of the Preliminary Drainage Plan which include, but are not limited to, all necessary on-site and off-site improvements including storage designed in accordance with Section 9 above, storm drainage systems, channel modifications, driveway adjustments and culvert improvements.

When offsite grading is required or the development discharges concentrated flow on an adjacent property, a Notarized Letter of Permission or drainage easement from the affected property owner(s) will be required. The Notarized Letter of Permission shall be in a form approved by the City. Generally, if the purpose for the Notarized Letter of Permission is for a feature that requires maintenance by the affected property owner then the Notarized Letter of Permission shall be filed with DRTCT and shall be a covenant running with the land. Sample of letter is available at PWT..

## **12. Site Grading**

The construction drawings shall include a site-grading plan designed in accordance with the drainage area map. The site-grading plan shall show existing and proposed contours and any additional information to clearly show how the site will be graded.

## **13. Minimum Finished Floor Elevation**

The City reserves the right to require minimum finished floor elevations on any lot. Minimum finished floor elevations are required for all lots located in the floodplain or near open drainage features and shall be set 2 feet above the 100-year fully urbanized water surface elevation. Elevation certificates will be required for lots located in the floodplain. Refer to the FEMA website for the most current version.

**14. Miscellaneous**

**a. Flumes**

Flumes constructed between lots and/or are visible from a street shall be constructed with alternative materials or finishes in lieu of traditional reinforced concrete to soften the appearance. Examples of acceptable alternatives are colored concrete, or concrete pavers. Other alternatives may be submitted with the construction plans and will be evaluated for acceptance.

Flumes are not allowed in lieu of an underground drainage system without approval of the PWT.

**b. Temporary Tie-ins to County-type Roads**

Tie-ins to existing county-type roadways planned for future improvements are considered temporary. Culverts under driveways and roadways shall be a minimum of 18 inches and designed to carry the 5-year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow. If the driveway or roadway is located in an area of shallow bar ditches and a culvert is not feasible, the driveway or roadway shall be constructed with an invert. Other requirements are noted on the typical detail.

**c. Trinity River Corridor Development Certificate (CDC)**

The Corridor Development Certificate (CDC) process is a regional process used to stabilize flood risks along the Trinity River. The CDC process does not necessarily prohibit floodplain development, but ensures that any development that occurs in the floodplain will not raise flood water levels or reduce valley storage capacity.

While the City retains ultimate control over its floodplain permitting decisions, other cities along the Trinity River may review and comment on projects throughout the corridor.

The CDC permit is required for any development activities proposed within the Trinity River floodplain. A technical review of the application is conducted by the U.S. Army Corps of Engineers and a fee is charged to the owner to recover review costs. The requirements for the CDC permit may be obtained from the PWT or the NCTCOG.

**G. TxDOT Submittal**

A permit from TxDOT is required when constructing facilities within state right-of-way. Three sets of 11" x 17" plans shall be submitted to the CDP who will forward the plans to TxDOT for review. A permit from the TxDOT shall be obtained prior to beginning work.

## **H. Construction Requirements**

### **1. Release for Early Grading**

- A. In accordance with the Subdivision Regulations, the City will not allow construction of any public improvement or issue permits for any construction activity until the plat is approved and filed with the county. Upon written request from the owner, the PWT Director may allow the construction of public improvements prior to the plat being filed with accepted plans and inspection. The owner must demonstrate that an inability to file the plat within a reasonable timeframe is the result of filing requirements that do not have a substantive impact upon the development of the land. Should the City allow the development of public improvements prior to plat filing, the improvements will not be accepted until a plat is filed of record. No grading, clearing or fill shall commence without a SWPPP and prior approval of CDP.
- B. Upon written request from the owner, the Director may allow early grading prior to the construction plans being accepted or plat being filed under the following conditions:
- No soil disturbance, including grading, clearing, fill or removal of concrete in the case of demolition shall commence without an approved and implemented SWPPP
  - The site grading plan shall be substantially complete.
  - Work is limited to grading activity only.
  - Early grading has been approved by the Landscape Administrator
  - The owner shall accept any responsibilities for subsequent revisions prior to final grading plans acceptance.

### **2. Fill**

If fill has been placed on areas of proposed roadways without City inspections, the owner shall provide compaction testing reports to ensure proper compaction was attained and the quality of the fill is acceptable prior to proceeding with construction. The testing will be at the owner's expense and be performed by a geotechnical engineering company approved by the PWT.

### **3. Construction Responsibility**

The owner shall be responsible for all improvements required for the development of the subdivision, including any necessary offsite facilities and construction staking. If construction is not feasible at the time of site development, the owner may request to escrow the costs with the City. The escrow amount shall be equivalent to the owner's share of the construction cost plus actual engineering cost. The City shall determine whether escrow will be accepted in lieu of construction. The escrow shall not be subject to refund.

### **4. As-built Letter/Plans**

Prior to final inspection being performed, an as-built letter prepared by the engineer or architect shall be submitted. The letter shall state the site grading and drainage improvements are constructed in accordance with the plans. The following information may be requested with the as-built letter:

Paving

Survey data/cross sections  
Subgrade densities and thickness  
Lime application rate  
Steel size and placement  
Concrete thickness and strength

Drainage

Survey data/cross sections  
Pipe embedment  
Pipe placement  
Pipe connections  
Pipe sizes  
Ditch backfill and densities  
Steel size and placement for structures  
Concrete thickness and strength for structures

If the improvements were not constructed in accordance with the plans, appropriate documentation shall be provided to substantiate any changes. If changes were made to public facilities, the City shall require the engineer to document field changes by submitted certified as-built plans.

**5. Standard Specifications (Street and Drainage Facilities)**

Street and drainage improvements shall be constructed in accordance with the most recent City of Arlington Special Provisions and the Standard Specifications for Public Works Construction as issued by the North Central Texas Council of Governments (NCTCOG), which is commonly referred to as the standard specifications or NCTCOG specifications. Where any discrepancies occur between the Special Provisions and NCTCOG specifications, the Special Provisions shall govern.

**6. Typical Details (Street and Drainage)**

Street and drainage improvements shall be constructed in accordance with the City's typical details. These details may be obtained through the City's web site or by obtaining a CD-ROM from the PWT. The details are subject to change and it is the responsibility of the engineer to use the most current details. If a detail is not available, it is the responsibility of the design engineer to provide the detail in the plans.

**I. Contractor Requirements – Public Improvements**

**1. Pre-qualification**

All public paving and drainage improvements shall be constructed by a contractor employed by the owner and pre-qualified by the City. If the contractor has not been pre-qualified, the contractor shall complete a pre-qualification form indicating the type of work for which the contractor desires to be pre-qualified. The information will be reviewed by the PWT and the contractor will be notified of pre-qualification status. Allow up to three weeks for this process. Should the contractor's pre-qualification be denied, the owner shall select a contractor that is pre-qualified or one that is able to obtain pre-qualification with the City of Arlington. Pre-qualification forms for paving and drainage projects are available in the PWT or on the City's web site.

## **2. Contract Requirements**

Standard Three-Party Contracts executed by the owner, contractor, and the City are required for construction of all public improvements. The contract shall provide for 100-percent performance bond, payment, and maintenance bonds, except when the contract is less than \$25,000. When the contract is less than \$25,000, only a maintenance bond is required. If the stand-alone streetlight and/or street sign contract is less than \$5,000, the Director of PWT may waive the maintenance bond requirements. The bonds shall not be executed prior to the date of execution of the contract. An insurance certificate with coverage approved by the City is also required with the contract documents. The expiration date of the insurance policy shall not be prior to the completion of the project. Additionally, an administration and inspection fee established by the City (refer to Chapter 3 of this manual) shall be paid prior to commencing construction. A trench safety plan shall also be submitted with the contract.

## **3. Traffic Control Plan**

When construction impacts existing roadways, a detailed traffic control plan shall be submitted with the contract. All traffic control plans shall be in accordance with the City's Work Traffic Control Manual and the Texas Manual on Uniform Traffic Control Devices. The City's Work Traffic Control Manual is available at the PWT. The site-specific plan shall be submitted to the CDP for approval 10 working days prior to beginning construction.

## **4. Inspection Requirements**

The contractor shall notify the PWT 48 hours prior to the start of any construction of public facilities. The contractor shall also ensure that, when applicable, proper authorities with TXDOT, franchise utility companies, railroads, or any other affected entities are notified.

## **Section 5.7 Fire Department**

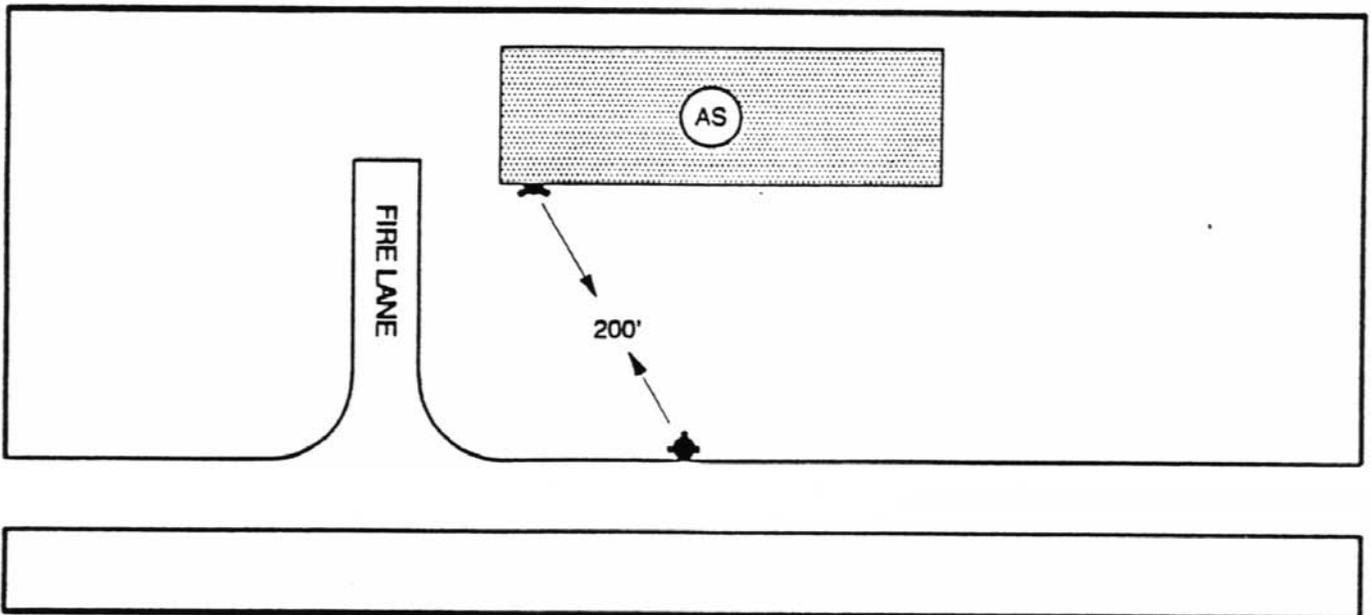
### **A. Fire Protection**

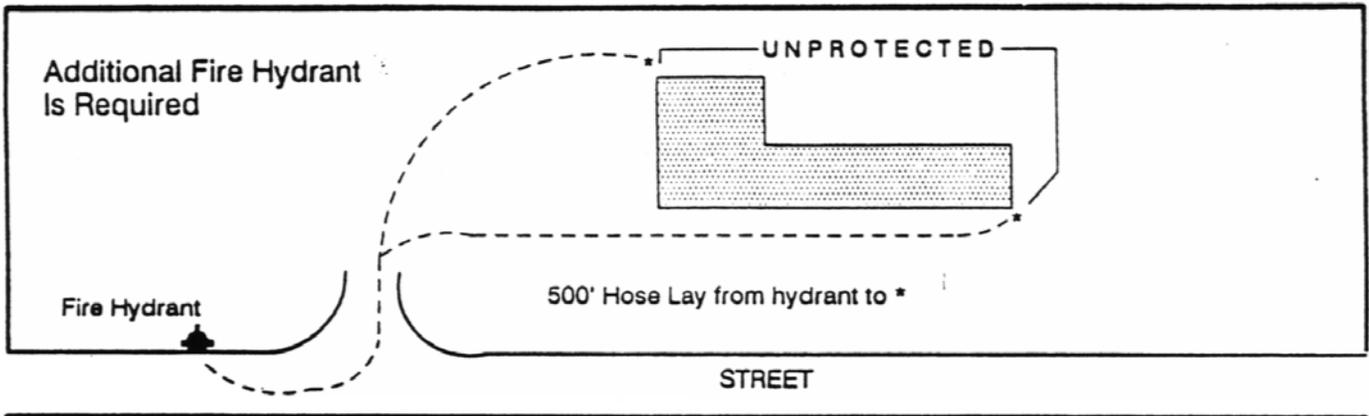
**1. Water Lines**

- An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are constructed, in accordance with the Fire Code. Total fire flow requirements depend upon the type of construction and number of square feet.
- In all cases, it is the responsibility of the owner to provide adequate water line piping capacity in order to provide the minimum water flow.

**2. Hydrants**

- An additional fire hydrant shall be required for every 2,000 gallons per minute (gpm) or portion of fire flow required. (Example: Fire flow of 3,100 gpm. is required. Two fire hydrants shall be required to supply this amount).
- For all land uses except single family and duplex residences, fire hydrants are required within 500 feet of all exterior portions of the building. The distance shall be equal to the laying distance for fire apparatus hose lines along public street and fire lanes from the nearest water supply.
- A fire hydrant is required within 200 feet of lay distance from the fire department connection for a standpipe or fire sprinkler system.
- When the street is designated on the Thoroughfare Development Plan as a minor arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians, regardless of size, shall have fire hydrants on the same side as the construction.





- All required fire hydrants shall be in place and accepted before any construction continues above the slab.
- A clear space of 3 feet shall be maintained around all fire hydrants.
- For insurance and reliability, the Fire Department prefers and encourages looped water systems for fire hydrant supply lines. Minimum pipe sizing for private looped fire protection water lines shall be determined by the Fire Department.
- As an acceptable alternative to looped fire supply lines, dead-end water lines shall meet the following requirements for minimum pipe sizes:
  - one hydrant, max. 150 feet - 6 in.
  - one hydrant, max. 500 feet - 8 in.
  - one hydrant and fire sprinkler supply, max. 150 feet -8 in.
  - one hydrant and fire sprinkler supply, max. 500 feet- 10 in.
  - two hydrants, maximum 500 feet - 10 inch
  - three hydrants or two hydrants and fire sprinkler supply - not permitted on dead-end line
- Wall hydrants are to be used only where fire lane access is not possible or where otherwise required by the policy for fire lanes. Wall hydrants are not allowed as an alternative to fire hydrants.

### 3. Fire Sprinkler Systems

All underground piping, beginning at the point where water is used exclusively for sprinklers, shall be installed by a State certified fire sprinkler firm.

- Pipe depth shall be 42 inches minimum and 60 inches maximum to top of pipe.

- In all cases, clean sand backfill shall be provided a minimum of 6 inches around pipe. In rock, tamped backfill shall be used six inches under and around the pipe and at least two feet above the pipe, per NFPA.
- Standard thrust blocks shall be provided at each change in direction and at all tees, hydrants, plugs, caps, and bends.
- All underground mains shall have a clearance of 2 feet to any other utility or obstruction.
- All plans shall have the registration number of a State certified firm and RME number with original signature.
- A fire hydrant shall be installed no more than 200 feet from the Fire Department connection for a standpipe or automatic sprinkler system. The Fire Department Connection shall be within 50 feet of a fire lane or street.

## **B. Fire Department Connection**

All fire department connections shall be 4-inch Storz connections. The permanent Storz adapter shall be constructed of high strength, lightweight, corrosion resistant aluminum alloy capable of being securely attached to standpipe/sprinkler outlets designed for fire department Storz connections. The Storz lug connection shall conform to industry standards. The hose-sealing surface shall consist of a machined metal seat to eliminate rubber gaskets, coated to protect against long term exposure to the environment. The Storz connection shall connect to the pipe outlet using National Standard Thread. The connection shall be placed between 30 and 48 inches off grade and angled downward at a 30° angle. A semi-permanent ¼" mesh screen, constructed of corrosion resistant metal shall be provided inside the Storz adapter.

A 4-inch Knox Storz aluminum cap with chain or cable shall be provided for the fire department connection. For each additional 1500 gpm required or fraction thereof, an additional 4" Storz connection is required.

## **C. Fire Lane Requirements**

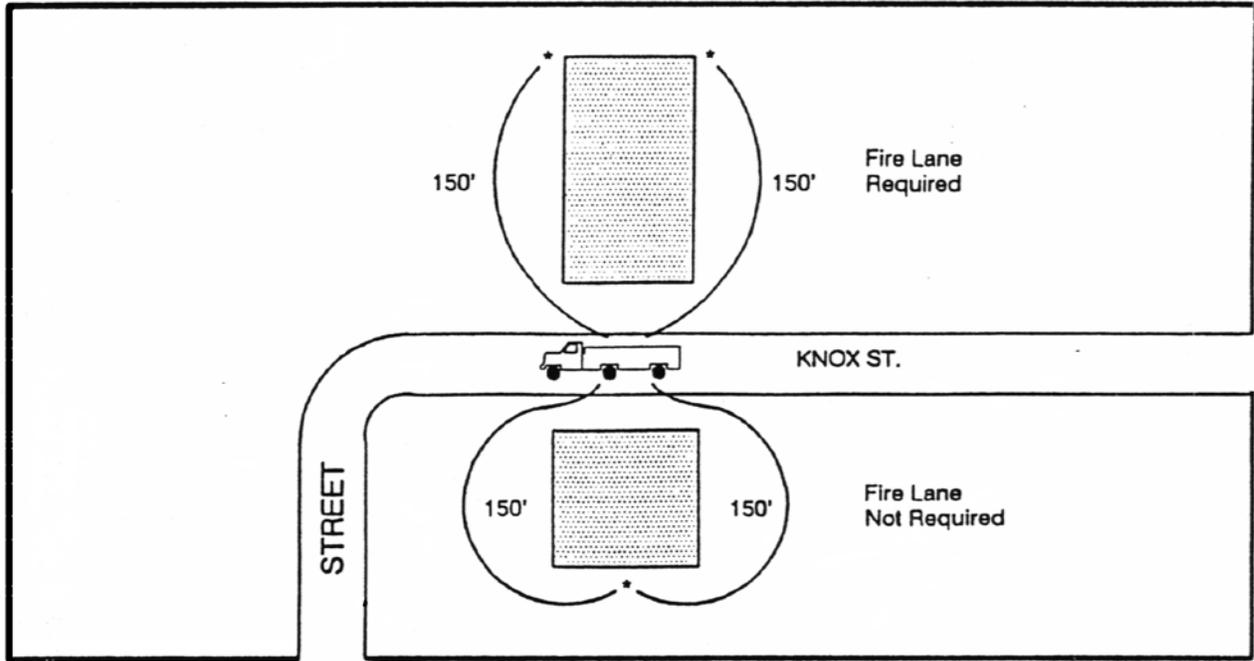
### **1. Construction Requirements**

To provide adequate emergency vehicle access all required streets or fire lanes be installed and accepted before any construction goes above the slab.

### **2. Hose Lay Distance**

All buildings or structures shall be constructed in such a way that all ground level, exterior sides of the building are within 150 feet of the dedicated street or fire lane. The 150 feet is measured along the route necessary to extend fire hose lines around

the building. If the 150 feet cannot be reached from a public street, a fire lane will be required on site.



**3. Unusual Conditions**

When fire lanes cannot be installed due to topography, waterways, non-negotiable grades or other similar conditions, the Fire Department may require an additional fire protection system or systems.

**4. Surface**

Fire lanes shall be constructed with a concrete or asphalt surface to provide all-weather driving capabilities and shall support a 60,000 pound vehicle.

**5. Vertical Clearance**

All fire lanes shall have a minimum vertical clearance of 14 feet to allow a fire truck to pass under.

**6. Width**

The minimum unobstructed width of a fire lane shall be 24 feet to allow two fire trucks to pass in case of an emergency.

**7. Turning Radius**

All fire lanes shall have at least a 30 foot inside turning radius and a 54 foot outside turning radius.

**8. Grade**

The maximum grade for a fire lane is 8 percent when serving a building not protected throughout by an automatic sprinkler system.

**9. Bridges**

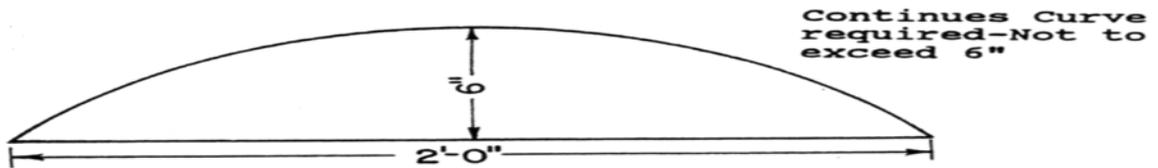
When a bridge is required to be used as access, it shall be constructed and maintained to carry a load of 60,000 pounds.

**10. Gates**

All gates across streets or fire lanes must be approved by the Fire Department and CDP. Plans shall be submitted to both departments and approved prior to a permit being issued. Opticom receivers are required for all electric gates across fire lanes. A manual means of opening the gate shall also be provided. Refer to Chapter of this manual for Gated Entry guidelines.

**11. Obstruction**

The required fire lane width shall not be obstructed by parked vehicles or other obstructions. Speed bumps or similar obstacles that have the effect of slowing or

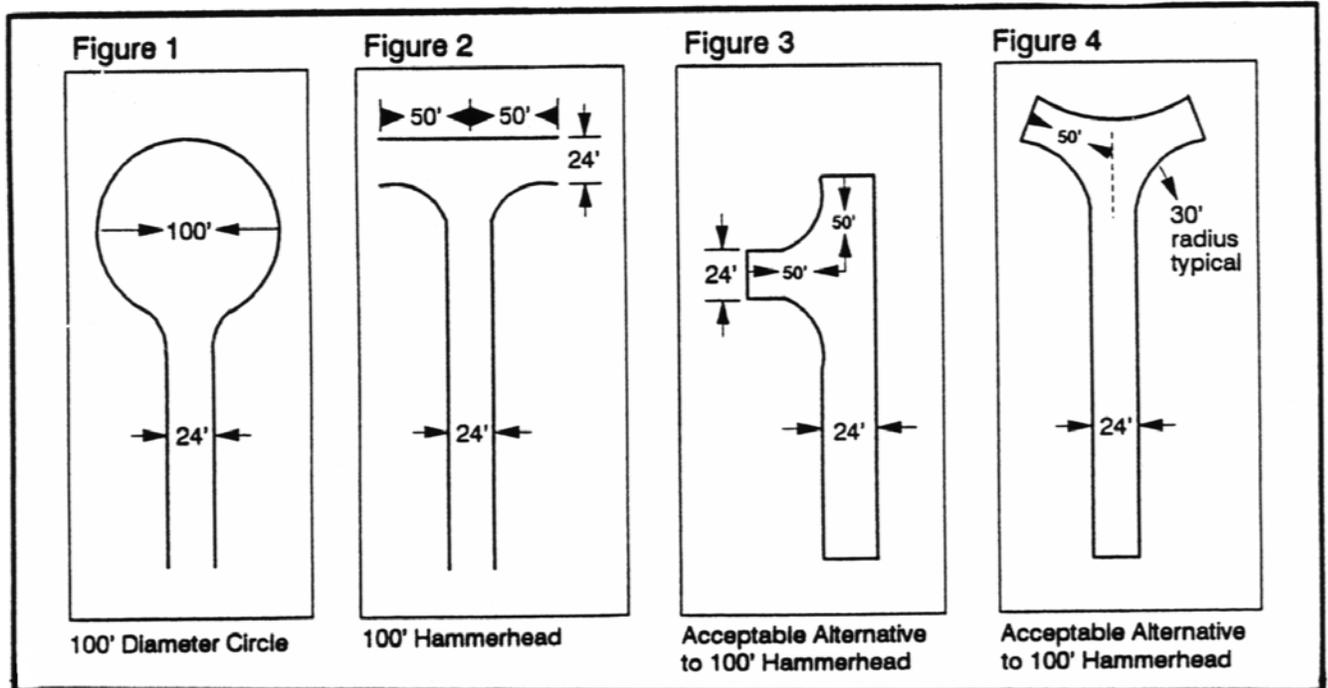


impeding the response of fire apparatus shall be approved by the Fire Department prior to installation.

**12. Turn-Around Areas**

When it is not possible to connect a fire lane at both ends to a dedicated street, an approved turn-around shall be provided. Dead-end fire lanes shall not exceed 150

feet in length. Illustrations of approved turn-around arrangements are as follows:



### 13. Striping

Fire lanes shall be maintained with fire lane striping that consists of a 6 inch wide red background stripe with 4 inch high white letters stating "No Parking, Fire Lane" painted on the red stripe every 15 feet. Where a curb defines the fire lane, the markings shall be painted on the vertical surface of the curb. When repainting, additions to the existing fire lanes are not allowed without prior approval of the Fire Department. Only designated fire lanes shall be marked. Illustration of approved fire lane markings is as follows:

### 14. Signs

Signs may be substituted for fire lane striping in residential areas with approval of the Fire Department. If the Fire Department determines that striping is ineffective to designate a fire lane, signs may be required by written notice to the property owner.

### 15. Maintenance

All designated fire lanes shall be maintained at all times.

**16. Special Hazards**

Fire lanes for high-pile combustible storage have special requirements in accordance with the Fire Code

## CHAPTER 6

### CAPITAL IMPROVEMENTS

#### **Section 6.1 Introduction**

The purpose of these guidelines is to provide information required to prepare construction plans for capital improvements projects. Specific information required for plan submittal can be found in the following sections or in the checklists located in the Appendices. Additional requirements may be specified in the Professional Services Contract.

#### **Section 6.2 Plan Submittal**

Plans shall be submitted in accordance with the checklist for capital projects (Appendix U) and with the Professional Services Contract.

#### **Section 6.3 Stormwater Management Division/Department of Public Works & Transportation**

##### **A. Permanent Best Management Practices**

During the conceptual design of the project, the engineer shall meet with the Stormwater Management Division of the PWT to evaluate the potential for incorporating permanent features and controls into the project to decrease the quantity and improve the quality of urban stormwater runoff. The engineer and the City shall reach agreement on these permanent BMPs and the design criteria to be used. Permanent BMPs selected for the project shall be shown on the same sheets as the drainage plans, designed as an integral part of the storm drainage system, and shall be sealed by a Professional Engineer. It is the responsibility of the engineer to schedule the meeting.

##### **B. Stormwater Pollution Prevention Plan (SWPPP) – Temporary Controls During Construction**

###### **1. Applicable Regulations and Ordinances**

Construction activities shall comply with the SWPPP requirements in the effective TPDES General Permit relating to Stormwater Discharges from Construction Activities, of the Stormwater Pollution Control Ordinance and the appropriate federal (Environmental Protection Agency) and state (Texas Commission on Environmental Quality) regulations. When the ordinance and applicable regulations are in conflict, the most stringent requirements shall apply.

## 2. General Requirements

Projects that disturb less than 1 acre shall have a SWPPP that complies with the requirements in the Checklist for Small Projects. Projects that disturb 1 acre or more shall comply with the requirements in the Checklist for TCEQ Regulated Construction Projects. These checklists are in Appendices C and D, respectively.

The SWPPP for projects that disturb more than 5 acres shall be sealed by a Professional Engineer and submitted to PWT with the street and drainage plans for review and acceptance.

## 3. Best Management Practices (BMPs) During Construction

Structural BMPs shall comply with details and specifications in the latest edition of the NCTCOG BMP Manual titled "*Stormwater Quality Best Management Practices for Construction Activities*" and this manual. When the NCTCOG Manual and this manual are in conflict, this manual shall govern.

The SWPPP shall provide a series of changing BMPs that are appropriate for each phase of construction. The SWPPP shall also identify which contractor or operator is responsible for installing, inspecting and maintaining each BMP during the different phases of construction. All temporary BMPs must be removed after final stabilization is achieved.

The following items are acceptable temporary BMPs for use during construction:

- Preservation of existing vegetation - This is a preferred BMP. When areas of existing vegetation are to be preserved, the areas shall be delineated on the plans, and the plans shall include notes stating that temporary chain-link fencing shall be installed to protect the vegetation.
- Vegetated buffer strips – Buffer strips may consist of preserved or planted vegetation. The strip shall be at least 15 feet wide, identified on the SWPPP, and flagged or otherwise designated in the field to prevent disturbance. Wider strips shall be specified when the slope is steeper than 10H:1V. If existing vegetation is used, it may be removed at the end of the project for establishment of permanent landscaping. The following design criteria shall be met when using vegetated buffer strips:
  - 1 The drainage area shall not exceed 0.25 acres per 100 feet length of vegetation.
  - 2 The maximum distance of flow to the vegetated buffer shall be 100 feet or less.
  - 3 The maximum up-slope grade perpendicular to the vegetated buffer shall not exceed 5H:1V.
- Soil retention blankets – Soil retention blankets shall be anchored per the manufacturer's recommendations. On areas with slopes of 3H:1V or flatter, the blanketed area shall be at least 8 feet wide. Greater widths

and additional BMPs shall be specified on steeper slopes. The blankets shall be seeded if used for temporary stabilization before start of home construction. Soil retention blankets used in channels shall meet TxDOT requirements for Type E-H blankets, as appropriate.

- Silt fence - Silt fences shall have wire mesh backing and be supported by metal posts. When used as a perimeter control, they shall only be placed down-slope from the construction activity, with the ends turned up-slope, perpendicular to the contours, to form a sediment trap. Silt fences may be used for concentrated flows up to a maximum design flow rate of 0.5 cfs. The following design criteria shall be met when using silt fence:
  - 1 The drainage area shall not exceed 0.25 acres per 100 feet of fence length.
  - 2 For slopes between 50H:1V and 3H:1V, the maximum distance of flow to the silt fence shall be 100 feet or less.
  - 3 For slopes of 3H:1V and steeper, the maximum distance of flow to the silt fence shall be 20 feet.
  - 4 The maximum up-slope grade perpendicular to the fence line shall not exceed 1H:1V.
- Curb inlet protection - Inlet protection is the least desirable BMP. It will only be accepted on private streets and on public streets when no other BMP is viable. Temporary inlet inserts shall be used unless a written request to use other measures is submitted to and approved by the Director. If other measures of protecting the inlet are requested, the engineer shall evaluate them for possible flooding in low areas and flow diversion on steep slopes
- Temporary detention structure - If 10 or more disturbed acres drain to a common drainage point, a temporary or permanent sedimentation basin shall be used. Storage volume may be calculated as the volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained. When calculating the volume of runoff from a 2-year, 24-hour storm event, it is not required to include the flows from offsite areas and flow from onsite areas that are either undisturbed or have already undergone permanent stabilization, if these flows are diverted around both the disturbed areas of the site and the sediment basin. Capacity calculations shall be included in the SWPPP. A sedimentation basin providing at least 3,600 cubic feet of storage per acre drained until final stabilization of the site may be used in lieu of calculating the runoff volume. This practice is advisable on smaller drainage areas where practicable.
- Rock check dams - Rock check dams are appropriate for areas of concentrated flow such as swales, ditches, and outfalls. Rock shall be contained within a wire mesh. Check dams shall be placed at a spacing that sets the top elevation of a dam at the toe elevation of the next upstream dam, with the top of the furthest upstream dam set at the invert of the last stabilized portion of the swale or ditch. When check dams are

used as an outfall control, the first check dam shall be at least 10 feet from the outfall, but no further than 50 feet from the outfall.

- Earthen berms - Earthen berms may be used as a perimeter control to divert runoff from adjacent sites away from the development or to retain runoff within the development. Earthen berms shall be stabilized within 14 days of their construction. The engineer shall analyze the impact of these diversion berms on adjacent sites.
- Fibrous mulch - Fibrous mulch may be used as an erosion control to limit the runoff from disturbed areas within the development. Mulch shall be at least 3 inches thick and cover all disturbed areas. When used on slopes of 3H:1V or steeper and in critical areas such as waterways, mulch matting must be anchored with netting to hold it in place.
- Hydromulch - Hydromulch stabilization may be used as an alternative to seeding for erosion control when all disturbed area is covered by the hydro-mulch. A strip of hydromulch is not acceptable unless additional structural controls are provided.
- Stabilized construction entrance - All construction entrances shall be stabilized with rock or other non-erodible material. If rock is used, the minimum effective diameter shall be 3 inches. Entrances shall be placed at high points or other areas where runoff from the construction site will not be directed to the entrance. The construction entrance shall not extend into the street or block flow in the gutter.
- Temporary inlet inserts - Commercially available or fabricated inserts may be used when inlet protection is the only viable BMP. Inlet inserts must be configured to pass the inlet's design flow without causing flooding.
- Other BMPs - It is the responsibility of the engineer to design appropriate BMPs for each site. If the most appropriate BMP is not in the NCTCOG BMP Manual, the engineer shall submit calculations and references for design of the BMP to PWT.

#### **4. Waste and Hazardous Material Controls**

Covered containers shall be provided for waste construction materials and daily trash. Hazardous materials shall be stored in a manner that prevents contact with rainfall and runoff. On-site fuel tanks and other containers of motor vehicle fluids shall be placed in a bermed area with a liquid-tight liner or be provided with other secondary containment and spill prevention controls.

The SWPPP shall require federal, state and local reporting of any spills and releases of hazardous materials greater than the regulated Reportable Quantity (RQ) and reporting to the PWT's Stormwater Management Division,

Environmental Compliance Section of all spills and releases to the storm drainage system.

## **5. Temporary Stabilization**

Portions of a site that have been disturbed but where no work will occur for more than 21 days shall be temporarily stabilized as soon as possible, and no later than 14 days, except when precluded by seasonal arid conditions or prolonged drought.

Temporary stabilization shall consist of providing a protective cover, without large bare areas, that is designed to reduce erosion on disturbed areas. Temporary stabilization may be achieved using the following BMPs: temporary seeding, soil retention blankets, fibrous mulches, hydro-mulches and other techniques that cover 100 percent of the disturbed areas until either final stabilization can be achieved or until further construction activities take place.

Perimeter BMPs such as silt fence, vegetated buffer strips or other similar perimeter controls are intended to act as controls when stabilization has not occurred. Perimeter BMPs may remain in place during temporary stabilization, however, they are not acceptable as temporary stabilization.

## **6. Final Stabilization**

Final stabilization consists of soil cover such as vegetation, geotextiles, mulch, rock, chemical modification of the soil, or placement of pavement. For vegetative stabilization, perennial vegetation must cover all disturbed areas without large bare areas and with a density of 70 percent of the native background vegetative cover. Vegetated buffer strips are not allowed unless designed and credited as a permanent BMP. All other forms of stabilization must cover 100 percent of the disturbed area.

For stabilizing vegetated drainage ways, sod or seeded soil retention blankets shall be used. Hydromulch will not be allowed in vegetated swales, channels or other drainage ways. BMPs may remain in place during stabilization, however, BMPs shall be removed after stabilization is achieved.

The plan for final stabilization shall be coordinated with the permanent BMPs in the SWMSP and with the landscaping plan, if applicable.

## **7. Concrete Batch Plants**

Temporary concrete batch plants constructed to serve capital improvement projects shall be covered by a SWPPP regardless of whether their location is contiguous with the project. If the plant is constructed to serve only one project, it may be added to the SWPPP for the construction project with the following note:

“\_\_\_\_\_ is the sole contractor and operator of the batch plant and is responsible for installation, operation and maintenance of all Best Management Practices and stormwater controls associated with the batch plant.”

If the concrete batch plant will serve two or more projects, it shall meet all the requirements of one of the following permits:

- TPDES General Permit No. TXR050000 Relating to Stormwater Discharges Associated with Industrial Activity
- NPDES General Permit No. TXG110000 for Discharges from Ready-Mixed Concrete Plants, Concrete Product Plants and Their Associated Facilities in Texas
- TPDES or NPDES Individual Discharge Permit
- Other authorized TPDES or NPDES permit

**8. Notice of Intent (NOI)**

On projects 5 acres in size or larger, the contractor shall submit a NOI and applicable fees to TCEQ at least 7 days (if submitting by paper) or immediately (if submitting online) prior to the start of any construction activity. Because the City is also considered by TCEQ to be a Primary Operator, the contractor shall also prepare the Notice of Intent (NOI) for the City of Arlington and submit applicable fees to TCEQ at least 7 days (if submitted by paper) or immediately (if submitted online) prior to the start of any construction activity. The contractor shall provide the City a copy of the NOI's.

**9. TCEQ Construction Site Notice**

On projects that are 1 acre and larger but smaller than 5 acres, the contractor shall complete the Construction Site Notice provided in the TCEQ's New General Permit for Construction and submit a copy of it to the PWT at least two days prior to commencement of construction activities. The contractor shall post a signed copy of the Construction Site Notice at the construction site prior to start of any construction activity in a location where it is readily viewed by the general public during all construction activity.

**10. Notice of Termination (NOT)**

All contractors that submitted a NOI shall submit a NOT to TCEQ within 30 days after final stabilization is established.

**11. Inspection and Maintenance during Construction**

The contractor shall construct all BMPs and other controls required by the SWPPP. The contractor shall have qualified personnel inspect the BMPs at least every two weeks during construction and within 24 hours after a storm event of 0.5 inches or greater. Alternately, inspections may be performed every 7 days with no additional inspections after rain events. Certified inspection reports shall be retained as part of the SWPPP. Within 7 days of the inspection, BMPs identified as damaged or deteriorated shall be repaired or replaced, as appropriate. BMPs shall also be cleaned to maintain adequate capacity. If a discharge of soil or other pollutant occurs, the BMPs shall be evaluated. Changes or additions shall be made to the BMPs within 7 days to prevent future discharges. In addition, the contractor shall implement procedures to remove discharged soil from all portions of the Municipal Separate Storm Sewer System (MS4) that received the discharge, including streets, gutters, inlets, storm drains, channels, creeks, and ponds.

Notes requiring the inspection and maintenance shall be placed on SWPPP drawings. The SWPPP shall identify the responsible party for inspecting and maintaining each BMP. If no party is identified, each contractor and operator that submitted a NOI for the site shall be fully responsible for implementing all requirements of the SWPPP.

Inspectors for the City will not allow construction of public improvements to start, nor will they grant final acceptance of public improvements, until the SWPPP is implemented and maintained.

## **Section 6.4 Water Utilities Engineering Department**

### **A. Horizontal and Vertical Control**

#### **1. Horizontal Control**

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

#### **2. Vertical Control**

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City's web page.

### **B. Digital File Requirements**

Prior to acceptance of three-party contracts, the owner's engineer shall furnish the City an electronic file of the water and sewer construction drawings in AutoCAD R14 or higher

in .DXF or.DWG format. The information shall be provided to the City on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Water Lines	C-WTR-WL
Water Line Text	C-STR-WL-TXT
Water Line Valves	C-WTR-GV
Water Line Valve Text	C-WTR-GV-TXT
Water Line Fire Hydrants	C-WTR-FH
Water Line Fire Hydrant Text	C-STR-FH-TXT
Sewer Lines	C-SWR-SL
Sewer Line Text	C-SWR-SL-TX
Sewer Lines Cleanouts	C-SWR-CO
Sewer Lines Cleanout Text	C-SWR-CO-TXT
Sewer Lines Manholes	C-SWR-MH
Sewer Lines Manhole Text	C-SWR-MH-TXT

All files shall be in the same directory, including all construction documents with their dependencies (XREFS), plot files, and any support files needed. The electronic files shall use only standard AutoCAD fonts with “ROMANS” as the main font.

**C. Design Plan Information**

Plan review information is included in Appendix E. This information is used by the WUED when reviewing plans and provides guidance to the engineer as to the type of information that will be required for water and sewer plans.

Additional resources for water and sanitary sewer requirements are:

- The Water Chapter and the Subdivision Chapter of the City Code, and
- The Standard Details and Specifications for Water and Sewer Construction.
- The Texas Commission on Environmental Quality (TCEQ)
- The National Sanitation Foundations (NSF)
- The Texas Department of Insurance
- The Insurance Services Office

**D. Design Requirements – Water**

**1. Pipe Sizing**

- Water mains shall be sized for fully developed conditions based on the 2001 Water Distribution Analysis or latest revision. In addition, 12-inch water mains shall be installed on a ½ mile grid pattern and 8-inch water mains shall be installed on a ¼ mile grid pattern. Water lines shall be a minimum of 6 inches throughout the distribution system, except in industrial or manufacturing areas where the minimum size shall be 8

inches. Where the length of the line exceeds 800 feet, the minimum shall also be 8 inches.

- Water lines shall be designed based on 1 gpm for each unit or residence up to 100 and 0.60 gpm for each unit or residence over 100. This criteria shall be used to determine the size of the water lines required to serve a development and eligibility for oversized participation.
- Dead end systems shall be avoided where possible, but if necessary shall not exceed 2000 feet.

**2. Line Placement**

If street improvements are proposed, the water line placement shall be coordinated with the street plans.

**a. Vertical**

- The following note shall appear on the water layout plan sheets: “There shall be a minimum cover of 42 inches over the water pipe as measured from the top of the pipe to the existing ground. Existing ground may be the flow line of the bar ditch, natural ground on the low side of a county-type road, or the proposed finished grade, whichever is lowest.”
- Lines shall be at least 2 feet below curb inlets.
- Water lines along unimproved streets shall have a minimum depth of 5 feet below the lowest ditch elevation to the top of the pipe to provide grade for future street improvements.
- A profile drawing shall also be provided for all water mains 12 inches and larger.

**b. Horizontal**

- Water lines shall be located 2 feet behind the proposed curb. Lines shall be located to clear curb inlets by at least 2 feet by deflecting the pipe or using offset bends.
- The minimum radius to be used for PVC water pipe is as follows:

<u>Pipe Size (Inches)</u>	<u>Minimum Allowable Radius (Feet)</u>
6	150
8	200
10	250
12	300

For pipe sizes larger than 12 inches, the minimum radius shall be:  $300 \times D$  (where  $D$  = pipe diameter in feet).

### **3. Gate Valves**

Gate valves shall be installed at pipe intersections to allow for the isolation of lines for repairs and the routing of poly pigs. Valves shall also be placed such that no more than 35 lots will be out of service when a line is out of service. When installed at street intersections, main line valves shall be installed 2 feet behind the back of the curb at the point of tangency for the curb return. Valves installed between intersections shall align with common lot lines. Gate valves are not to be used on fire hydrant leads when connected to water mains smaller than 12 inches in diameter.

### **4. Fire Hydrants**

- For all single family detached and duplex residences, excluding townhouses and apartments, fire hydrants shall be spaced to have an effective radius of 500 feet or a fire hose laying distance of 600 feet, whichever results in the closer fire hydrant spacing, or as required in the current Fire Code. The fire hose laying distance is measured by the laying of fire apparatus hose lines along streets and right-of-way from the nearest water supply on a street to the most distant point on the exterior of the building.
- Fire hydrants for all other land uses shall be spaced to have an effective radius of 300 feet or a fire hose laying distance of 500 feet, whichever gives the closer fire hydrant spacing, or as required in the current Fire Code.
- A fire hydrant shall be installed at the end of mains on cul-de-sacs and other locations where lines terminate. Other fire hydrants shall be located at street intersections and shall align with common lot lines. Additional fire hydrants may be required between intersections to meet the minimum spacing requirements.
- When the street is designated on the Thoroughfare Development Plan as an arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians shall have a fire hydrant on the same side of the street that the building is to be constructed.
- Fire hydrants shall be located in accessible protected areas. They shall be located a minimum of 3 feet and no more than 8 feet behind the back of curb.

- Fire hydrants shall be located outside curb returns and at least 4 feet from a driveway.
- A clear space of three feet shall be maintained around all fire hydrants.
- Fire hydrant mains shall be placed between 4 feet and 6 feet in depth. Offsets or bends shall be used to bring the fire hydrant up to allowable depths.
- Private fire protection systems and private fire hydrant locations shall be approved by the City of Arlington Fire Department prior to construction. A fire hydrant shall be installed no more than 200 feet from the fire department connection for an automatic sprinkler system.

**5. Water Services**

- The minimum size water service line shall be 1 inch.
- Where water meter banks are installed, permanent metal tags with addresses shall be installed on the service line at the curb stop to link the service with the address. The meters shall be installed in a logical sequence.
- Water meters shall be located in accordance with the standard details.

**6. Miscellaneous**

The City may install detector checks or water taps on lines greater than 2 inches at the owner’s request. The owner may request a cost estimate for materials and installation by contacting the Water Utilities/Customer Services Office. A set of approved plans and a copy of the approval letter from the WUED shall accompany the request.

**E. Design Requirements – Sanitary Sewer**

**1. Pipe Sizing**

- Sanitary sewer mains shall be adequately sized to serve the development and upstream drainage basin. Sanitary sewer mains shall be extended through the development to serve abutting property as required. Sanitary sewer mains shall be a minimum of 8 inches in diameter.
- Sanitary sewer systems shall be designed based on 1 gpm of flow for up to 100 units or residences and 0.60 gpm for each unit or residence over 100. When the drainage area is larger than 100 acres and the proposed land use (zoning) is unknown, Harmon’s Formula shall be used to determine peak dry weather flow.

Harmon's Formula:

$$M = 1 + \frac{14}{4 + \sqrt{P}}$$

M = Ratio of design load to average load

P = Population in thousands, assuming a density of 14 people per acre

- In addition, infiltration shall be estimated at 100 gpd per acre of drainage basin and shall be added to the peak dry weather flow to determine the total peak flow. The peak flow shall be 75 percent of the pipe capacity. Capacities shall be calculated using a Manning's (n) equal to 0.013. The Engineer may be required to submit design calculations to the WUED for review.
- Other methods may be used with WUED approval. Line sizing is subject to the final approval of the Director of Utilities.
- A minimum velocity of 2 fps shall be maintained. Associated slopes are listed below:

<u>Diameter (inches)</u>	<u>Slope (ft/ft)</u> <u>n = 0.013</u>
8	0.0040
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010
24	0.0008
27	0.00067
30	0.00058
36	0.00046

**2. Line Placement**

If street improvements are proposed, the sanitary sewer line placement shall be coordinated with the street plans.

**a. Vertical**

- Sewer mains shall be installed on a uniform grade between manholes. Particular care shall be taken to avoid rapid grade changes or reduced velocities at the lower section of the sewer main.

- Sanitary sewer lines constructed along unimproved streets shall be a minimum of 8 feet below the level of the lowest part of the existing street or bar ditch to provide grade for future street improvements.
- Sanitary sewer mains and services shall be encased in Class ‘A’ concrete where:
  - 1) the cover is 3 feet or less in paved areas, measured from the top of subgrade
  - 2) the cover is 2 feet or less in parkways
  - 3) the line has 2 feet or less of clearance beneath proposed storm drains or conduits.
- A profile drawing shall be provided for all sanitary sewer mains.

**b. Horizontal**

- The minimum radius for P.V.C. sewer pipe shall be determined using the following formula:  

$$R = 300 \times D$$

R = minimum allowable radius of curvature  
 D = pipe diameter  
 R & D are in the same dimensional units
- Sanitary sewer lines shall be placed along the centerline of the street unless prohibited by topography.

**c. Manholes and Cleanouts**

- Manholes shall be required at a maximum spacing of 500 feet on public sewer lines. Manholes are required at direction, pipe size, and grade changes.
- A standard manhole is 48 inches in diameter. A 60 inch diameter manhole is required when designed as a drop manhole, deeper than 12 feet or the main is 15 inches or larger.
- Drop manholes shall only be used for depths exceeding 12 feet.
- A manhole shall be installed at the end of mains on cul-de-sacs.
- A maximum of three sanitary sewer services may be installed at a manhole at the end of a cul-de-sac.
- Where manholes and cleanouts are located within the 100-year floodplain, watertight rings and lids shall be used.

- The top of manholes shall be set at 1 foot below the top of the subgrade when located in future pavement and raised to grade with the pavement construction, or 6 inches above existing natural ground outside pavement areas.
- Cleanouts may be installed at the end of main lines, except at the end of lines in cul-de-sacs.
- When tying to existing manholes, the invert must be reworked.

**d. Sanitary Sewer Services**

- Generally, sanitary sewer services are a minimum of 4-inches in diameter, shall be installed below water services and 9 feet downstream of the centerline of the lot. Exceptions will be considered on an individual basis.
- Where lot grades are lower than the street, located in the floodplain, or a storm drain crosses the sanitary sewer main, the flow line elevation of the sewer service line at the property line shall be provided.

**e. Miscellaneous**

- Generally, where lines are connected, the crown of each pipe shall be matched. Where a larger upstream line connects to a smaller downstream line, the flow lines shall be matched.
- Aerial crossings of open drainage features shall incorporate the use of trusses, wide flange beams, or strapping of the line to bridge structures or culverts to minimize the number of piers within the open drainage feature. Spread footings shall not be used in pier design.
- Ductile iron pipe shall generally be used for aerial crossings, trench spans, fill areas, bored and grouted pavement crossings, or where cover is minimal. All 12-inch and smaller sanitary sewer mains using poly-wrapped ductile iron pipe shall be Class 350 or greater. A greater pipe class may be required to accommodate trench conditions.

**F. Submittals**

**1. Utility Companies**

The owner shall submit plans to the utility companies when new water and sanitary sewer lines will be installed along perimeter streets or as approach

(offsite) mains to a development. A list of utility companies and contact names can be obtained from the WUED at the time of submittal.

## **2. TxDOT**

A permit from TxDOT is required when constructing facilities within state right-of-way. The WUED will provide the forms that are to be completed by the owner. Five copies of the completed form and five additional sets of plans shall be submitted to the WUED. The WUED will forward the forms and the plans to TxDOT for approval. The permit must be approved prior to commencing construction.

## **G. Utility Easements (Water & Sanitary Sewer)**

Utility easements are required for all public water and sanitary sewer lines installed outside of the street right-of-way. Generally, utility easements shall be a minimum of 15 feet wide except when a utility easement is adjacent to another easement or right-of-way where 10 feet is allowed. When both water and sanitary sewer lines are located in the same easement, or other facilities are within the easement, the minimum width shall be 20 feet. Where water or sanitary sewer lines are constructed deeper than 10 feet, the easement width shall be a minimum of 20 feet. For deep lines, the width of the easement shall encompass the trench width and side slopes that are one horizontal to one vertical for each side of the trench unless otherwise approved by the WUED.

The owner shall submit the ownership information, a metes and bounds description, and the exhibit of the utility easement to the WUED. The description and easement shall be sealed, signed, and dated by a surveyor.

The filing process for separate easements can be found in Chapter 3 of this manual.

## **Section 6.5 Transportation/Department of Public Works & Transportation**

### **A. Intersection Geometric Design**

Typical layouts of various street intersections are included in Appendix H.

### **B. Sight Distance Criteria**

At controlled or uncontrolled intersections of any public street, the minimum intersection sight distance (visibility triangles) shall have the dimensions as illustrated in Figure 1 in Appendix I. Where a driveway intersects a public street, the minimum intersection sight distance shall have the dimensions as illustrated in Figure 2 in Appendix I. Additional sight distance may be required base on topography, roadway curvature, vegetation, or other sight hindrance.

Deviations from the minimum intersection sight distance requirements may be allowed provided the configuration proposed will provide adequate sight distance as required

based on AASHTO standards. All deviations from the requirements must be approved by the PWT.

**C. Driveway Design Criteria**

The values in Table 1 represent standards for driveways.

**TABLE 1  
Driveway Design Standards**

<u>Requirements</u>	<u>Street Class</u>	<u>Residential Driveway</u>	<u>Apartment-Commercial Driveway</u>	<u>Industrial Driveway</u>
Driveway Throat Width	Local	10-28 feet	24-36 feet	24-45 feet
	Minor Collector	10-28 feet	24-36 feet	30-45 feet
	Major Collector	12-28 feet	24-36 feet	30-45 feet
	Arterial	12-28 feet	30-36 feet	30-45 feet
Driveway Curb Radius	Local	2.5-10 feet	10-20 feet	15-20 feet
	Minor Collector	2.5-10 feet	15-20 feet	15-30 feet
	Major Collector	10-20 feet	15-30 feet	20-30 feet
	Arterial	15-30 feet	20-30 feet	20-30 feet
Driveway Angle		70-90 degrees	90 degrees	90 degrees
Max Approach Grade <sup>1,3</sup>	Local/Minor	+9%	+6%	+6%
	All Others	+6%	+3%	+3%
Min Approach Length <sup>2,3</sup>	Local/Minor	6 feet	9 feet	9 feet
	All Others	9 feet	20 feet	20 feet

Notes:

<sup>1</sup> The percent slope measured along the centerline of the driveway.

<sup>2</sup> The minimum distance over which the maximum approach grade must be maintained.

<sup>3</sup> The approach grade and length shall be altered to include a sidewalk section through the drive approach as applicable. See typical details for drive approaches.

**D. Pavement and Street Marking Installation**

**1. Standardization of Application**

All pavement markings within the City shall conform to the fundamental use and design requirements set forth in the Texas Manual on Uniform Traffic Control Devices (TMUTCD). Markings shall be visible during hours of darkness and be reflectorized.

## 2. **Materials and Application**

- a. Type I Marking Materials: Type I markings are thermoplastic type materials that require heating to elevated temperatures for application. Type I marking materials shall conform to current and appropriate TxDOT Standard Specifications for Construction of Highways, Streets and Bridges. Type I markings are used for all longitudinal and transverse markings, crosswalks and stop bars. The thickness of thermoplastic is applied at 60 to 90 mils for stop bars and crosswalks and at 30 to 60 mils for longitudinal markings. Reference AASHTO Thermoplastic Specification.
- b. Type II Marking Materials: Type II markings are paint-type materials that are applied at ambient or slightly elevated temperatures. Type II marking materials shall conform to current and appropriate TxDOT Materials Specifications. Type II may only be used in parking lots or as temporary pavement markings.

The two basic types of raised pavement markers used in the City are reflectorized and non-reflectorized traffic buttons. They are typically installed with epoxy. They can be used in addition to thermoplastic for longitudinal lines on highly traveled streets. Additionally, the City does not use any raised pavement markers greater than two inches in height. Marking configurations with raised pavement markers that may be used in the City with permission from PWT are shown in the Figures in Appendix Q.

Pavement arrows and words are installed using either thermoplastics or cold layed plastics. Cold layed plastic is applied at a thickness of 90 mils (min.).

## 3. **Color**

Pavement markings should be yellow, red or white and shall conform to fundamental use and design requirements listed in the TMUTCD.

## 4. **General Design Criteria**

Pavement markings, including both longitudinal and transverse, should be installed on all collectors and streets of a higher classification. High-speed (Speed Limit 40 or higher) rural roadways should also have center lines and edge line markings.

Longitudinal pavement markings on residential streets and most minor collector streets are typically not needed. However, when they are necessary, thermoplastic shall be used in order to reduce maintenance needs. The following table can be used as a reference to determine when pavement markings are installed.

Note: (1) A-No Markings; B-Center-Line; C-Center-Line and Lane Line Marking.  
(2) Non-curbed and gutter streets serving as a collector or thoroughfare shall have center-line and edge line markings.

<b>Volume (trips)</b>					
<b>Street Width (ft)</b>	<b>0-1000</b>	<b>1000-2000</b>	<b>2000-5000</b>	<b>5000-1000</b>	<b>&gt; 10000</b>
< 30	A	A	B	B	B
30-39	A	A	B	B	B
40-49	B	B	B	C	C
49-60	B	B	C	C	C
> 60	B	B	C	C	C

The following guidelines for color and patterns of longitudinal lines are summarized from the TMUTCD:

- Yellow lines delineate the separation of traffic flows in opposing directions or mark the left edge of the pavement of divided highways and one-way roads and ramps.
- White lines delineate the separation of traffic flows in the same direction or mark the right edge of pavement.
- Red markings delineate roadways that shall not be entered.
- Broken lines are permissive in character.
- Solid lines are restrictive in character.
- Width of lines indicates the degree of emphasis.
- Double lines indicate maximum restrictions or prohibitions.

## **5. Width and Patterns of Longitudinal Markings**

The width and patterns of longitudinal lines shall be as follows:

- Typical line widths are 4 inches
- Wide line widths are at least 8 inches

See figures in Appendix R for typical line patterns.

## **6. Typical Applications of Longitudinal Markings**

The following describes specific applications of different types of longitudinal markings (see Appendix R for typical designs):

### **a. Center Lines**

Yellow centerlines separate traffic traveling in opposite directions and do not need to be the geometrical center of the pavement. Double yellow centerlines consist of two normal solid yellow lines and delineate the separation between travel paths in opposite directions where overtaking and passing is prohibited in both directions.

**b. Lane Lines**

Lane lines are normally dashed white lines that permit lane changing with care. A solid white line is used to separate through traffic lanes from special secondary lanes and left or right turn lanes. Their length is determined based on the geometry of the intersection, length of queue, and speed (design or posted speed limit) of the street. Solid white lane lines (not edge lines) shall be eight inches in width when added emphasis on separation is desired.

**c. Lane Line Extensions**

Lane line extensions (puppy tracks) should be installed when conditions make it desirable to provide control or guide vehicles through an intersection. Such cases may include offset intersections, skewed intersections, and dual turning movements. All extensions should be 3 feet lines with 3 feet skips. They shall be the same color of the line that is to be extended.

**d. Other Types and Applications**

A single solid white line is used to delineate the edge of the travel path where travel in the same direction is permitted on both sides of the line but crossing the line is discouraged. It is also used to mark the right edge of the pavement (edge line).

A double solid white line is used to delineate a travel path where travel in the same direction is permitted on both sides of the line, but crossing the line is prohibited.

A double line consisting of a single broken yellow line and a single solid yellow line delineate a separation between travel paths in the opposite directions. Overtaking and passing is permitted with care for traffic adjacent to the broken line and is prohibited for traffic adjacent to the solid line (One Direction No-Passing Marking).

A double normal broken yellow line delineates the edge of a lane in which the direction of travel is changed from time to time in such a way that the line serves as the center line of the roadway during some periods (Reversible Lane Lines).

**e. Left Turn Channelization**

With the exception of continuous two-way left turn lanes and trapped lanes, most left turn lanes on undivided roadways will require a transition before left turn storage is provided. This transition or taper can be of a variety of designs and lengths. Refer to Appendix S and the following table.

NOTE: Where the street has been flared to provide a left turn lane, the storage length should be maximized and the taper length should be reduced. The typical taper length in this case is 150 feet for streets that with a speed limit of 40 or higher.

<b>TYPICAL TAPER RATIO PER FOOT OF LATERAL SHIFT</b>		
<b>SPEED LIMIT (mph)</b>	<b>APPROACH TAPER</b>	<b>BAY TAPER</b>
30	1:15	1:10
35	1:20	1:12
40	1:30	1:14
45	1:35	1:15
50	1:40	1:17

**f. Storage Length**

This is the distance from the end of the bay taper to the intersection nose or stop bar. This distance should be determined based upon left turn demand and the type of control at the intersection. The desirable distance is the length of the vehicle queue plus 100 feet for the deceleration that must take place before vehicles stop in queue. The desirable minimum storage length used in the City is 150 feet.

**g. Non-Longitudinal Markings**

The following are different types of non-longitudinal markings:

- Stop Bars
- Crosswalks
- Word and Symbol Markings
- Shoulder Markings
- Parking Space Markings
- Crosshatch Markings
- Median Markings

Non-longitudinal (or transverse) markings shall be white except transverse median markings applied at the median nose, which shall be yellow. Typical dimensions and patterns of some of the transverse markings are discussed below. Typical sketches are provided in Appendix T.

**(1) Stop Bars**

Stop Bars shall be 24 inches in width. The typical placement is 15 feet from the cross street curb line and shall be four feet in advance of any marked crosswalk. In some cases, that distance can be increased due to possible conflicts with left turn vehicles turning from the cross street and the proper design of crosswalks to accommodate pedestrian movements. However, in no case

shall the stop bar be less than four feet or more than 30 feet from the cross street curb line.

Stop Bars should be installed across one or more approaches when any of the following conditions exists:

- When high pedestrian movements (greater than 50 in one hour) cross a stopped approach.
- When a multi-way stop exists involving a major collector street or a street of higher classification.
- At all signalized intersections.
- For stopped approaches at designated school crossings.
- At any location where a STOP sign cannot be placed where vehicles should come to a stop for safety purposes and field observations show a significant amount of traffic needs the extra delineation to enter the intersection safely. In these cases, the stop bar may be placed closer than 15 feet from the cross street if there are no significant pedestrian movements.
- In advance of any marked crosswalk.

**(2) Crosswalks**

Crosswalks shall be installed if any of the following conditions exists:

- For each approach at a signalized intersection unless pedestrians are prohibited from crossing a specific approach.
- For controlled approaches at a designated school crossing.
- At controlled approaches where pedestrian movements exceed 100 in any one hour.

Mid-block crosswalks shall not be allowed on city streets except at established school crossings controlled by school crossing guards.

All crosswalks should be installed using thermoplastic unless the pavement condition has a short life span, in which case paint should be used.

**(3) Word and Symbol Markings**

Pavement words and symbols shall be limited to no more than three lines of information. Pavement words and arrows shall be used in conjunction with Lane Use Control signs, railroad crossings, continuous left turn lanes, and where needed to provide proper guidance. The font size shall be a minimum of eight feet in height. "SCHOOL" markings are not normally used in the City but can be installed where special emphasis is needed.

**E. Traffic Signal Design Requirements**

Location of proposed signals shall be based on an approved TIA or as directed by the City Traffic Engineer. The consultant shall include signal design at all TxDOT intersections in the street and paving plans. The City’s Traffic Engineering Division will provide the signal design at all other street intersections.

**1. Proposed or Existing Signals**

Pull boxes and conduits are required at all proposed or existing signalized intersections to accommodate future and existing signals. There shall be at least one pull box on every corner of the intersection plus one in each median nose and in any islands. All pull boxes shall be connected by 4-inch PVC, Schedule 40 conduits.

**2. Signal Design Requirements**

This section provides the basic elements to design a traffic signal for the City. . All signal designs shall conform to the latest TxDOT signal design standards.

Signal design shall conform to City standards of Video Imaging Vehicle Detection System (VIVDS). The City uses Autoscope Video Detection.

**a. Site Investigation**

A site investigation shall be conducted and should include the following items. Check with PWT to determine if drawings of the location are available.

All existing improvements within 300 feet of the intersection shall be located including:

- Existing signing, including sizes and exact legend, if different from the TMUTCD. Otherwise, just the TMUTCD number will suffice.
- All pavement markings.

- All existing signal features. Refer to the signal face legend in the Traffic Signal Specifications (available from the PWT) for signal faces.
- Probable power source and new controller locations. They should be located on the same corner, if possible, with adequate corner clearance for traffic turning right.
- Visible overhead and underground utilities. If overhead lines appear to be in conflict with a new signal installation, measure the height of the lines above the ground at the points of conflict.
- Verification of all improvements shown on the drawing, if available.

**b. Design Layout**

The design layout shall include the following information and show staging if necessary.

- Lay out crosswalks to match ramp locations. The outside crosswalk lines shall extend to the curb line without intersecting adjacent outside crosswalk lines.
- Locate signal poles so that vehicle and pedestrian signals are properly oriented and pedestrian push-buttons are easily accessible to wheelchair operators.
- Locate necessary signal pedestals and push-button sign posts. When possible, mount pedestrian signals on signal poles. If signal poles are too far from crosswalks for proper push-button placement, use push-button sign posts. Minimize the use of signal pedestals.
- Locate necessary special features, such as flashing beacons, streetlights, or any aesthetic components.

**c. Pull Boxes**

- Pull boxes shall be placed at the back of curb and be constructed with 2-foot concrete aprons.
- One pull box shall be located on every corner, including medians and islands.
- Where conduit will be bored, a pull box shall be provided on each end of the conduit section. Every conduit run shall terminate in a junction box.

- Intermediate pull boxes shall be used when any run of conduit is longer than 500 feet.
- Poles and pedestal bases shall not be used in place of junction boxes.
- A pull box shall be used for changes in conduit size or type.
- Supplemental pull boxes shall be used when a feature is more than 20 feet from one of the pull boxes required above.

**d. Conduit**

- Conduit for the power service shall be 1 ½-inch Schedule 40 PVC conduit. It shall run from the disconnect enclosure on the service pole to a junction box and then to the controller foundation. In such a case, a pull box shall be used to accommodate the need and the conduit between the power source and the pull box shall be larger as necessary to accommodate the extra circuits. For power runs to the cabinet, no splices shall be permitted in the pull box. Power service shall not share conduits with other circuits.
- Except as otherwise noted, underground conduit shall be PVC. Conduit on poles may be either rigid metal conduit or elastic metal tubing (EMT).
- Signal conduit under streets shall be 4-inch PVC schedule 40. All signal conduits shall be terminated using 90 degree elbows.
- Conduit under existing streets shall be installed using the horizontal directional boring process, at a minimum depth of 54 inches.
- If the power service is across the street from the controller and there is no convenient utility pole to receive overhead service, conduit shall be installed under the pavement. Do not set a new service pole that will have no other function.
- Two 4-inch PVC and one 1 ½-inch and one 2-inch conduit shall be used between the controller and its pull box.
- When the signal is a span wire installation, a 4-inch conduit shall be used from the controller's pull box to the nearest signal pole and for the riser on the pole.

- Provide minimum 2-inch PVC Schedule 40 conduit for streetlight circuits (luminaries on top of signal pole) as necessary.

**e. Existing Conditions**

Design plans shall show existing conditions, including, the roadway, sidewalks, inlets, right-of-way, other physical features existing signs, signal shafts/poles, mast arms, pedestals, push-button sign posts, signal symbols, pull boxes, conduit, controller, and pavement markings.

Dimension the locations of all poles, pedestals, push-button sign posts and the controller from the back of curb. Locate all other utilities to ensure no conflict with the foundations. Revise the design as needed to avoid utility conflicts.

**f. Signal Design**

The following information shall be shown on the plan sheets:

- Signal face numbers and letter designations. Letter designations shall be as shown in Figure 3.1 of the Traffic Signal Specifications (available from the PWT). All signal faces that have the same indications (whether horizontal or vertical) and operate identically in the sequence (including flashing operation) shall be numbered identically.
- Signal phasing diagram with NEMA phase numbers.
- Definition of signal face control by NEMA phases and overlaps and a definition of the overlaps, if any.
- Detector connection chart.
- Identification and description of any special features or equipment. Bid item numbers can be used to do this if available.
- For unusual phasing or sequences and for preemptions, a color sequence chart.

**F. Fiber Optic Cables**

**1. Conduit and pull box installation.**

Conduit for fiber optic cables shall be installed along the length of the major roadway connecting signals and other City infrastructure for communication, in accordance with the City's network fiber plan. 1-1/2" HDPE conduit shall be utilized and may be placed in a trench with streetlight conduit if the streetlights

are in the median. Pull boxes for the fiber optic cables shall be at the median noses at all signalized intersections, and placed every 1000 feet in between. Pull boxes on median noses will be for juncture of both signal conduit and fiber conduit at signalized intersections. All pull boxes shall be Type C quazite material (not concrete or metal).

**2. Location of existing fiber**

Signal fiber optic cables are the main trunk lines running along roadways throughout the City connecting traffic signals. City network fiber optic cables are the branch lines off the main trunk that serve City facilities. These are generally perpendicular to the roadway. Contact the Network Designer in the Information Technology Department to verify location of any existing signal fiber or City network fiber.

**G. Streetlight Design Requirements**

**1. Local and Minor Collector Streetlight Design Standards**

**a. Placement Criteria**

- Streetlights shall be installed on streets 38 feet wide or less typically at a distance of 4 feet from the curb. They shall be 100 watt open bottom high pressure sodium type.
- Streetlights shall be installed at mid-block locations not less than 250 feet or greater than 500 feet from any adjacent streetlight and on the inside of each horizontal curve with a 200 feet centerline radius or less.
- Additional streetlights may be required whenever geometric conditions may create a traffic safety hazard that can be reduced by the installation of a streetlight.

**b. Pole Type**

The standard for streetlight poles is 22 feet mounting height steel telescoping. The City may consider other options such as fiberglass, concrete or other decorative poles with a post top decorative fixture. Spacing of alternate poles will remain the same as standard steel poles. Only one pole type typically will be allowed.

If decorative streetlights are used, 10% of the total light assemblies shall be provided for future maintenance and damage, or a minimum of two poles, arms, and fixtures. Spacing of decorative poles will be the same as standard streetlights when lighting levels on the street pavement meets or exceeds the standard lighting levels.

**2. Major Collector and Arterial Streetlight Design Standards**

**a. Placement Criteria**

- Type III refractors are required at all mid-block locations where intersection criteria does not control locations.
- Streetlights shall be 150 watt HPS cobra head

**b. Lighting Configurations**

Median Lighting -- Light poles with twin arms and luminaries shall be installed at the center of the median of 4-lane and 6-lane boulevards. Lighting poles within the median of an initial four-lane boulevard planned for expansion to a six-lane boulevard shall be designed such that the poles will not need to be relocated when the roadway is expanded (i.e., at left turn lanes, and transitions for left turn lanes).

Staggered Lighting -- Light poles shall be installed in an alternating pattern within parkways along both sides of the roadway on undivided roadways.

One-side Lighting -- Light poles may be installed within the parkway on one side of the roadway along 4-lane undivided roadways only if staggered lighting is not feasible.

**c. Spacing Requirements**

The standard spacing distance between all poles in non-intersection areas shall be as shown below. Spacing less than standard can be used to clear obstructions and may be increased no more than 15 feet where necessary to avoid conflicts.

<b>Standard Spacing (feet)</b>			
	<b>One-Side Lighting</b>	<b>Median Lighting</b>	<b>Staggered Lighting</b>
<b>Major Collector</b>	160	210	160
<b>Minor Arterial</b>	N/A	210	130
<b>Major Arterial</b>	N/A	190	100

Any deviation requiring a tolerance of more than 15 feet. shall require submittal of calculated  $E_h$  (avg),  $E_h$  (avg)/Min., and Max./Min. values indicating compliance with the design criteria.

$E_h$  (avg) -- The average maintained horizontal illumination in ft. candles shall be a minimum of 0.90.

$E_h$  (avg)/Min. -- The average maintained horizontal illumination value divided by the lowest illumination point encountered within the area of roadway being lighted shall be 3.0 or less.

Max./Min. -- The highest illumination point divided by the lowest illumination point encountered within the area of roadway being lighted shall be 9.0 or less.

**d. Major Intersection Placement**

Type II four way refractors are required at intersections. For major collector and arterial intersections having geometric layouts that vary from those specified, streetlight poles shall be located to achieve the illumination values shown on the figure for the most comparable intersection layout. Alternate designs or intersection lighting locations which vary from those shown in the above referenced figures shall be reviewed by City upon submittal of calculations indicating conformance to lighting design criteria.

For intersection lighting layouts, the PWT shall be consulted to determine if traffic signal poles shall be required in the future at the intersection. If so, the lighting standards shall be integrated with the traffic signal pole and the pole type will be determined.

**e. Adjustment for Topographic Height Variations**

Where the base of the lighting standard is 5 feet higher or lower than the adjacent top of curb, a non-standard spacing between adjacent poles shall be specifically calculated to meet the required illumination values as specified.

**f. Lateral Clearances**

Poles shall be installed a maximum of 8 feet from the back of the curb for one-side or staggered lighting. If this is in conflict with existing or proposed facilities, an alternative location will be determined.

Streetlight poles shall not be installed within 4 feet of any street, fire hydrant, drainage flume, inlet, driveway or within the drip line of any established tree.

**g. Pole Type Determination**

The standard for streetlight poles is 40 feet mounting height, steel with breakaway base.

**h. Color Determination**

New streetlight pole installations shall be nemecc bronze

### **3. General Requirements**

#### **a. Streetlight Plan Layout**

At minimum, the streetlight plans shall:

- be on 24" x 36" size sheets.
- have a title block located at the lower right-hand corner of the drawing, and the north representation shall be displayed in an up or right direction.
- show all service poles or transformer pads utilized for streetlight energy source. Include the electric delivery provider's electrical design. Connection to the power source shall be coordinated with the electric delivery service provider.
- shall be drawn using standard symbols and abbreviations.
- show all utilities and storm drain facilities, including their easements.

#### **b. Pole contacts**

Other agencies' facilities may not be utilized for installation of streetlights unless approved by PWT.

#### **c. Underground Service Standards**

- All underground connections shall be in accordance with the latest NEC guidelines.
- All underground streetlight services shall be placed in 2-inch PVC Schedule 40 conduit in a trench with a minimum depth of 30 inches.

#### **d. Overhead Service Standards**

Overhead Service Standard shall be in accordance with the latest NESC and NEC guidelines.

#### **e. Conductors/Insulation**

Cable and insulation shall be installed in accordance with the following table.

	LOCAL AND MINOR STREETS		MAJOR COLLECTOR AND ARTERIAL STREETS	
	Overhead	Underground	Overhead	Underground
Standard Practice	No	Yes	No	Yes
Stranded Aluminum	Duplex (XLP)	Triplex (XLP)	Duplex (XLP)	N/A
Annealed Copper	N/A	N/A	N/A	2 Insulated Plus One Bare Wire (THHN)
240 Volt	N/A	N/A	Standard	Standard
120 Volt	Standard	Standard	N/A	N/A

**f. Special District Standards**

All streetlights in the Entertainment District shall conform to the Entertainment District Design Standards. All streetlights in the Downtown District shall conform to the Downtown Neighborhood and Downtown Business Design Standards.

**H. Street Signs Design Requirement**

All street signs shall be fabricated and installed in accordance with TMUTCD’s standards and specifications. Any deviations shall be approved by PWT.

For the street marker blades, the sheeting and lettering shall be 3M Scotchlite High Intensity Series #3870 White and #3870 Blue, or equivalent. White lettering on a blue background shall be used to indicate public streets, whereas blue lettering on a white background is used to indicate private streets.

All signs in the Entertainment District shall conform to the Entertainment District Design Standards. All signs in the Downtown District shall conform to the Downtown Neighborhood and Downtown Business Design Standards.

**Section 6.6 Engineering Division/Department of Public Works & Transportation**

**A. Right-of-Way**

Right-of-way required for capital projects shall conform to the TDP. Deviations from the plan shall be approved by the Director of PWT.

**B. Horizontal and Vertical Control**

**1. Horizontal Control**

All plans shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

**2. Vertical Control**

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City’s web page.

**C. Digital File Requirements**

The engineer shall furnish the City a digital graphics file of the street and drainage construction drawings in .DXF or .DWG format. The information shall be provided on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Closed Storm Sewer System	STORM
Back of Curb	CURB
Right of Way	ROW
Edge of Sidewalk	SIDEWALK
Open Storm Sewer Systems	CHANNEL

**D. Design Plan Checklist**

A plan review checklist is included in Appendix U. The checklist is used by the PWT when reviewing plans and provides guidance to the engineer as to the type of information that will be required for street and drainage plans.

**E. Street Plan Design Requirements**

**1. Design Speed**

All streets shall be designed and constructed to provide the following design speeds:

<u>Street Type</u>	<u>Design Speed</u>
Arterial	45 miles per hour
Major Collector	40 miles per hour
Minor Collector	35 miles per hour
Local Street	30 miles per hour

**2. Minimum Radius**

The required radius for curb returns at intersections shall be as follows:

Arterial/Arterial	80 feet*
Arterial/Collector (departure side)	80 feet*
Collector/Collector	30 feet
Arterial/All Others	30 feet
Collector/All Others	30 feet

All Others 20 feet

\*The minimum allowable radius is 35 feet and 30 feet, respectively. See Intersection Geometric Design in Appendix H.

The minimum radius for the back of curb on a cul-de-sac shall be 39 feet.

### 3. Vertical Alignment

All streets shall be designed and constructed to a minimum grade of 0.5%; however, if the required geotechnical report indicates the soil has a PI greater than or equal to 40, a minimum grade of 1% shall be required.

All streets shall have a maximum grade as follows:

<u>Street Type</u>	<u>Maximum Grade</u>
Arterial	6.0%
Major Collector	8.0%
Minor Collector	8.0%
Local	8.0%

In order to maintain adequate sight distance, all streets shall be designed and constructed to comply with the following minimum vertical curve length for each algebraic percent difference in grade.

<u>Street Type</u>	<u>Crest Curves</u>	<u>Sag Curves</u>
Arterial	120	90
Major Collector	80	70
Minor Collector	50	50
Local	30	40

The following maximum intersection grades involving arterial and major collector roadways shall be used at controlled intersections.

<u>Design Street Type</u>	<u>Intersecting With</u>	<u>Design Street Maximum Grade</u>	<u>Distance</u>
Arterial	Arterial	2%	300 feet
Arterial	Major Collector	3%	300 feet
Major Collector	Arterial	3%	200 feet
Major Collector	Major Collector	3%	200 feet
Minor Collector/Local	Arterial/Major Collector	4%	150 feet

### 4. Horizontal Alignment

The following minimum centerline radii shall be used in the design of all street construction:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	1000 feet
Major Collector	800 feet
Minor Collector	500 feet
Local	As approved by the Director of PWT 50 feet radius to right-of-way line
Cul-de-sacs and Loop Streets	

Reverse curves shall be separated by a tangent section in accordance with the following table:

<u>Type Street</u>	<u>Minimum Tangent Length</u>
Arterial	200 feet
Major Collector	100 feet
Minor Collector	50 feet
Local	As approved by the Director of PWT

Collector or arterial roadways intersecting other collector/arterial roadways shall have the following minimum horizontal centerline approach tangent section length as measured from the nearest right-of-way line of the intersecting street, unless such requirement is waived by the Director of PWT:

<u>Type Street</u>	<u>Intersecting With</u>	<u>Minimum Approach Tangent</u>
Arterial	Arterial	200 feet
Collector	Arterial	150 feet
Collector	Collector	100 feet

**5. Paving Requirements** (Amended Ord #09-030 6/23/09)

Streets shall be designed in accordance with the requirements outlined below.

- Standard pavement widths and sections shall be constructed on prepared subgrade in accordance with the City of Arlington Standard Details and Specifications. Pavement widths shall be measured from back of curb except for local rural roadways where the width is measured from edge of pavement. The street classification shall be as shown in the Thoroughfare Development Plan and the width and thickness shall be in accordance with the following table:

<b>Street Type</b>	<b>Width</b>	<b>Thickness Concrete</b>	<b>Thickness HMAC</b>
Residential	28 feet	7 inches concrete over 8 inches lime/cement subgrade	5 inches HMAC over 12 inches lime/cement subgrade
Collectors and Minor Arterial	38 feet, 45 feet, or as indicated in Thoroughfare Plan	9 inches concrete over 8 inches lime/cement subgrade	7 inches HMAC over 12 inches lime/cement subgrade
Major Arterial	As indicated in Thoroughfare Plan	9 inches concrete over 12 inches lime/cement subgrade	8 inches HMAC over 16 inches lime/cement subgrade

- All concrete shall have #4 bars on 24-inch centers.
- All streets shall be constructed with a lime/cement stabilized subgrade in accordance with the above table. The application rate shall be specified in the plans. With the approval from PWT, the consultant may request a variance to the above table by submitting a geotechnical report prepared by an engineer indicating an alternate design.
- In small areas, such as the addition of median openings or auxiliary lanes to existing facilities, consultant may submit a request to the City to allow alternate pavement sections to match existing and/or alternate subgrade treatment, such as 6-inch cement treated base or 4-inch additional pavement thickness on compacted base.

## **6. Sidewalks and Access Ramps**

- The location of sidewalks and access ramps shall be shown on the plans. Sidewalks shall be placed within the right-of-way and shall be 4 feet wide and placed 1 foot off the right of way line. If necessary sidewalks may be placed closer to the curb, but no closer than 2 feet except where site restrictions require the sidewalk to be placed closer to the curb. In these cases, the sidewalk shall be adjacent to the curb and shall be six feet in width.
- If obstructions are within the path of a proposed sidewalk, the sidewalk width and placement may be adjusted to allow the obstruction to remain. In these cases, a minimum sidewalk width of three feet shall be maintained.

## **F. Drainage Plan Design Requirements**

Drainage facilities shall be designed in accordance with the following.

**1. Peak Runoff**

The City may have flow rates available for watersheds. If so, these shall be used in the drainage calculations. Where no flow rates are available, a unit hydrograph technique (WinTR55, TR20, HEC1, etc) is preferred and recommended. The Modified Rational Method (Q=CCaIA) may be used for calculating peak runoff from watersheds of less than 20 acres. The Rational Method is not appropriate for designs other than small side ditches, median ditches, and driveway pipes.

**a. Runoff Coefficients**

Stormwater runoff shall be based on a fully urbanized watershed. The most intense land use and zoning shall be used to determine the runoff coefficient for the fully urbanized watershed. The following table gives values for runoff coefficients that shall be used in the determination of stormwater runoff if the Modified Method is used.

**RUNOFF COEFFICIENT “C”**

Zoning or Land Use	Hydrologic Soil Groups			
	A	B	C	D
Parks and Permanent Open Space	.35	.37	.39	.41
“E” Zoning	.43	.45	.47	.50
“R” Zoning	.50	.52	.55	.58
“D” and “R1” Zoning	.60	.63	.66	.70
“R2” and “MH” Zoning	.65	.68	.72	.76
“TH” Zoning	.65	.70	.77	.80
Multi-family Zoning	.65	.71	.87	.90
Commercial, Schools & Churches	.95	.96	.98	1.00
Commercial Business District/Industrial	1.00	1.00	1.00	1.00

**SOIL GROUP CLASSIFICATION**

- Group A Deep sand, aggregated silts
- Group B Sandy loam
- Group C Clay loam, shallow sandy loam
- Group D Heavy plastic clays

**b. Rational Method Antecedent Precipitation Factor (C<sub>a</sub>)**

C<sub>a</sub> values to be used are shown in the following table:

**ANTECEDENT PRECIPITATION FACTOR "C<sub>a</sub>"**

<b>Recurrence Interval (Years)</b>	<b>"C<sub>a</sub>"</b>
5	1.00
25	1.10
100	1.25

NOTE: The product of CC<sub>a</sub> shall not exceed 1.0.

**c. Intensity**

For times of concentration less than or equal to one hour, Hydro-35 shall be used to determine the rainfall intensity. For times of concentration greater than one hour, TP-40 shall be used to determine the rainfall intensity. Refer to Appendix K.

**d. Time of Concentration**

The time of concentration shall be based on fully urbanized conditions for the upstream watershed. The total time of concentration shall include overland and channelized flow. The maximum length allowed for the overland portion of the calculation is 50 feet. The remainder of the watershed shall be considered channelized flow. Refer to Appendix L to determine the velocity, which is used to calculate the time of concentration or utilize the WinTR55 tool to calculate the time of concentration.

**e. Storm Frequency**

The following table shows the minimum design frequency to be used when designing drainage facilities:

<u><b>Type Of Facility</b></u>	<u><b>Minimum Design Frequency</b></u>
On-grade inlets	5 year
Low point inlets	25 year
Storm sewers upstream of low points	5 year
Storm sewers downstream of low points	25 year
Street right-of-way	100 year*
Channels and creeks	25 year
Creek culverts and bridges	25 year
Permanent bar ditch and associated culverts	5 year

\*Depending on the amount of flow in the right-of-way, additional drainage infrastructure may be required to reduce the flow in order to protect the health, safety and welfare of the general public.

**f. Drainage Areas**

The drainage area shall be based on fully urbanized areas within and contributing to the project, shall follow natural drainage features, and shall not be diverted. Existing or anticipated features modified by the project shall be considered when determining drainage areas. A drainage area map shall be prepared that complies with the checklist in Appendix U.

**2. Roughness Coefficients and Permissible Velocities**

The following table provides roughness coefficients and permissible velocities:

Type of Section/Feature	Coefficient of Roughness “n”	Maximum Permissible Velocity fps <sup>1</sup>
I. Natural Creeks		
A. Creek Section		
1. Some grass and weeds; little or no brush	0.045	3.0 to 6.0
2. Dense growth of grass or brush	0.055	3.0 to 6.0
3. Dense brush and trees	0.065	3.0 to 6.0
B. Floodplain/Overbank Areas		3.0 to 6.0
1. Grass, Weeds, Some Brush and Trees	0.045	
2. Dense Grass, Weeds or Brush	0.055	3.0 to 6.0
3. Dense Brush and Trees	0.080	3.0 to 6.0
II. Constructed/Modified Open Channels		
A. Gabion Channels	0.035	Receiving stream limit
B. Pre-Cast Concrete Block Channels	0.035	Receiving stream limit
C. Natural Stone Channels	0.035	Receiving stream limit
D. Grass Vegetated Channels (maintained)	0.035	3.0 to 6.0
E. Concrete Channels	0.016	Receiving stream limit
F. Rock Rip-Rap Channels	0.035	5.0 to 10.0
III. Streets		
A. Concrete	0.015	N/A
B. Asphalt	0.015	N/A
IV. Pipe		
A. Reinforced Concrete Pipe	0.013	Receiving stream limit
B. Corrugated Metal Pipe <sup>1</sup>	0.022	Receiving stream limit
C. High Density Polyethylene Pipe <sup>1</sup>	0.011	Receiving stream limit

<sup>1</sup> If approved by PWT

**3. Street Capacity Design**

Local and minor collector streets shall be designed to flow less than curb deep during a 5-year storm. For major collectors and minor arterials, ½ of the inside lane shall remain dry during the design storm. For major arterials, the full inside

lane (5<sup>th</sup> and 6<sup>th</sup> lanes) shall remain dry for the design storm. The runoff from the 100-year storm shall be contained within the right-of-way and shall not exceed 0.2 feet above the lowest top of curb.

#### **4. Closed System Design**

The closed system shall be connected to an existing system or extended until it reaches an open channel or creek.

##### **a. Drainage Easements**

A drainage easement shall be dedicated for all closed systems. The minimum width of a drainage easement is 15 feet. When combined with other utilities, the minimum width is 20 feet. The easement may need to be larger to accommodate systems with pipe sizes larger than 60 inches or deep systems.

##### **b. Hydraulic Grade Line (HGL)**

The hydraulic grade line (HGL) shall be shown on the plans and shall be below the bottom of the subgrade for systems under pavement. For systems outside of the pavement, the HGL shall be lower than all inlet throats and shall not exceed one pipe size above the top of pipe. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher.

##### **c. Head Losses**

The design techniques and methods used in the determination of all head losses shall be approved by the PWT. The City of Fort Worth's Storm Drainage Criteria and Design Manual is an acceptable guide for calculating head losses.

##### **d. Entrance/Outfall Structures**

Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm sewer systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow. The sloped end treatment shall be a 6H:1V end section. Storm sewer systems that outfall to a creek shall be extended to the centerline of the creek. Gabion mattresses shall be installed at the outfall structure to lower velocities and prevent erosion.

##### **e. Pipe**

Underground systems shall be constructed with Class III reinforced concrete pipe. The pipe size shall be a minimum of 18 inches. A higher

class of pipe may be required when constructed shallow or deep. The City may allow plastic pipe for certain applications; however, plastic pipe is never allowed under street paving.

All pipe bends and fittings shall be prefabricated. Collar connections shall be in accordance with the City standards.

Radius pipe is allowed and shall be placed in accordance with the manufacturer's lay schedule.

Field connections may be allowed when the main pipe is twice the diameter of the lateral; however, field connections are not allowed when the lateral slope is greater than 10 percent.

**f. Access Points**

A manhole or inlet with a minimum 36 inch RCP lateral shall be constructed every 500 feet to provide access into the closed system.

**g. Inlets**

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all concrete streets except local streets. Grate inlets are not allowed on public systems. Drop/Y inlets may be utilized to intercept offsite.

**5. Open System Design**

For a capital improvement that includes, or is adjacent to a creek, a hydraulic analysis (flood study) shall be submitted to determine easements. A flood study is also required if modifying existing floodplain or floodway. The requirements for each flood study differ according to the existing creek designation (i.e., within a FEMA designated floodplain) and whether improvements are proposed for the creek. This section will address the requirements for flood studies.

**a. Unimproved Creeks (Natural)**

For a creek in its natural undisturbed state, a flood study shall be submitted to determine the easement limits. The requirements for this type of submittal are included in the Flood Study Matrix in this section.

A drainage easement based upon its natural undisturbed state shall be dedicated for the 25-year storm event for the fully urbanized conditions.

Where natural creeks connect to improved systems, permanent transitional materials are required. Additionally, in areas along natural creeks where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be

required to stabilize the creek. Stabilization materials shall be approved by the Director of PWT.

**b. Constructed/Modified Open Channels**

A flood study will be required for an existing or proposed constructed/modified open channel. The study shall define the easement limits and the 100-year flood elevations. If the open channel is located in a FEMA designated floodplain (i.e., on the FIRM), then the study will be sent to FEMA. Additional hydraulic analyses are required and shall be in accordance with the information outlined in the Flood Study Matrix in this section.

If the modifications are located between the top of banks, the plans shall be submitted PWT for submittal to the Army Corps of Engineers for review and permitting.

A constructed/modified open channel shall be evaluated by the Director of the PWT. Constructed or modified open channel design may incorporate one of the following:

- Gabions
- Pre-cast concrete blocks
- Native stone
- Vegetation
- Bio-engineered materials

A drainage easement shall be dedicated to include a channel designed to convey the runoff from the 25-year storm for the fully urbanized watershed conditions plus one foot of freeboard. The drainage easement shall also contain 10 feet on each side of the channel for access. Additional easement may be needed at specific locations for access to the feature for maintenance.

Where constructed or modified open channels connect to a closed system, natural creeks, or a channel of a different material, a transitional area shall be designed. Channels shall be designed with the following minimum criteria:

	Concrete	Vegetated	Other Material
Side slopes	2:1	4:1	*
Bottom width	6 feet	6 feet	6 feet

\* As specified by manufacturer or design.

For channels with vegetated bottoms, the design shall include a pilot channel with an invert which conveys low flows and allows for maintenance.

For earthen channels, see Protection and Restoration of Linear Park Land in this chapter for recommended plant and vegetation species.

## **6. FEMA Designated Floodplain**

In order to remove all or portions of property from the floodplain, or to improve a creek and construct a channel (concrete, earthen or other approved material), the hydraulic analyses must be submitted to the City for acceptance and then to FEMA for approval. If the 100-year ultimate development floodplain is not dedicated as a drainage easement, any fill to be placed in a FEMA designated floodplain shall require 1:1 hydraulically equivalent compensatory storage. There are several types of map changes available through FEMA. The following lists the types of map changes available:

### **a. CLOMA – Conditional Letter of Map Amendment**

A CLOMA is FEMA’s concurrence that a proposed structure upon construction would be excluded from the Special Flood Hazard Area (SFHA) shown on the effective Flood Insurance Rate Map (FIRM). The letter becomes effective on the date approved by FEMA. The letter does not revise an effective FIRM; it indicates whether the project, if built as proposed, will be recognized by FEMA.

### **b. LOMA – Letter of Map Amendment**

A LOMA is an official amendment, by letter, to an effective FIRM. This is typically used to correct an error on the map and is based on current detailed topographic information. A LOMA establishes a property/structure’s location in relation to the SFHA based on natural ground. The letter becomes effective on the date approved by FEMA.

### **c. CLOMR-F – Conditional Letter of Map Revision Based on Fill**

A CLOMR-F is FEMA’s concurrence that a proposed structure/property involving the placement of fill outside of the floodway would exclude an area from the SFHA shown on the FIRM. The letter becomes effective on the date approved by FEMA. This letter does not revise an effective FIRM, it indicates whether the project, if built as proposed, will be recognized by FEMA.

### **d. LOMR-F – Letter of Map Revision Based on Fill**

A LOMR-F is an official revision, by letter, to an effective FIRM. A LOMR-F provides FEMA’s determination concerning whether a

structure or parcel has been elevated on fill above the Base Flood Elevation (BFE) and excluded from the SFHA. The letter becomes effective on the date specified on the LOMR-F.

**e. CLOMR – Conditional Letter of Map Revision**

A CLOMR is FEMA’s concurrence that a proposed project that would affect the hydrologic and/or hydraulic characteristics of a channel/creek and thus result in the modification of the existing regulatory floodway or effective base flood elevations (BFEs). The letter becomes effective on the date approved by FEMA. This letter does not revise an effective FIRM; it indicates whether the project, if built as proposed, will be recognized by FEMA.

**f. LOMR – Letter of Map Revision**

A LOMR is an official revision, by letter, to an effective FIRM. A LOMR may change flood insurance risk zones, floodplain and/or floodway boundary delineations, and BFE. The letter becomes effective on the date specified on the LOMR.

**7. Flood Study Submittal Requirements**

**a. Unimproved Creeks and Constructed/Modified Open Channels**

The following information shall be submitted for all flood studies.

1) Hydrology

- Provide a current drainage area map
- Provide a proposed drainage area map – (be sure to include all offsite area and adjacent subdivisions)
- Provide all hydrology computations and describes the method used
- Provide channel cross sections showing the property lines, easement lines, 100 year floodplain, and floodway.
- Any other calculations – including verification that the downstream systems (bridges, pipes, bar ditches, etc.) are designed to handle the increased runoff.

2) Hydraulics

- Provide a site map showing existing topography and cross section locations
- Provide a site map showing proposed contours and cross section locations
- Provide the required HEC runs (see the following sections for details)
- Provide corresponding maps for each HEC run submitted.

- 3 Submit the flood study in a bound notebook with all pertinent information included. In addition to the above information, a FEMA's MT-2 form must be filled out and included in the report if the information will be submitted to FEMA.

**b. Flood Study Matrix**

Various HEC runs are required to establish criteria set by the City and FEMA. The matrix below is an attempt to clarify which HEC runs are required for the type of creek and improvements proposed. The matrix is divided into creek type (i.e., whether the creek is proposed to remain in its natural unimproved) condition or constructed/modified channel. For each type, the creek is further classified as mapped (FEMA designated Zones A and AE), or unmapped. For the specific type and classification of the creek, the following matrix indicates the HEC runs that are required with the Flood Study submittal. Additional HEC runs may be required depending on the analysis.

Flood Study Matrix							
	FEMA Class	City		FEMA			
		1	2	3	4	5	6
Unimproved Creeks	Mapped Zones A & AE	x	x				
	Unmapped	x	x				
Constructed/Modified Open Channels	Mapped Zone A	x	x			x	x
	Mapped Zone AE	x	x	x	x	x	x
	Unmapped	x	x				
<u>HEC Runs</u> Type 1: 25-year fully urbanized conditions model Type 2: 100-year fully urbanized conditions model Type 3: Duplicate effective model Type 4: Corrected effective model Type 5: Existing or pre-project conditions model Type 6: Revised or post-project conditions model							

- 1) Unimproved Creeks (Natural)  
The following HEC runs are required when a natural creek is mapped or unmapped. The information will not be submitted to FEMA.

- HEC analysis based on the 25-year storm event for a fully urbanized watershed (used to define the minimum easement). The 25-year storm event analysis is not required if the 100-year fully urbanized watershed drainage easement is granted.
- HEC analysis based on the 100-year storm event for a fully urbanized watershed (used to define the minimum finished floor (MFF) elevations).

2) Constructed/Modified Open Channels

The following HEC runs will be required when the development will be changing the FIRM or cross sections of the creek significantly. Some of the information will be submitted to FEMA (CLOMR/LOMR).

The following information is required by the City for all mapped or unmapped creeks. This information will not be submitted to FEMA.

- HEC analysis based on the 25-year storm event for a fully urbanized watershed (used to define the minimum easement). The 25-year storm event analysis is not required if the 100-year fully urbanized watershed drainage easement is granted.
- HEC analysis based on the 100-year storm event for a fully urbanized watershed (used to define the MFF elevations).

The following HEC models are required and will be sent to FEMA for review if the creek is within Zone A:

- HEC model based on existing or pre-project conditions – to reflect current conditions prior to the construction of the project using current cross sections and flows from development within the drainage area since the date of effective model.
- HEC model based on revised or post-project conditions – based on current flows plus additional flow caused by the improvements.

The following additional HEC models are required and will be sent to FEMA for review if the creek is within Zone AE:

- Duplicate Effective Model – model used in the effective Flood Insurance Study (can be obtained from FEMA).

- Corrected Effective Model - corrects any errors that occur in the duplicate effective model, adds cross sections, or incorporates more detailed topographic information.

## **8. Drainage Easements**

### **a. Unimproved Creeks**

The minimum easement is the 25-year fully urbanized floodplain.

### **b. Constructed/Modified Open Channels**

The minimum easement is the width of the channel, which shall hold the runoff from the 25-year storm for fully urbanized conditions plus one foot of freeboard. An additional 10 feet shall be dedicated on either side of the channel for access and maintenance.

## **9. Storage (Detention/Retention)**

Stormwater storage shall be designed and constructed with any improvements when downstream structural flooding is known or anticipated or when the capacity of the downstream drainage system is exceeded. The stormwater release rate from the proposed project shall not be greater than the pre-project condition.

For a detention facility, the following criteria shall apply:

- The release rate of the detention facility shall not exceed downstream capacity.
- In cases of structural flooding, the detention facility must detain the difference between the pre and post project conditions.

The storage and release rates from a post-construction landuse shall be evaluated for the 5, 25 and 100-year storm events. The release velocities shall be designed to minimize erosion downstream of the facility. A minimum of one foot of freeboard shall be provided.

All above ground facilities that store more than a total depth of 4 feet shall be designed to meet all state and federal criteria for small dams.

Acceptable design methods include computer model methods outlined in FEMA's approved Hydraulic Models: Determination of Water-Surface Elevation for Riverine Analysis list or manually using the Step Method.

## **10. Positive Overflow**

Positive overflow shall be evaluated for the entire project. Positive overflow means conveying the difference between the 100 year flow and the design frequency flow in a secondary drainage feature without flooding habitable

structures. The secondary drainage feature may be a street, a concrete flume or other permanent facility. When positive overflow is conveyed between lots it shall be contained within a concrete flume at least 4 feet wide (face to face) or a vegetated swale sized to carry the overflow and constructed in a drainage easement between lots.

## **11. Concentrated Runoff from Project**

In areas where concentrated runoff leaves the project, the following information shall be provided:

- The 5, 25 and 100-year design discharge.
- The depth of inundation of these discharges.
- The impacts of the 100-year discharge on flooding, stream channel stability and water quality on existing and proposed off-site facilities from the point at which the runoff leaves the project improvements downstream to the first hydraulic structure on a studied stream (either FEMA FIRM or previously accepted drainage study submitted to the City of Arlington).

Where drainage features such as storm sewer systems, ditches, channels, and natural creeks are available to receive concentrated runoff, the design storm shall be collected and connected to the feature. Calculations shall be performed to demonstrate that each feature receiving runoff is an adequate facility (runoff from the project will not exceed the capacity of the feature).

Upon analysis of the information submitted, the Engineer may be required to provide additional design to address negative impacts from the 100-year discharge. Mitigation plans shall be prepared and submitted as part of the Preliminary Drainage Plan which include, but are not limited to, all necessary on-site and off-site improvements including storage designed in accordance with Section 9 above, storm drainage systems, channel modifications, driveway adjustments and culvert improvements.

When offsite grading is required or the project discharges concentrated flow on an adjacent property, a drainage easement shall be prepared.

## **12. Miscellaneous**

### **a. Valley Gutters**

Transverse valley gutters are not allowed in lieu of an underground drainage system without approval from the PWT. Where approved, the valley gutter shall be a minimum of 8 feet in width for the full width of the street and constructed of reinforced concrete. The street crown transition shall be a minimum of 25 feet in both directions.

**b. Flumes**

Flumes constructed between lots and/or are visible from a street shall be constructed with alternative materials or finishes in lieu of traditional reinforced concrete to soften the appearance. Examples of acceptable alternatives are colored concrete or concrete pavers. Other alternatives may be submitted with the construction plans and will be evaluated for acceptance.

Flumes are not allowed in lieu of an underground drainage system without approval of the PWT.

**c. Temporary Tie-ins to County-Type Roads**

Tie-ins to existing county-type roadways planned for future improvements are considered temporary. Culverts under driveways and roadways shall be a minimum of 18 inches and designed to carry the 5-year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow. If the driveway or roadway is located in an area of shallow bar ditches and a culvert is not feasible, the driveway or roadway shall be constructed with an invert. Other requirements are noted on the typical detail.

**G. TxDOT Submittal**

A permit from TxDOT is required when constructing facilities within state right-of-way. Three sets of 11" x 17" plans shall be submitted to the PWT who will forward the plans to TxDOT for review. A permit from the TxDOT shall be obtained prior to beginning work.

**H. Standard Specifications (Street and Drainage Facilities)**

Street and drainage improvements shall be constructed in accordance with the most recent City of Arlington Special Provisions and the Standard Specifications for Public Works Construction as issued by the North Central Texas Council of Governments (NCTCOG), which is commonly referred to as the standard specifications or NCTCOG specifications. Where any discrepancies occur between the Special Provisions and NCTCOG specifications, the Special Provisions shall govern.

**I. Typical Details (Street and Drainage)**

Street and drainage improvements shall be constructed in accordance with the City's typical details. These details may be obtained through the City's web site or by obtaining a CD-ROM from the PWT. The details are subject to change and it is the responsibility of the engineer to use the most current details. If a detail is not available, it is the responsibility of the design engineer to provide the detail in the plans.

**Section 6.7 Parks Department**

The following describes the requirements for median and right-of-way landscaping requirements.

**A. Tree Types**

The goal of the median and right-of-way landscaping policy is to have stately native trees that line the thoroughfares throughout the City. Trees that provide canopy cover, seasonal color, and food for wildlife were selected based on the species natural range and drought tolerance. To ensure an aesthetically pleasing mix, canopy trees were paired with ornamental trees. Most medians in Arlington range in length from 450 – 600 feet. Due to this fact, combinations of canopy and ornamental species have been selected to insure one combination of trees per median. The following table displays the list of the species combinations.

Combination Number	Canopy Tree	Scientific Name		Ornamental Tree	Scientific Name
1.	Bur Oak	<i>Quercus macrocarpa</i>	and	Flameleaf Sumac	<i>Rhus lanceolata</i>
2.	Shumard Oak	<i>Quercus shumardii</i>	and	Red Bud	<i>Cercis canadensis</i>
3.	Texas Red Oak	<i>Quercus texana</i>	and	Red Bud	<i>Cercis canadensis</i>
4.	Eastern Cedar	Red <i>Juniperus virginiana</i>	and	Texas Smoketree	<i>Cotinus obovatus</i>
5.	Chinquapin Oak	<i>Quercus muehlenbergii</i>	and	Flameleaf Sumac	<i>Rhus lanceolata</i>
6.	Cedar Elm	<i>Ulmus crassifolia</i>	and	Eve's Necklace	<i>Sophora affinis</i>
7.	Chinese Pistache	<i>Pistacia chinensis</i>	and	Possumhaw	<i>Ilex decidua</i>
8.	Western Soap Berry	<i>Sapindus drummondii</i>	and	Yaupon Holly	<i>Ilex vomitoria</i>

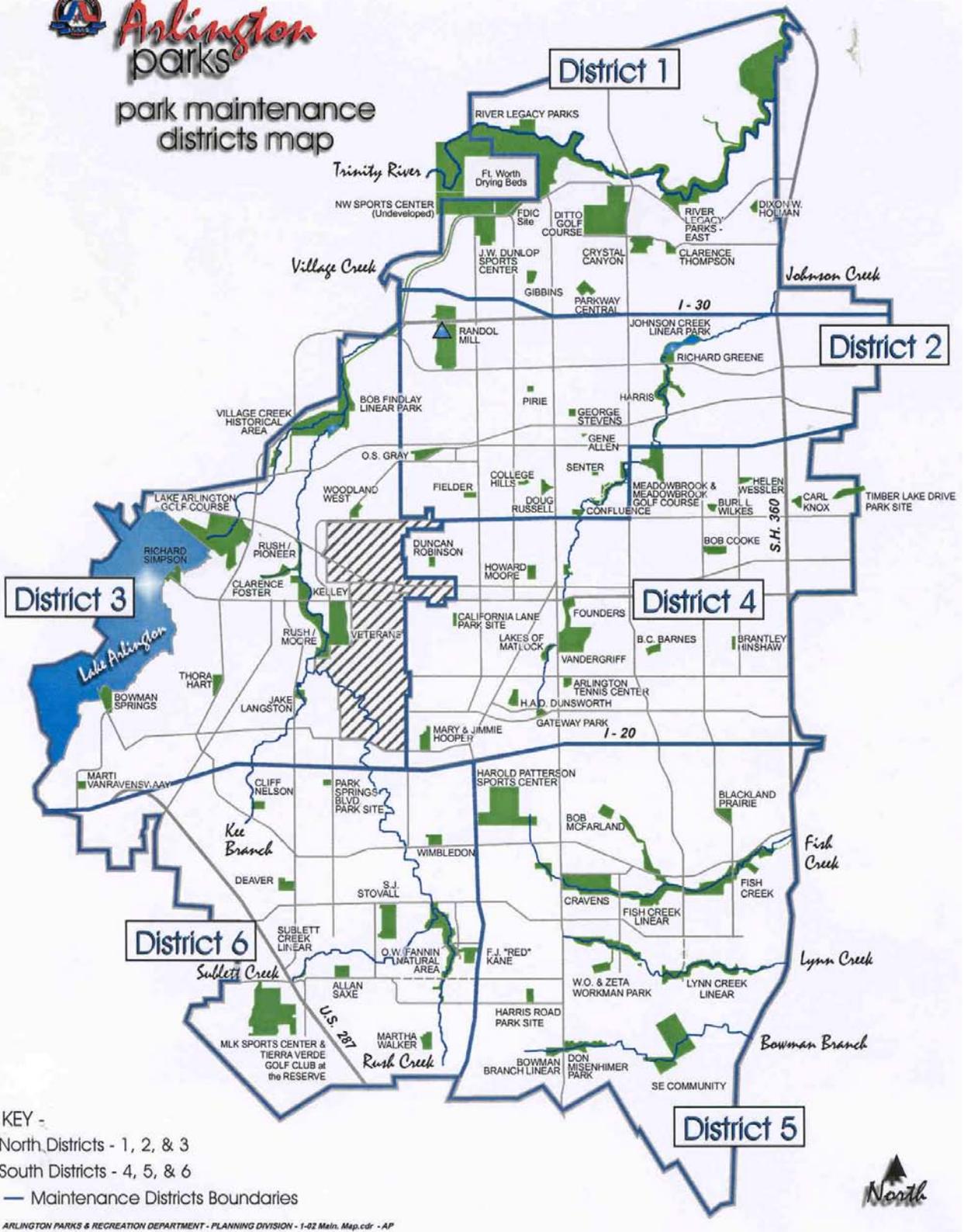
Tree combinations were analyzed to determine suitability for different areas of the City. Soil characteristics and existing vegetation were identified throughout the City. Combinations were established for each of the Parks and Recreation Department’s six maintenance districts.

MAINTENANCE DISTRICT	COMBINATION NUMBER
District 1	1 and 8 (Bur Oak/Flameleaf Sumac and Western Soap Berry/Yaupon Holly)
District 2	2 and 3 (Shumard Oak/Red Bud and Texas Red Oak/Red Bud)
District 3	5 (Chinquapin Oak/Flameleaf Sumac)
District 4	6 (Cedar Elm/Eve’s Necklace)
District 5	4 (Eastern Red Cedar/Texas Smoketree)
District 6	7 (Chinese Pistache/Possomhaw)



# Arlington parks

## park maintenance districts map



### CHAPTER 6 CAPITAL IMPROVEMENTS

## **B. Tree Spacing and Distribution**

All tree combinations, with the exception of Bur Oak and Shumard Oak, should be distributed with canopy trees 40 feet on center and ornamental trees 20 feet on center from a canopy tree. Due to the size of the Bur and Shumard Oak, spacing should be 60 feet on center for the canopy trees with the ornamental trees spacing 30 feet on center from a canopy tree.

Trunk of tree shall be placed three to four feet from street light conduit, and tree shall be placed 50' from street lights. There must be at least five feet from trunk of tree to back of curb for the median to sustain tree planting.

All trees near intersections must be at least 40 feet from the median nose cone. In cases where speed limits are 40 MPH or more, trees shall be 75 feet from median nose cones due to visibility concerns.

For medians that will be widened in future, trees shall be placed such that they will not be disturbed during construction (where practicable).

### **1. Tree Height and Size**

Balled and burlap trees of 3 inch caliper and a minimum root ball size of 36 inches are preferred. The second choice is container-grown trees, with a minimum size of 65 gallons. No additional soil shall be placed over the root ball, and the first root shall be visible after planting. All trees to be planted on medians shall be a minimum of 10 feet tall.

Additional plants, other than trees, shall be in nursery plant containers with the minimum size noted on the plans. The container dimensions shall be as recommended by the American Standard for Nursery Stock (current edition) published by the American Association of Nurserymen.

### **2. Irrigation**

An underground automatic irrigation system approved by the City shall be provided to maintain all landscaped areas. All trees shall be zoned independently of other plantings and shall have two bubblers per tree.

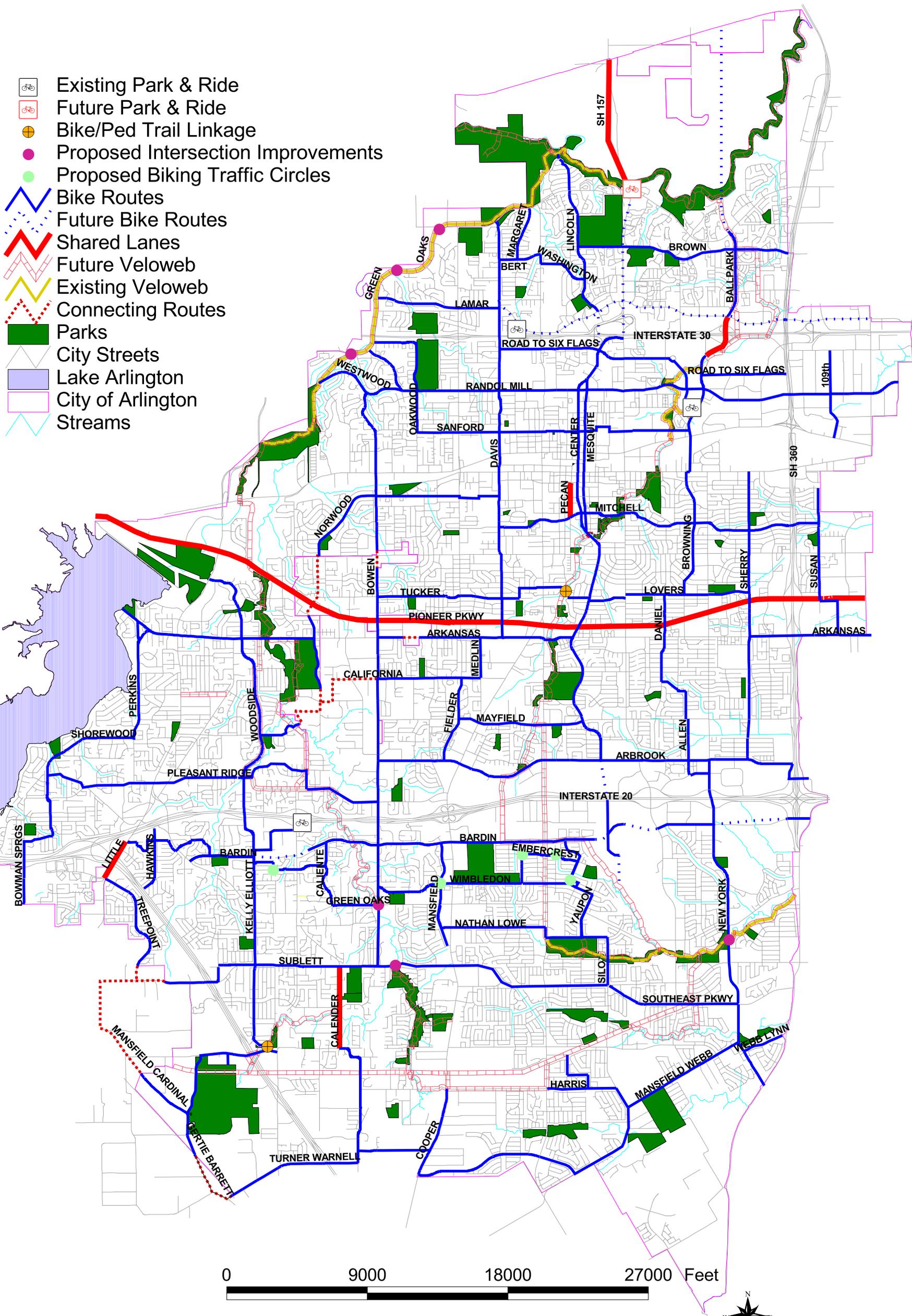
## APPENDICES

APPENDIX A

Bikeway Plan Map

# City of Arlington, Texas Bikeway System

-  Existing Park & Ride
-  Future Park & Ride
-  Bike/Ped Trail Linkage
-  Proposed Intersection Improvements
-  Proposed Biking Traffic Circles
-  Bike Routes
-  Future Bike Routes
-  Shared Lanes
-  Future Veloweb
-  Existing Veloweb
-  Connecting Routes
-  Parks
-  City Streets
-  Lake Arlington
-  City of Arlington
-  Streams



0 9000 18000 27000 Feet



## City of Arlington Bikeway Plan Map

**Introduction** – This map is an illustration of the City of Arlington Comprehensive Bikeway Plan, as amended December, 2002. This Bikeway Plan is a component of Arlington’s Thoroughfare Development Plan. It represents efforts by the City to identify and address bikeway facility needs in the community that may change over time in a rapidly growing environment.

**Bikeway Planning Goals** –The Comprehensive Bikeway Plan is based upon the following long-term goals that were provided by the citizens of Arlington:

- Improve safety for current trips made solely by non-motorized alternative means, including the support of programs which promote the use of helmets and the employment of traffic control devices.
- Increase the service area of bicycle and pedestrian facilities in order to increase the share of trips taken by non-motorized means and provide adequate maintenance for these facilities.
- Provide a system linking residences, employment centers, schools, parks and transit facilities to promote the use of bicycles as an alternative mode of transportation.

**Bikeway Planning Guidelines** - A citywide bikeway system contains a mixture of trails, striped roadway lanes, and signed streets. The shared use trail system, or veloweb, will provide linkages to the DFW regional veloweb system. The on-street portion of this plan, which includes bike routes and bike lanes, will provide linkages to the larger veloweb system to ensure connectivity for both short and long distance bicycle commuting. The Arlington Comprehensive Bikeway Plan is based on standards established in the federally sanctioned “Guide for the Development of Bicycle Facilities,” developed by the American Association of State Highway and Transportation Officials (AASHTO), and the “1995 Bike and Pedestrian Facilities Planning and Design Guidelines,” by the North Central Texas Council of Governments (NCTCOG). This Bikeway Plan was developed to increase the local share of non-motorized trips in order to 1) reduce automobile emissions, and 2) reduce the number of automobiles on major thoroughfares. The Comprehensive Bikeway Plan facility dimensions are consistent with those of the Thoroughfare Development Plan and are listed as follows:

**Bikeway Facility Requirements,  
Thoroughfare Development Plan Requirements and Level of Services Guidelines**

Roadway Classification	No. of Lanes	Anticipated Traffic Volumes Based On C/D LOS	Interior Lane Widths	Shared Lane Curb Lane Widths	Median Widths	Right-of-Way Mid-Block	Shared Lane Right-of-Way Mid-Block	Right-of-Way Intersection	Shared Lane Right-of-Way Intersection	Average Trip Lengths
Freeway	4-10		12'	12'	48'	400'	400'	400'	400'	Over 5 Miles
Fwy Frontage	2-4		12'	12' + 5' Shoulder						
Major Arterial										
8D <sup>b</sup>	8	60,000	12'	15'	16'-20'	140'	150'	160'	170'	Over 5 Miles
7U <sup>c</sup>	7	42,000	12'	15'	None	110'	120'	130'	140'	
6D <sup>b</sup>	6	42,000	12'	15'	16'-20'	120'	130'	140'	150'	3-5 Miles
Minor Arterial										
5U <sup>c</sup>	5	28,000	11'	14'	None	80'	90'	100'	110'	
4D <sup>b</sup>	4	28,000	12'	14'	16'-20'	90'	100'	110'	120'	1-3 Miles
Major Collector										
4U <sup>c</sup>	4	24,000	11'	14'	None	70'	80'	80'	90'	Under 1 Mile
Minor Collector										
3U <sup>c</sup>	2-3	12,000	12'	14'	None	60'	70'	60'	70'	Under ¼ Mile
Veloweb	2	2,000	6'	None	None	30'		30'		5 Miles

<sup>a</sup>1985 Thoroughfare Development Plan, Geometric Design Standards, 1995 Bike and Pedestrian Facilities Planning and Design Guidelines, NCTCOG

<sup>b</sup>D=Divided Roadway With Median

<sup>c</sup>U=Undivided Roadway

**Veloweb** – An interconnected network of off-street trails which makes connections to City roadways and is designed to provide safe, efficient mobility to high-speed bicycle commuters. NCTCOG has planned a regional veloweb network throughout the DFW Metroplex. The City shall seek the development of veloweb along the depicted routes to provide access to adjoining cities.

**Bike Routes (Signed Shared Roadway)** – Signed shared roadways are designated by bike route signs, and serve to provide continuity to other bicycle facilities, designate preferred routes through high demand corridors, and advise automobile drivers that bicycles are present.

**Bike Lanes** – These are streets which delineate the right of way assigned to bicyclists and automobiles by use of appropriate pavement markings and signing and provides for more predictable movements by each.

**Shared Lanes** – Wider curb lane widths are recommended due to the increased separation between pedestrians and vehicular movement, increased maneuvering room, better turning radii for emergency vehicles, and automobiles do not need to change lanes to pass.

**Design Standards** – Standards concerning geometrics are contained in the “Guide for the Development of Bicycle Facilities,” developed by AASHTO, and the “1995 Bike and Pedestrian Facilities Planning and Design Guidelines,” by NCTCOG. Specific questions concerning project designs and/or construction schedules should be directed to the Arlington Capital Improvements Department. The Comprehensive Bikeway Plan represents Arlington’s proposed bikeway network for the Year 2025. It recognizes the need to effectively modify the street system where necessary. The Comprehensive Bikeway Plan and the Thoroughfare Development Plan maps show approximate alignments for arterials, collector streets, veloweb, and the on-street bikeway system. Actual alignments of each roadway and/or bicycle lane/routes will be based on a number of features, including: existing roadways, approved plans and programs for realignment and expansion, approved concept plans, preliminary plats, existing and dedicated right-of-way, and final plats. Roadway and Bikeway locations are also developed with special attention to existing nature features, topography, waterways, flood-prone areas, and other natural features. Existing and proposed man made features such as railroads, major utility lines and facilities, existing developments and property lines are also considered in the City’s design process.

**Amendment Process** – The City, a developer, a neighborhood group or an individual may apply for an amendment to the Thoroughfare Development Plan by contacting the Department of Transportation.

**Important Phone Numbers**

459-6500 – Building Inspections Division  
459-6550 – Public Works

459-5434 – Street Division  
459-6600 – Utilities

459-6350 – Streetlights  
459-6550 – Real Estate Services

459-6650 – Planning & Development Services

## APPENDIX B

### Storm Water Pollution Prevention Plan (SWMSP) Checklist

**STORM WATER MANAGEMENT SITE PLAN (SWMSP) CHECK LIST**

A SWMSP is required for all development that disturbs a surface area of 12,000 SF and creates or adds 5,000 SF or more of impervious surfaces.

**Project name:** \_\_\_\_\_

**Project address:** \_\_\_\_\_

**Pre-application conference:**

**Date:** \_\_\_\_\_

**Developer's POC:** \_\_\_\_\_ **Phone:** \_\_\_\_\_

**EMD's POC:** \_\_\_\_\_ **Phone:** \_\_\_\_\_

**Acreage to be disturbed:** \_\_\_\_\_

**Acreage or square-footage of proposed impervious surface:** \_\_\_\_\_

**Paved private access easement:**            **Yes**    **No**

**Total number of BMPs required:**        **1**    **2**    **3**    **4**

**Are the following existing site features shown?**

Existing two foot contours.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Existing drainage patterns and features.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Existing "C" value (runoff coefficient).	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
"Q" for 2-year, 15-minute duration, storm event before development.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Approximate limit of tree canopy.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Tree survey, if commercial site.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Approximate limit of wetlands.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Soil type and classification.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
100-year flood plain.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA

**Are the following permanent, post-development features shown?**

New two foot contours.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Drainage system layout.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Post-development "C" value (runoff coefficient).	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
"Q" for 2-year, 15-minute duration, storm event.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Site layout.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Areas to be protected from disturbance.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Trees to be saved.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
100-year flood plain.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Drainage easements.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
List of potential pollutants.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
<p>BMP # 1 (describe) _____</p> <ul style="list-style-type: none"> <li>• Design criteria provided.</li> <li>• Appropriate application.</li> <li>• Shown as public or private.</li> <li>• Coordinated with drainage plan.</li> <li>• Coordinated with landscaping plan.</li> <li>• Other comments.</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA

<p>BMP # 2 (describe) _____</p> <ul style="list-style-type: none"> <li>• Design criteria provided.</li> <li>• Appropriate application.</li> <li>• Shown as public or private.</li> <li>• Coordinated with drainage plan.</li> <li>• Coordinated with landscaping plan.</li> <li>• Other comments.</li> </ul>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p>
<p>BMP # 3 (describe) _____</p> <ul style="list-style-type: none"> <li>• Design criteria provided.</li> <li>• Appropriate application.</li> <li>• Shown as public or private.</li> <li>• Coordinated with drainage plan.</li> <li>• Coordinated with landscaping plan.</li> <li>• Other comments.</li> </ul>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p>

BMP # 4 (describe) \_\_\_\_\_

- Design criteria provided.
- Appropriate application.
- Shown as public or private.
- Coordinated with drainage plan.
- Coordinated with landscaping plan.
- Other comments.

Yes  No  NA

APPENDIX C

Storm Water Pollution Prevention Plan (SWPPP) Checklist  
(small sites)

## CHECKLIST FOR SMALL PROJECTS:

**RESIDENTIAL: 12,000 s.f. to 1 ac. DISTURBED**  
**NON-RESIDENTIAL: 0 s.f. to 1 ac. DISTURBED**

### **Project Description: Are the following provided?**

Construction plans or identifying notice containing the following:	
Contact person, company name, address and phone number of each Contractor or other person controlling the daily construction activity at the site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Company name, contact, address and phone number of the site Owner/Developer.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of the site by street address and legal description.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A description of the construction activity.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
SWPPP and plans signed and sealed by a Professional Engineer licensed in Texas.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a

### **Site Map: Does the site map include the following?**

Limits of soil disturbance to avoid disturbing vegetation in areas outside the minimum needed for construction.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of the construction entrance, designed to limit tracking.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of structural storm water and sediment controls.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a

### **Best Management Practices: Are the following practices present?**

Sediment barriers along the down-slope perimeter of disturbed areas and stockpiles where there is a potential for sediment discharge to adjacent property, streets and drainage facilities. Turn ends of sediment barriers up-slope to form sediment traps.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Permanently stabilize exposed soil, within and adjacent to the site, that is disturbed by vehicles, grading and other construction activities.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Prevention of the discharge of building materials, lime, cement, concrete, asphalt, and mortar to the MS4 or to the waters of the United States.	
Liquid tight bermed area (liner required) or other spill protection measure per the Fire Code for any temporary fuel tanks placed on site during construction.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A pit for temporary on-site disposal of concrete waste from mixing drums and chutes.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Note to contain all runoff from materials used in the subgrade stabilization process.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Covered trash receptacle for on site litter and construction debris provided.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Notes requiring inspections by the permittee(s) once every 2 weeks and within 24 hours after a storm event of 0.5 inches or more.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a

Do the inspections include:	
Disturbed areas of the construction site that have not been stabilized.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Areas used for storage of materials that are exposed to precipitation.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Structural control measures.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Locations where vehicles enter or exit the site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Identification of measures that need to be maintained, modified, or added to correct problems.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Comments:	

**STORM WATER MANAGEMENT SITE PLAN (SWMSP) CHECK LIST**

A SWMSP is required for all development that disturbs a surface area of 12,000 SF and creates or adds 5,000 SF or more of impervious surfaces.

**Project name:** \_\_\_\_\_

**Project address:** \_\_\_\_\_

**Pre-application conference:**

**Date:** \_\_\_\_\_

**Developer's POC:** \_\_\_\_\_ **Phone:** \_\_\_\_\_

**EMD's POC:** \_\_\_\_\_ **Phone:** \_\_\_\_\_

**Acreage to be disturbed:** \_\_\_\_\_

**Acreage or square-footage of proposed impervious surface:** \_\_\_\_\_

**Paved private access easement:**            **Yes**    **No**

**Total number of BMPs required:**        **1**    **2**    **3**    **4**

**Are the following existing site features shown?**

Existing two foot contours.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Existing drainage patterns and features.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Existing "C" value (runoff coefficient).	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
"Q" for 2-year, 15-minute duration, storm event before development.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Approximate limit of tree canopy.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Tree survey, if commercial site.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Approximate limit of wetlands.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Soil type and classification.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
100-year flood plain.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA

**Are the following permanent, post-development features shown?**

New two foot contours.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Drainage system layout.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Post-development “C” value (runoff coefficient).	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
“Q” for 2-year, 15-minute duration, storm event.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Site layout.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Areas to be protected from disturbance.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Trees to be saved.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
100-year flood plain.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Drainage easements.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
List of potential pollutants.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
BMP # 1 (describe) _____ <ul style="list-style-type: none"> <li>• Design criteria provided.</li> <li>• Appropriate application.</li> <li>• Shown as public or private.</li> <li>• Coordinated with drainage plan.</li> <li>• Coordinated with landscaping plan.</li> <li>• Other comments.</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA

<p>BMP # 2 (describe) _____</p> <ul style="list-style-type: none"> <li>• Design criteria provided.</li> <li>• Appropriate application.</li> <li>• Shown as public or private.</li> <li>• Coordinated with drainage plan.</li> <li>• Coordinated with landscaping plan.</li> <li>• Other comments.</li> </ul>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p>
<p>BMP # 3 (describe) _____</p> <ul style="list-style-type: none"> <li>• Design criteria provided.</li> <li>• Appropriate application.</li> <li>• Shown as public or private.</li> <li>• Coordinated with drainage plan.</li> <li>• Coordinated with landscaping plan.</li> <li>• Other comments.</li> </ul>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p>

BMP # 4 (describe) \_\_\_\_\_

- Design criteria provided.
- Appropriate application.
- Shown as public or private.
- Coordinated with drainage plan.
- Coordinated with landscaping plan.
- Other comments.

Yes  No  NA

APPENDIX D

Storm Water Pollution Prevention Plan (SWPPP) Checklist  
(large sites)

## CHECKLIST FOR TCEQ REGULATED CONSTRUCTION PROJECTS

**ALL PROJECTS: 1 ac. OR MORE DISTURBED**

**Site/Project Description: Are the following provided?**

Nature of Construction Activity.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Potential pollutants and sources	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Sequence of major soil disturbing events.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Total number of acres of the entire property	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Total number of acres where construction activities will occur, including off-site material storage, overburden and stockpiles of dirt and borrow areas.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A map showing the general location of the site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Which permittee is responsible for each event.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Listing of controls associated with each event.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Existing data describing the soil and quality of any discharge from the site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A copy of the signed Notice of Intent for owner if site larger than 5 acres.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A copy of the signed Notice of Intent for contractor if site larger than 5 acres.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A copy of the TCEQ site notice.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Signature of the owner and operator.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A copy of the TPDES General Permit.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Signature and seal of a Professional Engineer licensed in Texas.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Comments:	

**Site Map: Have plans been provided that include the following?**

Topographic map of the site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Existing drainage patterns.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Proposed drainage patterns and approximate slopes after grading activities..	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Locations where stabilization practices are expected to be used.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Locations of major storm water controls.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Limits of soil disturbance.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of off-site borrow materials.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of off-site equipment storage areas.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of on-site or near site wetland or surface waters.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of storm water discharges to on-site or near-site wetland or surface waters.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of on-site and off-site support activities (asphalt/concrete plant).	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Location of industrial discharges to on-site or near-site wetland or surface waters.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Name of receiving water(s) (location or direction).	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Comments:	

**Best Management Practices: Are the following practices present?**

Velocity dissipation devices at discharge locations and along the length of any outfall channel to provide a non-erosive flow velocity from the structure to the watercourse (i.e., no significant changes in the hydrological regime of the receiving water).	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Measures to minimize off-site vehicle tracking.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Measures to minimize and generation of dust.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Fencing to protect any vegetation to be preserved.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Updateable list of materials to be stored on-site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Covered trash receptacle for on-site litter and construction debris.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A temporary detention structure if 10 or more acres drain to a common point or a discussion of why it is not feasible.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A pit for temporary on-site disposal of concrete waste from mixing drums and chutes.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A liquid tight bermed area (liner required) or other spill protection measure per the Fire Code for any temporary fuel tanks placed on site during construction.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A list of allowable non-storm water discharges and indicate appropriate control measures for non-storm water components of the discharge?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A note that ensures and demonstrates compliance with applicable federal, state and/or local waste disposal, sanitary sewer or septic system regulations?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A list of measures to be installed during construction that will remain after construction and be used to control pollutants in the storm water?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Are the measures provided adequate and in compliance with the Design Criteria Manual?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Comments:	

**Site Maintenance: Are the following activities included?**

The maintenance of all erosion and sediment control measures and other protective measures to ensure effective operating conditions.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
The inspection of adjacent areas daily, and the pick up of construction waste materials, debris, and fugitive sediment that have blown or washed off-site.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Updates of the plan that may be necessary to protect surface water resources when the permittee is notified of such changes.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Sediment removal from controls (to include silt fences, ponds, etc...) when design capacity is reduced by 50%.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a

**Site Inspection:**

Does the SWPPP provide for inspections by the permittee(s) once every 2 weeks and within 24 hours after a storm event of 0.5 inches or more. Alternatively inspections may be performed once every 7 days without additional inspections after rain events.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Is an example inspection checklist provided?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Do the inspections include:	
A place for the inspector's name and qualifications?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A place for the date(s) of the inspection(s) to be recorded?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Disturbed areas of the construction site that have not been stabilized?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Areas used for storage of materials that are exposed to precipitation?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Structural control measures?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Locations where vehicles enter or exit the site?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Identification of measures that need to be maintained, modified, or added to correct problems (and specify update of plan within 7 calendar days)?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
A place to be signed in accordance with 30 TAC § 305.128?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Is the checklist provided adequate?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Comments:	

**Site Stabilization:**

Does the SWPPP include a description of interim and permanent stabilization practices for the site, including a schedule of when the practices will be implemented? (Examples include temporary/permanent seeding, mulching, geotextiles, sod, etc...)	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Does the SWPPP address initiation of stabilization measures by the 14 <sup>th</sup> day where construction activity temporarily or permanently ceases and will not resume on that portion of the site within 21 days?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Does the SWPPP include a note requiring the removal of all temporary controls and filing of an Notice of Termination when final stabilization is achieved?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Are stabilization specifications adequate and in compliance with the Design Criteria Manual?	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Does the SWPPP include a requirement to maintain records that include dates of major grading activities, dates when construction stops temporarily or permanently, and the date when stabilization are initiated.	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> n/a
Comments:	

APPENDIX E

Water Utilities Engineering Department  
Plan Review Information

The following checklist is to serve as a helpful reminder of the information required on the water and sanitary sewer plan. It is not intended to replace reading the ordinance. Questions should be directed to the Engineering Staff in Water Utilities Department at 817-459-6600.

General Information:

1. Label the addition (name, lot, and block) on the plans in the title block.
2. Include a site location map on the plans.
3. All plans including water and sanitary sewer detail sheets shall be stamped, signed, and dated by the Licensed Texas Professional Engineer responsible for the design.
4. Include the latest revised standard City of Arlington details as appropriate stamped, signed & sealed by the Licensed Texas Professional Engineer responsible for the design.
5. A North directional arrow shall be included on all sheets.
6. All sheets shall be 24-inches by 36-inches.
7. Label all street names.
8. Include a City approved Bench Mark on all approved water and sanitary sewer plans.
9. All utility easements submitted shall consist of correct field notes and exhibit(s) describing the proposed easement exclusively. The field notes and the exhibit(s) will be placed on separate sheets (8½"x11" or 8½"x14"). Each sheet shall be stamped, signed, and dated by the Texas Professional Registered Surveyor responsible for the work. All surveys shall comply with the surveying standards as set forth in the Texas Surveyors Association Manual of Practice for Land Surveying in Texas. The field notes, the exhibit(s) and the name of the property owner for any proposed utility easements must be submitted to this office, as prescribed above, for placement on the proper City form.

Payment of filing fees shall be coordinated with Ms. Linda Regalado, City of Arlington Real Estate Services Division. The forms should be signed and notarized by the appropriate person(s) and returned to this office for filing prior to beginning construction on this project.

10. A Texas Department of Transportation Permit will be required when entering right-of-way to access utilities. Enclosed is the proper form to be completed by your office and returned to me for signing. It will be necessary for five (5) copies of the permit application and five (5) sets of approved drawings to be submitted to this office for the City of Arlington to sign and submit to the

Texas Department of Transportation. The permit will have to have been approved by the Texas Department of Transportation prior to beginning construction on this project.

11. A Street Cut Permit, issued by the Engineering Services Department, will be required before open cutting or boring. Failure to acquire the proper permit and permission may result in a fine of \$500 per day to the contractor doing the work.
12. As a result of State Legislation, all construction projects in which trench excavation will exceed five feet (5') shall have detailed plans and specifications for adequate safety systems that meet OSHA standards. These plans and specifications shall include a separate pay item for the safety systems. However, it is department policy to require a Trench Safety Plan on every water and/or sanitary sewer construction project regardless of depth. These plans or details shall be stamped, signed, and dated by a Licensed Texas Professional Engineer and submitted with the 3-way contracts prior to the beginning of construction.
13. In order to facilitate a final review please return the enclosed marked-up set of plans. Any subsequent reviews will not occur until the marked-up set and the corrected set of plans has been returned to this office.
14. A deed restriction statement will have to be submitted before construction can begin on water or sanitary sewer mains for the residential subdivision development.
15. Prior to beginning any construction on this project, a "Storm Water Pollution Prevention Plan (SWPPP)", (sealed by a Licensed Professional Engineer of the State of Texas) meeting the minimum requirements of the City of Arlington ordinances must be submitted to Environmental Management Division, for approval. This plan shall be submitted and approved before any excavation, clearing, grubbing, or grading can commence. If this erosion control plan is installed under a separate contract, a bid item must be included in the proposal of the three party contracts for maintenance of the erosion control plan by the utility contractor.
16. A barricade plan will need to be submitted for any utility work that will cause lane closures.
17. Any request for City participation in oversize, offsite, or perimeter water and/or sanitary sewer lines shall be submitted and approved by Council prior to executing 3-way contracts and beginning construction. Any participation request submitted during or after construction will not be accepted.

Water Checklist:

18. All fire protection, including line sizing, shall be approved by the City of Arlington Fire Inspections Department, located on the second floor of the City Municipal Building at 101 West Abram Street (817) 459-8100.

19. All water mains using poly-wrapped ductile iron pipe shall be Class 350.
20. Gate valves are not required on fire hydrant leads being fed from water mains smaller than twelve inches (12").
21. Label the location to enter and exit the poly pigs for all proposed water mains.
22. Fire hydrants shall be located in protected areas where easily accessible.
23. Fire hydrants shall be located three to five feet (3'-5') from back of the curb, and shall not exceed eight feet (8') from back of the curb.
24. Water lines, fire hydrants, and service lines, up to and including water meters, shall be located in easily accessible and protected areas outside of traffic, preferably in parkways and islands.
25. Add the following note to your plans: "NOTE: There shall be a minimum cover of forty-two inches (42") over the water pipe as measured from the top of the pipe to the existing ground, or the proposed finished grade, whichever is greater."
26. Place an arrow next to each fire hydrant in order to indicate the direction the steamer nozzle should be installed.
27. Label the water lines as "PRIVATE" if applicable.
28. A profile shall be submitted for any 12" or larger water main.
29. The water main shall be installed in the parkway out from under the pavement. The location shall be dimensioned on the plans.
30. Call out all necessary fittings for the water main.
31. Detail the location of the fire hydrant being relocated in relation to the property line.
32. Station the water services.
33. Please have the utility contractor contact Mr. Dan Peden in Engineering Services/Inspections prior to beginning construction on any private water lines.
34. Enclosed is the *Mutual Covenant to Maintain Private Water Lines*, which is to be completed and executed by the owner prior to beginning construction. The executed Mutual Covenant should be returned to Claire Terry, Fire Prevention Specialist, 101 West Abram Street, along with a check for \$13.00 for filing.

35. Where meter banks are installed, permanent metal tags with addresses shall be installed on the service line at the curb stop to correlate the service with the address to be serviced.
36. All water services shall be one-inch (1") minimum.
37. Show the distances from the property line for water services within a cul-de-sac.
38. Always stub two (2) joints past the gate valve prior to plugging the main.
39. Please have the utility contractor contact Meter Services, or Mr. Dan Peden in Engineering Services/Inspections, prior to installing the detector check.
40. Detector check valves and/or water meters shall be installed within existing right-of-way outside of traffic, sidewalks, and driveways. If there is no space available, a utility easement will need to be provided.
41. All private fire hydrant bonnets shall be painted red.
42. Water services, which are 2-inches or smaller, shall be tapped on fire hydrant leads being fed from water mains larger than 16-inches.
43. Per the Arlington Fire Department, a fire hydrant shall be installed at the entrance of cul-de-sacs 200-feet in length and greater.
44. Per Water Utilities Field Operations, a fire hydrant shall be placed on the end of all dead end lines.
45. For single family residences, fire hydrants shall be spaced to have an effective radius of five hundred feet (500') or a fire hose laying distance of six hundred feet (600'), whichever gives the closer fire hydrant spacing.
46. A minimum eight-inch (8") main shall be installed where the length of the line exceeds eight hundred feet (800').

Sanitary Sewer Checklist Comments:

47. The contractor shall use OSHA approved confined space entry procedures when entering sanitary sewer manholes. The safety equipment shall be furnished by the contractor and shall be OSHA certified. Persons working in these areas shall be trained in the proper use of the safety equipment.
48. The maximum spacing for manholes is every five hundred feet (500'). Manholes are required at angle points, grade changes and line size changes. No vertical curve is allowed.

49. Five foot (5') inside diameter manholes are required under any of the following conditions:
  - the depth from top of cover to bottom of the manhole is 10' or greater,
  - a 15-inch or larger sewer connects to the manhole, or
  - the manhole is a drop-manhole.
50. Label the sewer lines as "PRIVATE" if applicable.
51. Give the flow line elevation of all sanitary sewer mains at each station and at fifty-foot (50') intervals.
52. A maximum of three (3) sewer services should be installed from a manhole.
53. A profile shall be submitted for all proposed sanitary sewer mains.
54. Station the sanitary sewer services.
55. The utility contractor shall set the tops of manholes at one foot (1') below the top of the subgrade where in future pavement, or flush with the existing ground where in parkway type areas. The paving contractor shall bring the manholes up to grade with his contract.
56. Rework the invert where tying into an existing manhole.
57. Show any proposed storm sewer where conflicts might arise. Show the flowline elevation of each service at the property where proposed storm sewer crosses over sanitary sewer services. If there is less than 2' of clearance between the storm sewer and sanitary sewer services, the sanitary sewer services will need to be ductile iron or concrete encased.
58. Show the 100-year flood plain boundary lines on plan view and reference the elevation on the profiles. All manholes and cleanouts shall have watertight rings where within the 100-year flood plain.
59. Show the distances from the property line for the sanitary sewer services within a cul-de-sac.
60. The City of Arlington logo on the manhole lid shall not be used on private sewer lines.
- 61.

The three (3) sets of contract documents shall be executed by the owner and the water and sanitary sewer contractor. Please return all three (3) executed sets of documents to Joyce Mallow in the Water Utilities Engineering Department (459-6629), along with the following items.

- An insurance certificate in each set showing proper coverage (at least one set has the original)
- Copy of the low bid

- Deed restriction statement
- A check for the 3¼% construction inspection fee (minimum \$250.00)
- Street Cut Permit
- Texas Department of Transportation Permit
- Mutual Covenant
- Storm Water Pollution Prevention Plan (SWPPP) approved by City of Arlington Environmental Management
- Trench Safety Plans

Please submit these items, as well as the red marked plans, and a minimum of one (1) set of the revised construction plans to this office for final review. It will be necessary for this office to receive all of the above items and approved water and sewer construction plans (a total of six (6) sets) prior to construction beginning on the project.

Upon our acceptance and receipt of all of the aforementioned items, the contractor shall notify Dan Peden of Engineering Services/Inspection (459-6550), at least twenty-four (24) hours prior to beginning construction on this project, and prior to setting the water meter boxes, so that we may have an inspector present. It will be the consulting professional engineer's responsibility to convey this information to the appropriate parties.

A copy of this letter must be presented at the Customer Services Office, 101 West Abram Street or 1100 SW Green Oaks Boulevard, when paying for the turbo-meter or detector check and other appropriate fees.

:\eng\ltr\dev\active\wsaddcorrect

APPENDIX F

Thoroughfare Development Plan Map

# THOROUGHFARE DEVELOPMENT PLAN

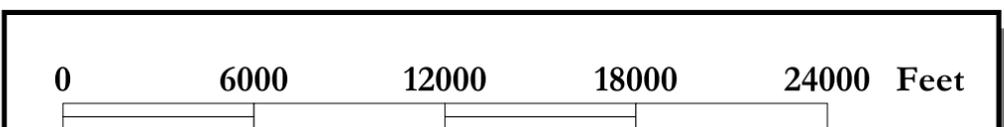
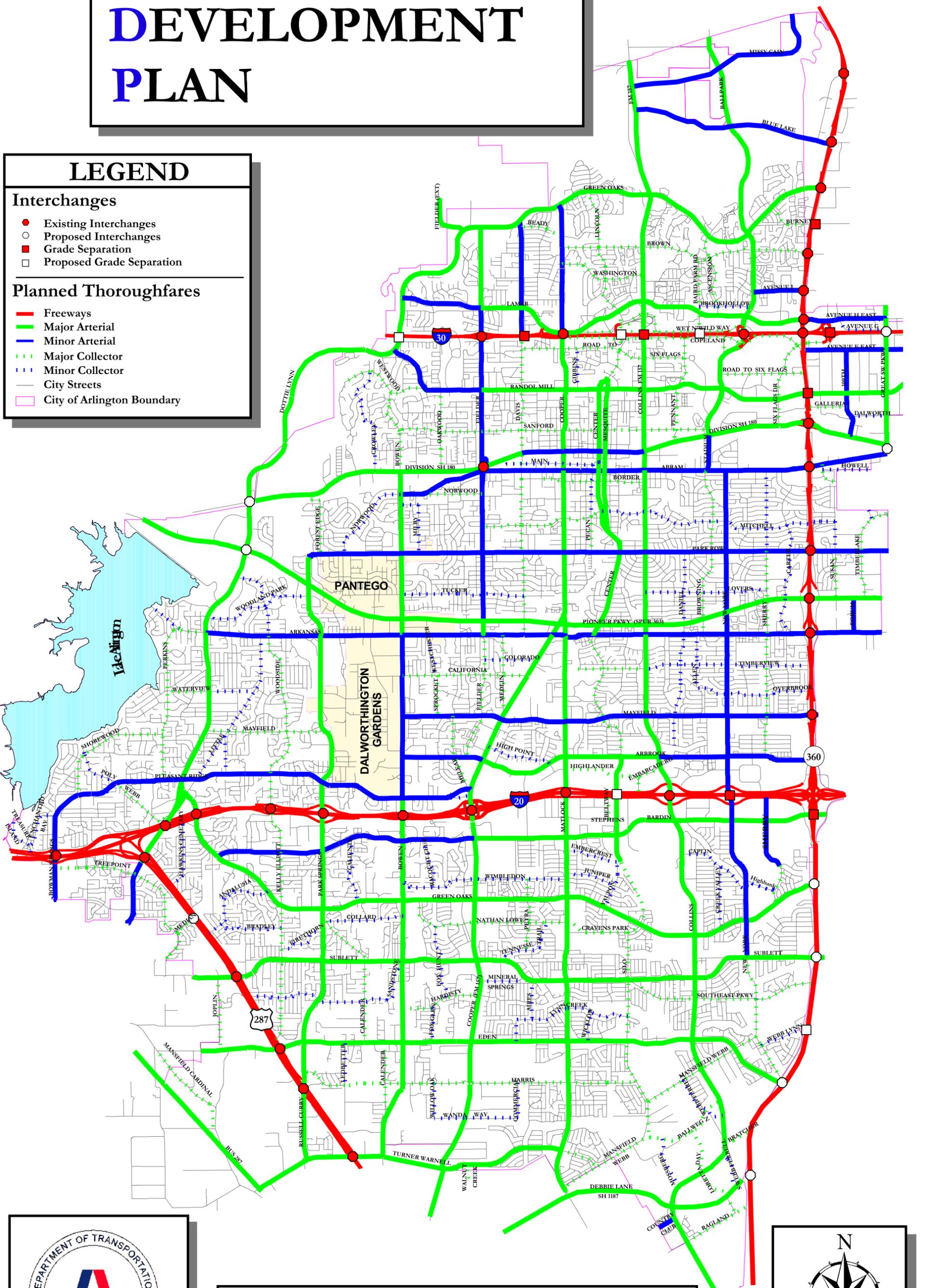
## LEGEND

**Interchanges**

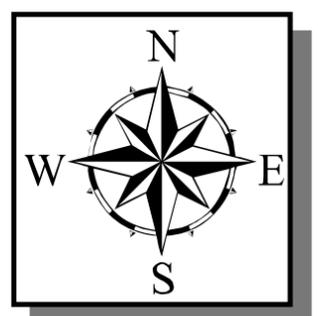
- Existing Interchanges
- Proposed Interchanges
- Grade Separation
- Proposed Grade Separation

**Planned Thoroughfares**

- Freeways
- Major Arterial
- Minor Arterial
- Major Collector
- Minor Collector
- City Streets
- City of Arlington Boundary



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March, 2002



## City of Arlington Thoroughfare Development Plan (TDP) Map

**Introduction** – This map and the accompanying Bikeway Plan is an illustration of the Draft Thoroughfare Development Plan. These represent efforts by the City to identify transportation needs that change over time in a rapidly growing environment.

**Thoroughfare Planning Guidelines** – A thoroughfare system contains a hierarchy of roadways, each of which is intended to serve defined needs with a specific balance between movement and access. The elements of the Arlington Thoroughfare Development Plan Map are freeways, strategic regional arterials, major arterials, minor arterials, collector streets, and veloweb. The Arlington TDP Map was developed in conjunction with a nationally developed traffic demand model known as TRANPLAN and the federally sanctioned “Guide for the Development of Bicycle Facilities” developed by the American Association of State Highway and Transportation Officials (AASHTO). The TRANPLAN model determines daily traffic volumes for the Year 2025 using projected growth trends, patterns, and land uses provided by the City of Arlington Planning Department. Using the existing thoroughfare street segments as a base, a network of roadway elements was developed to serve projected demands while maintaining acceptable levels of circulation and congestion. The characteristics of each specific roadway type are shown in the following table:

**Thoroughfare Development Plan (TDP) Designations and Level of Services (LOS) Guidelines**

Roadway Classification	No. of Lanes	Anticipated Traffic Volumes Based On C/D LOS	Interior Lane Widths	Shared Lane Curb Lane Widths	Median Widths	Right-of-Way Mid-Block	Shared Lane Right-of-Way Mid-Block	Right-of-Way Intersection	Shared Lane Right-of-Way Intersection	Average Trip Lengths
Freeway	4-10		12'	12'	48'	400'	400'	400'	400'	Over 5 Miles
Fwy Frontage	2-4		12'	12' + 5' Shoulder						
Major Arterial 8D <sup>b</sup> 7U <sup>c</sup> 6D <sup>b</sup>	8 7 6	60,000 42,000 42,000	12' 12' 12'	15' 15' 15'	16'-20' None 16'-20'	140' 110' 120'	150' 120' 130'	160' 130' 140'	170' 140' 150'	Over 5 Miles  3-5 Miles
Minor Arterial 5U <sup>c</sup> 4D <sup>b</sup>	5 4	28,000 28,000	11' 12'	14' 14'	None 16'-20'	80' 90'	90' 100'	100' 110'	110' 120'	1-3 Miles
Major Collector 4U <sup>c</sup>	4	24,000	11'	14'	None	70'	80'	80'	90'	Under 1 Mile
Minor Collector 3U <sup>c</sup>	2-3	12,000	12'	14'	None	60'	70'	60'	70'	Under ¼ Mile
Veloweb	2	2,000	6'		None	30'		30'		5 Miles

<sup>a</sup>1985 TDP, Geometric Design Standards, 1995 Bike and Pedestrian Facilities Planning and Design Guidelines, North Central Texas Council of Governments (NCTCOG)

<sup>b</sup>D=Divided Roadway With Median

<sup>c</sup>U=Undivided Roadway

**Freeway or Expressway** – This classification emphasizes the movement of traffic with little or no access to adjacent land. It is characterized by a high degree of access control and is normally used for longer trip lengths at higher speeds. It serves major centers of activity and high volume traffic corridors. The network formed is integrated and generally offers connections to the entire region. Frontage roads require paved shoulders due to high speed access and egress movements.

**Class I Strategic Regional Arterial** – A partially controlled access arterial serving multiple jurisdictions with design emphasis toward continuous regional traffic flow using grade separations at major intersections, curb and median access controls and signal progression.

**Class II Strategic Regional Arterial** – A major arterial roadway linking multiple jurisdictions designed to serve the movement of traffic allowing for grade separations at isolated intersections, curb and median access controls, and signal progression.

**Arterial** – Arterial streets serve major movements of traffic within an urbanized area while still providing some degree of access to adjacent property. They generally move high volumes of traffic through the City and provide access to the freeway and expressway network. Arterial streets are divided into two sub-categories, or types, based on trip lengths and traffic volumes. These sub-categories are major arterial and minor arterial. The major arterial carries higher volumes with longer trip lengths and is typically a six lane or eight lane divided roadway. The minor arterial is normally a four-lane divided facility. The speed of the minor arterial is generally lower and the trip lengths shorter than the major arterial.

**Collector** – The function of collector streets is two-fold. They serve to distribute traffic from arterials to local streets and adjacent land uses. They also collect traffic from local areas and distribute it to the arterial network. Major collectors are normally four lane undivided streets with rather rigid traffic controls. Major collectors are often found in areas with significant traffic movement, such as industrial and business parks and retail areas. They may include flared intersections to accommodate left and right turn lanes at busier intersections. The minor collector generally accommodates two moving lanes of traffic, is undivided, and allows some parking on each side.

**Shared Lanes** – Wide outside lanes prevent congestion delays when bicyclists are present, increase the separation between pedestrians and vehicular movement, and provide better turning radii for emergency vehicles. Bikeway Curb Lane widths shall be applied to new arterial and collector roadways.

**Veloweb** – An interconnected network of off-street trails which makes connections to City roadways and is designed to provide safe, efficient mobility to high-speed bicycle commuters. The veloweb alignment and Shared Lanes are depicted on the Arlington Bikeway System Plan Map.

**Design Standards** – Standards concerning horizontal and vertical street alignments are contained in the City of Arlington Subdivision Rules and Regulations. Specific questions concerning project designs and/or construction schedules should be directed to the Arlington Capital Improvements Department. The TDP represents Arlington’s street network for the Year 2025. It recognizes the need to effectively use the City’s current network and to modify that system as necessary. The TDP Map shows the approximate alignments for arterial, collector streets, and the veloweb. Actual alignments of each roadway and/or bicycle lane/routes will be based on a number of features, including: existing roadways, approved plans and programs for realignment and expansion, approved concept plans, preliminary plats, existing and dedicated right-of-way, and final plats. Roadway locations are also developed with special attention to existing nature features, topography, waterways, flood-prone areas, and other natural features. Existing and proposed man made features such as railroads, major utility lines and facilities, existing developments and property lines are also considered in the City’s design process.

**Amendment Process** – The City, a developer, a neighborhood group or an individual may apply for an amendment to the Thoroughfare Development Plan by contacting the Department of Transportation.

**Traffic Studies** – Developers and landowners are sometimes required to do traffic studies before zoning is granted or permits are issued. A traffic study may be necessary to assess the impacts of the specific development activity on the existing and planned roadway system. Development activities that could require a traffic study include rezoning, preliminary and final plats, development plan approvals, building permits, driveway permits, certificates of occupancy, annexations, and TDP amendments. There are two levels of traffic studies that may be required. A Traffic Impact Analysis (TIA) is a comprehensive study of all aspects of a development’s probable impacts on the transportation system. A TIA will be required when a development plan or preliminary plat proposes development which exceeds 5,000 trip ends per day and in a rezoning request the trip generation of the current zoning is exceeded by 1,000 vehicles per day. A Traffic Circulation Analysis (TCA) is a study of how a development’s traffic relates to traffic on internal and immediately adjacent roadways. A TCA may be required for zoning cases generating more than 500 but less than 5,000 vehicle trip ends per day. The specific content requirements for Traffic Studies are provided in a separate document, “Traffic Study Guidelines,” available in the Transportation Department. Trip generation estimates shall be based on the latest data contained in the Institute of Transportation Engineers Trip Generation Manual.

**Roadway Impact Fees** – Roadway Impact Fees are charged in Arlington to assess new development for the cost of roadway facilities necessary to serve the development’s traffic demand. The fee charged is dependent upon land use, location, and the number of vehicle miles the development will generate during the P.M. peak hour of the adjacent roadway network. Roadway Impact Fees are calculated and collected by the Building Inspections Department at the time of building permit issuance. Questions regarding offsets and credits to these fees should be directed to the Capital Improvements Department.

**Important Phone Numbers**

459-6500 – Building Inspections Division  
459-6550 – Public Works

459-5434 – Street Division  
459-6600 – Utilities

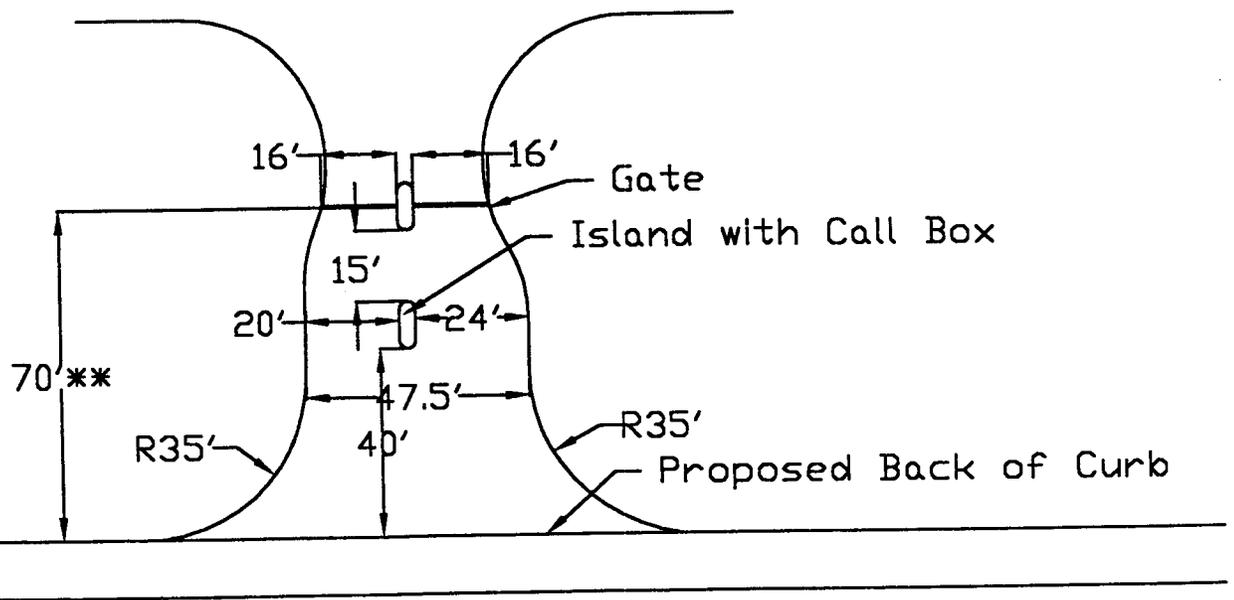
459-6350 – Streetlights  
459-6550 – Real Estate Services

459-6650 – Planning & Development Services

## APPENDIX G

### Gated Entry Layouts

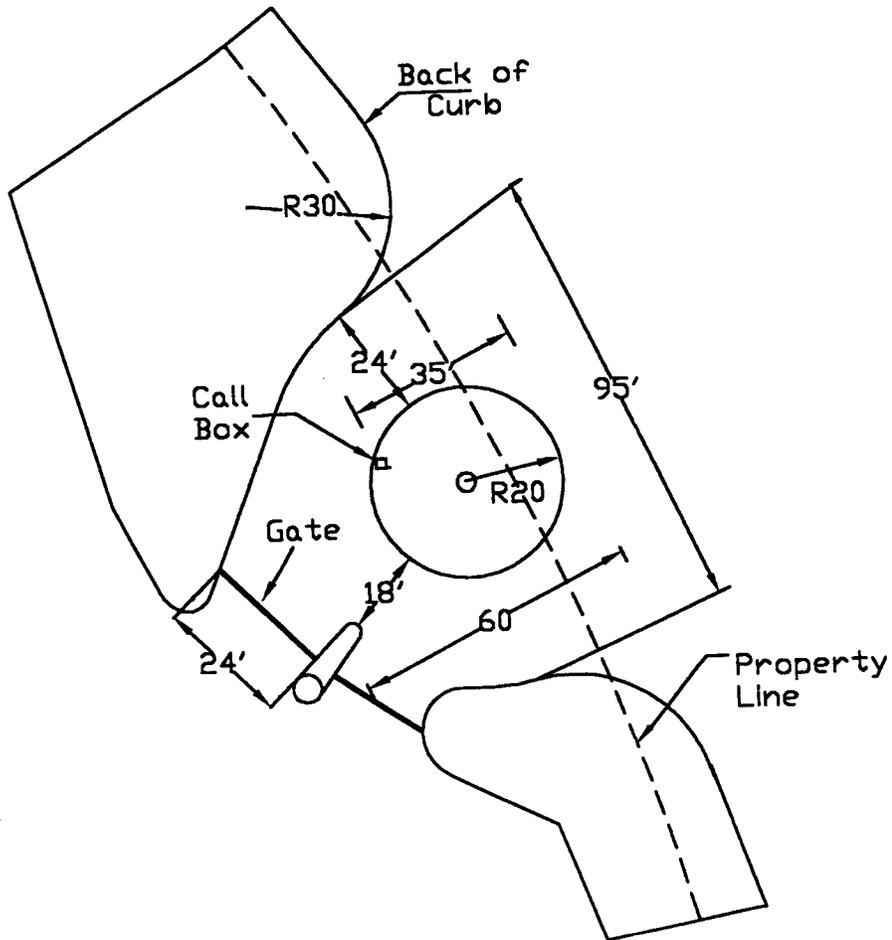
# Typical Residential Gated Entry Design



*\*NOTE: All dimensions are minimums.*

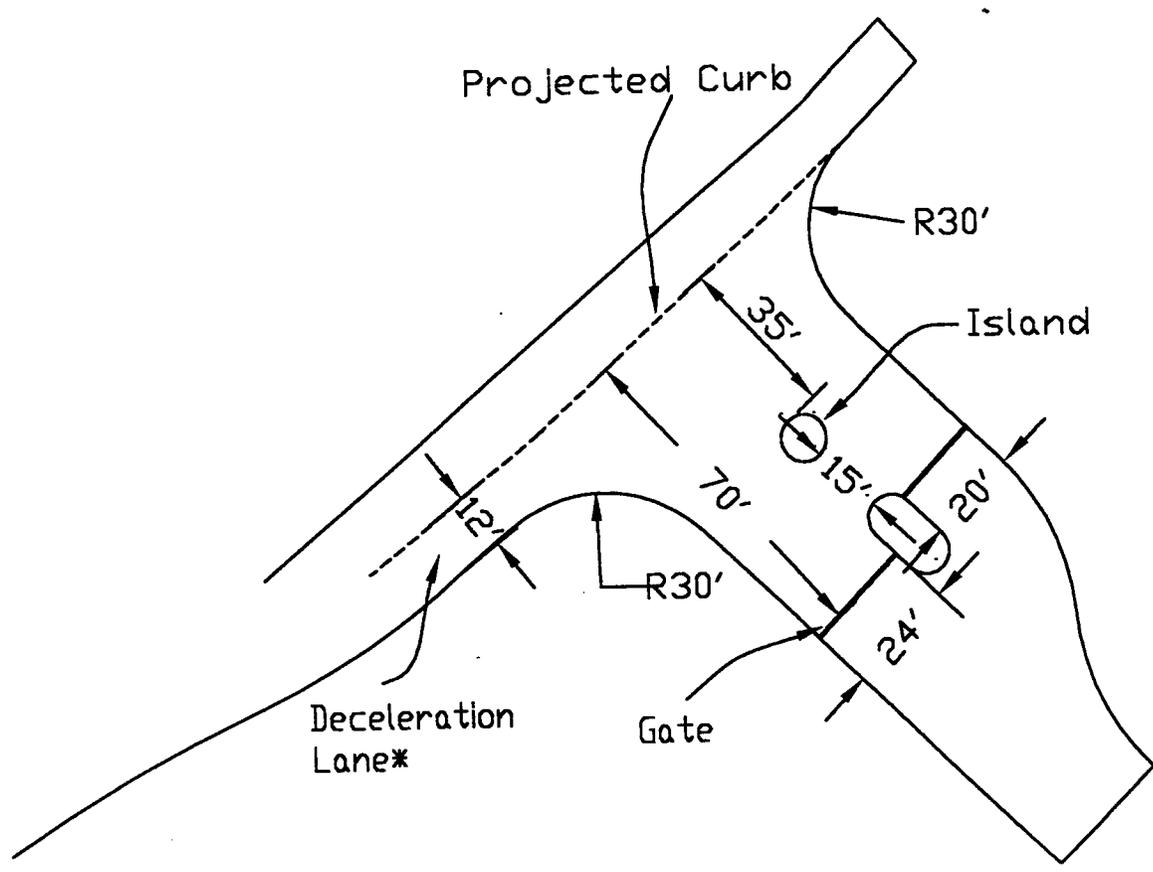
*\*\*NOTE: Distance between back of curb and gate may vary depending on traffic generated by site.*

# Circular Gated Entry



*\*NOTE: All dimensions shown are minimums.*

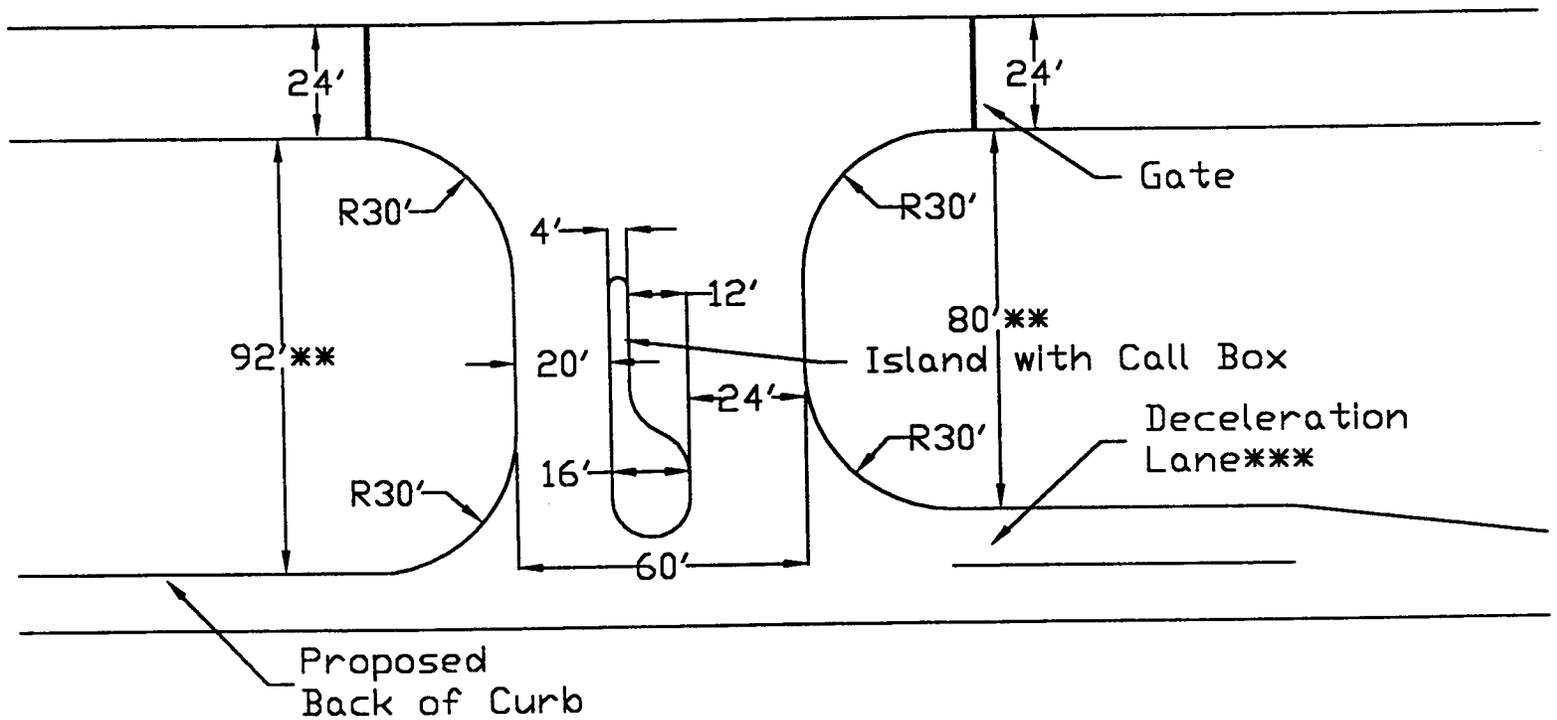
# Gated Entry for High Volume/High Speed Entry Way



*\*NOTE: Deceleration Lane length varies based on traffic generated.  
Minimum length=75'*

*\*\*NOTE: All dimensions shown are minimums*

# Typical Multi-family Gated Entry Design



*\*NOTE: All dimensions are minimums.*

*\*\*NOTE: Distance between back of curb and gate may vary depending on traffic generated by site.*

*\*\*\*NOTE: Deceleration lane length may vary depending on traffic generated by site.*

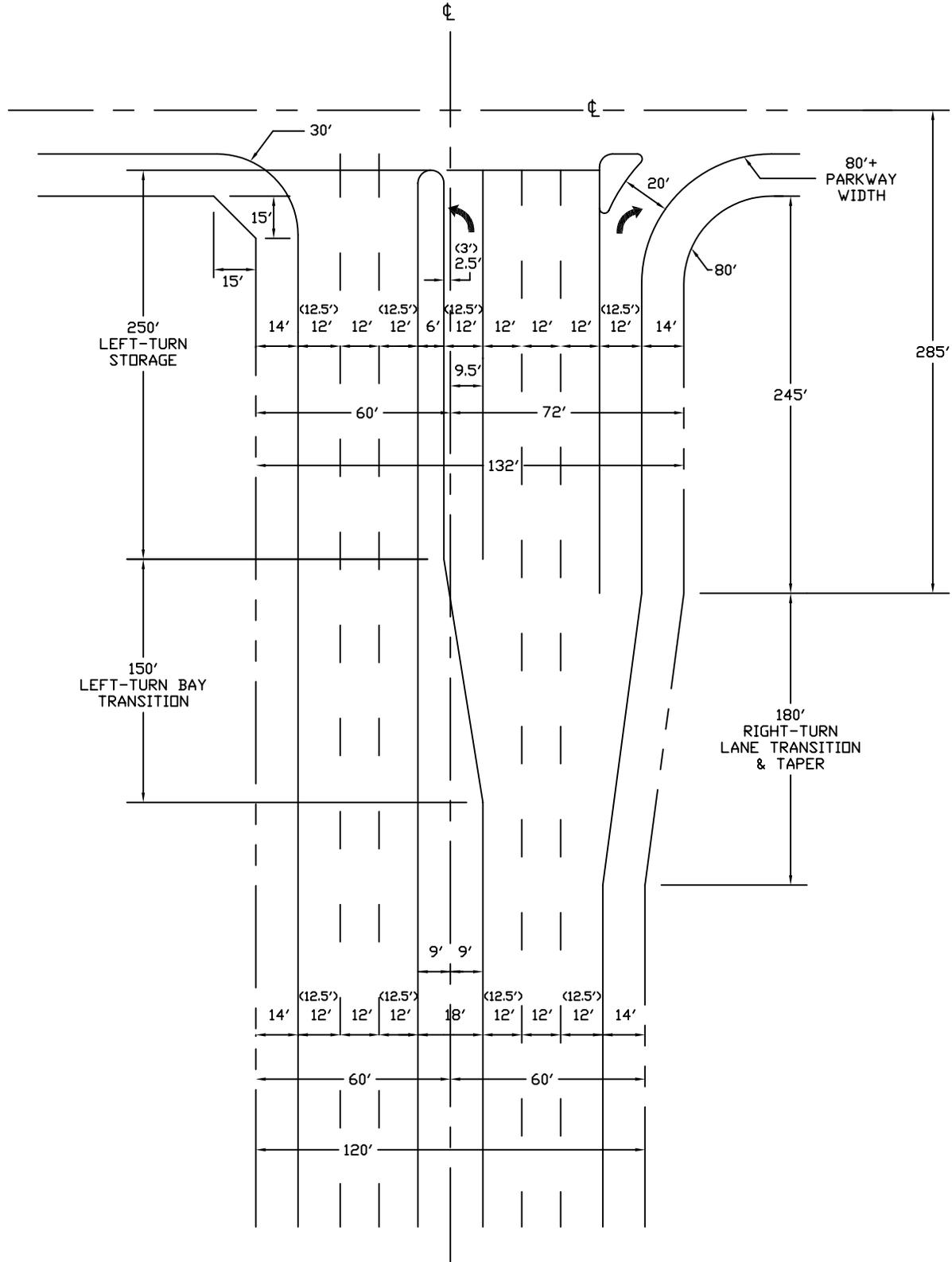
## APPENDIX H

### Intersection Geometric Design



# 6 LANE DIVIDED APPROACH

## INTERSECTING WITH 4U



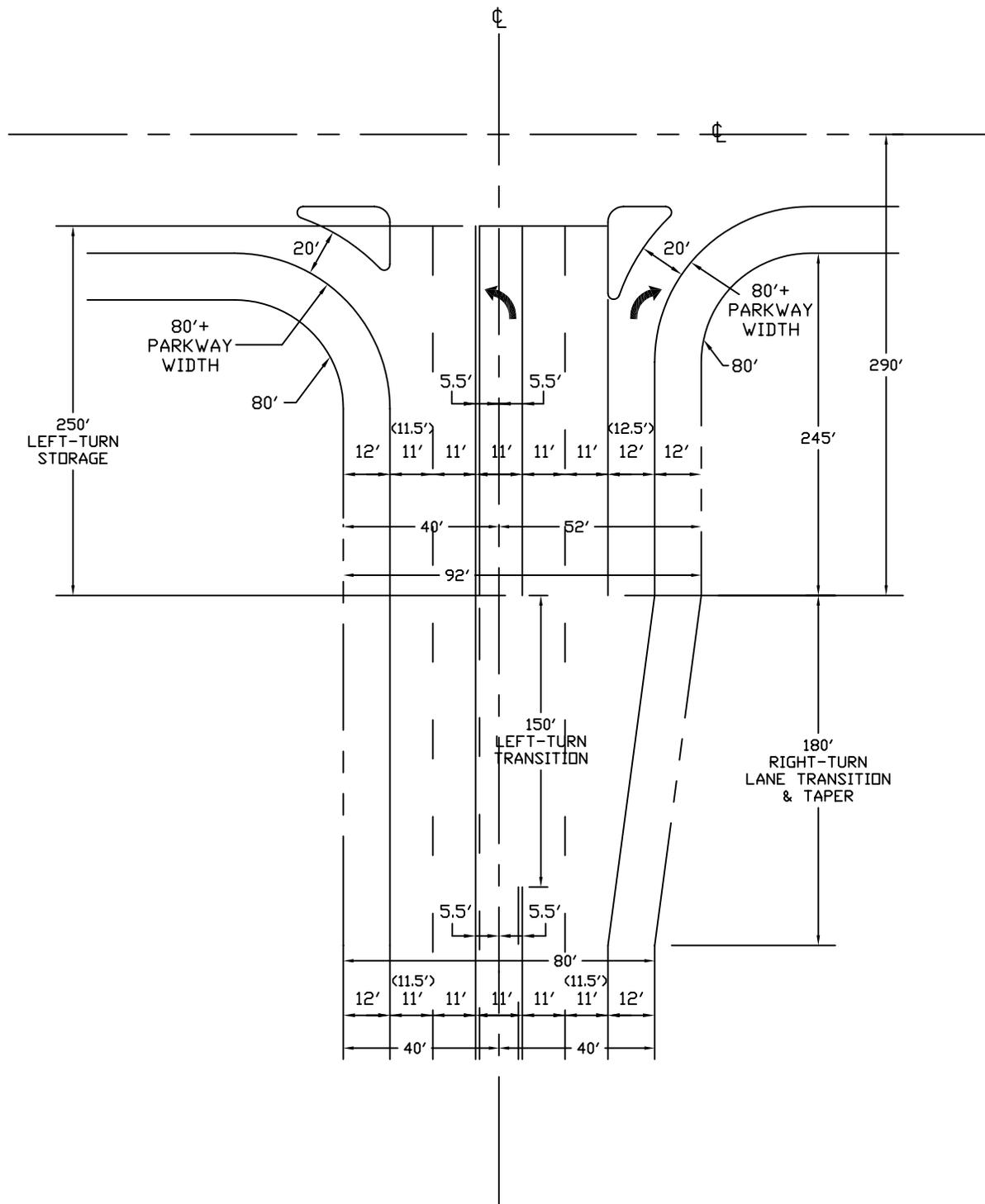
- \* Lane widths in parentheses ( ) are back of curb dimensions
- \* All transitions shall be designed using reverse curves
- \* Parkway dimension may vary at intersection flare
- \* Islands should be placed 2'-3' from outside edge of through lane traffic

N.T.S.



# 5 LANE UNDIVIDED APPROACH

## INTERSECTING WITH 5U, 4D

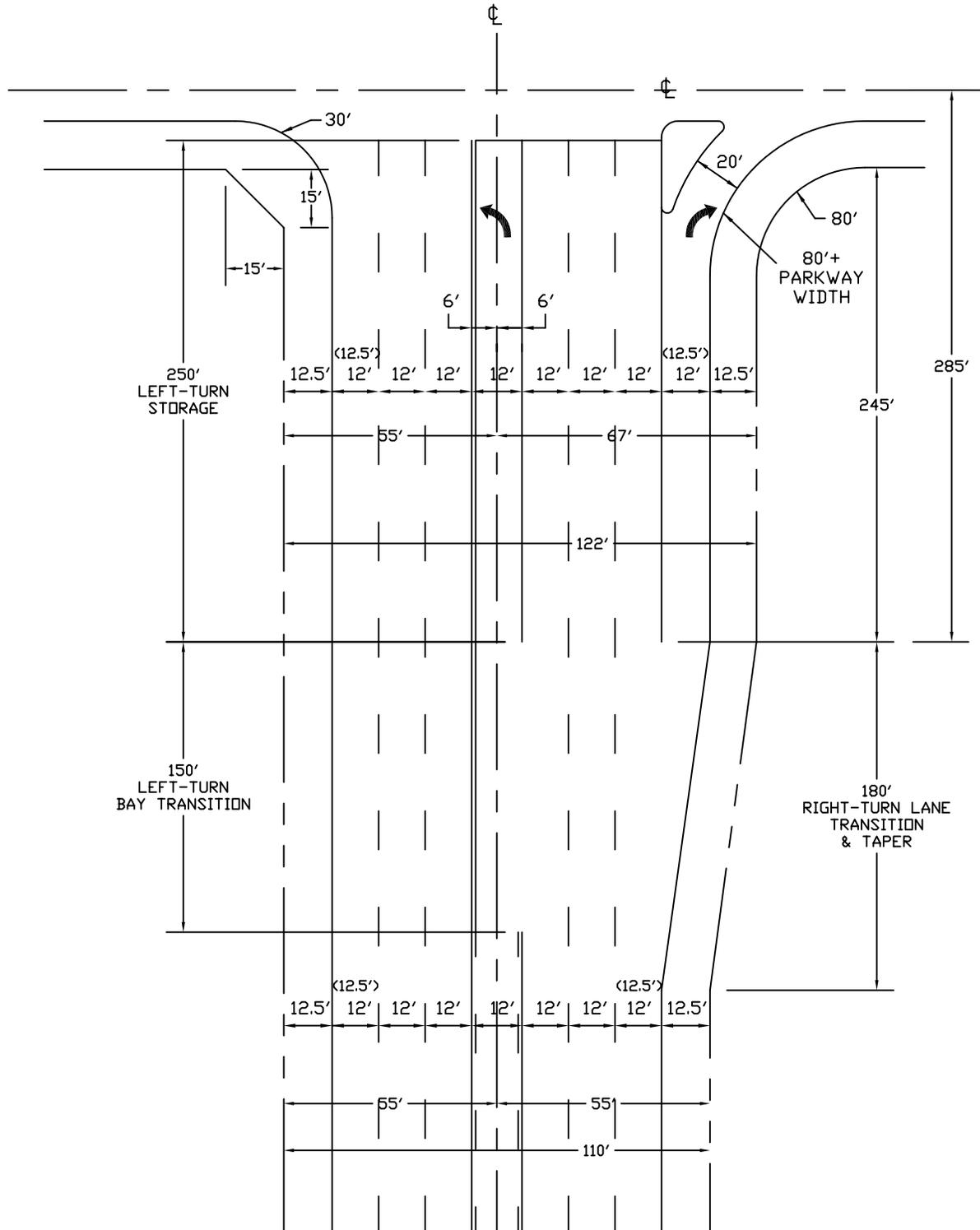


- \* Lane widths in parentheses ( ) are back of curb dimensions
- \* All transitions shall be designed using reverse curves
- \* Parkway dimension may vary at intersection flare
- \* Islands should be placed 2'-3' from outside edge of through lane traffic

N.T.S.

# 7 LANE UNDIVIDED APPROACH

## INTERSECTING WITH 4U



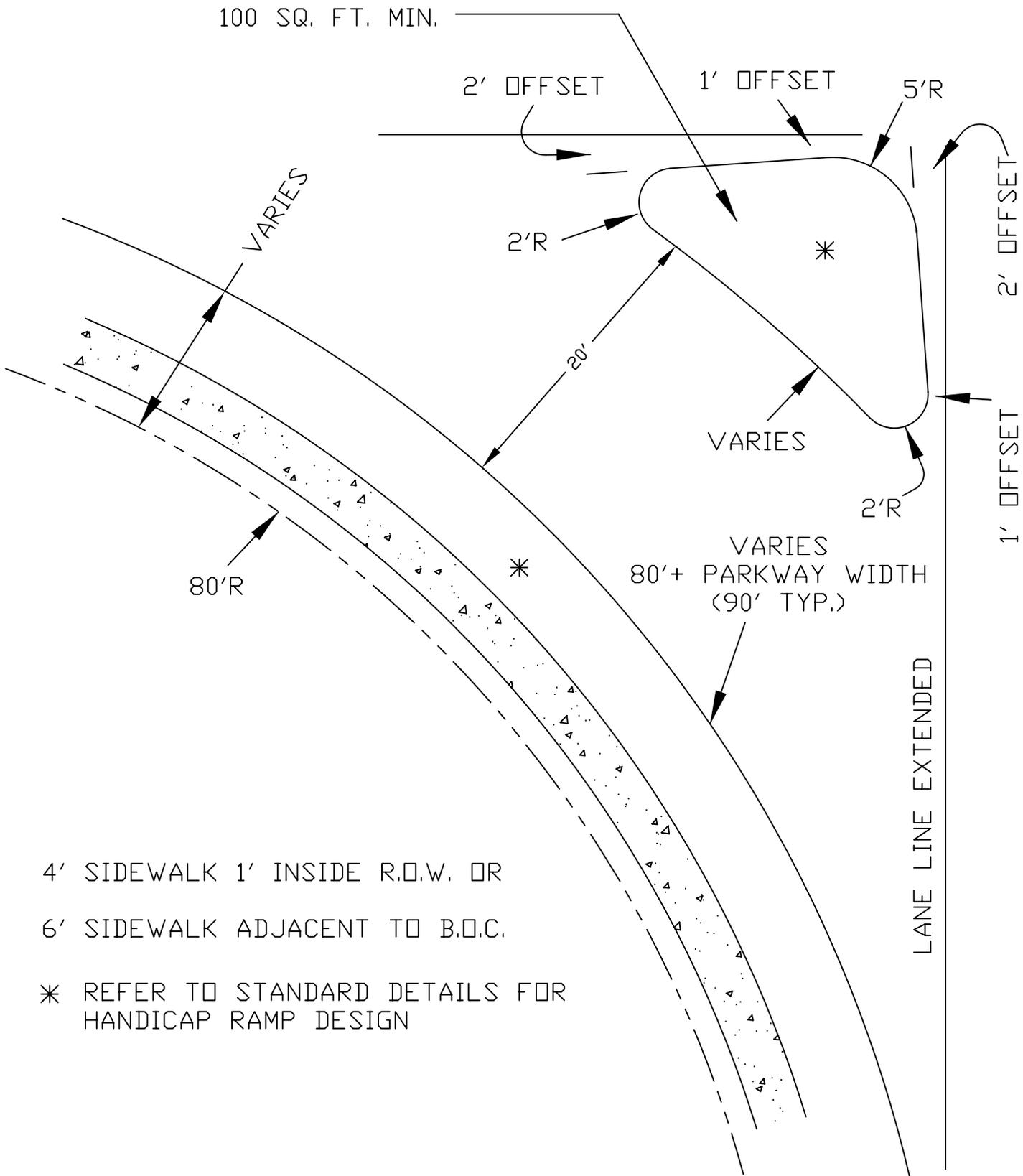
\* Lane widths in parentheses ( ) are back of curb dimensions

\* All transitions shall be designed using reverse curves

\* Parkway dimension may vary at intersection flare

\* Islands should be placed 2'-3' from outside edge of through lane traffic

N.T.S.

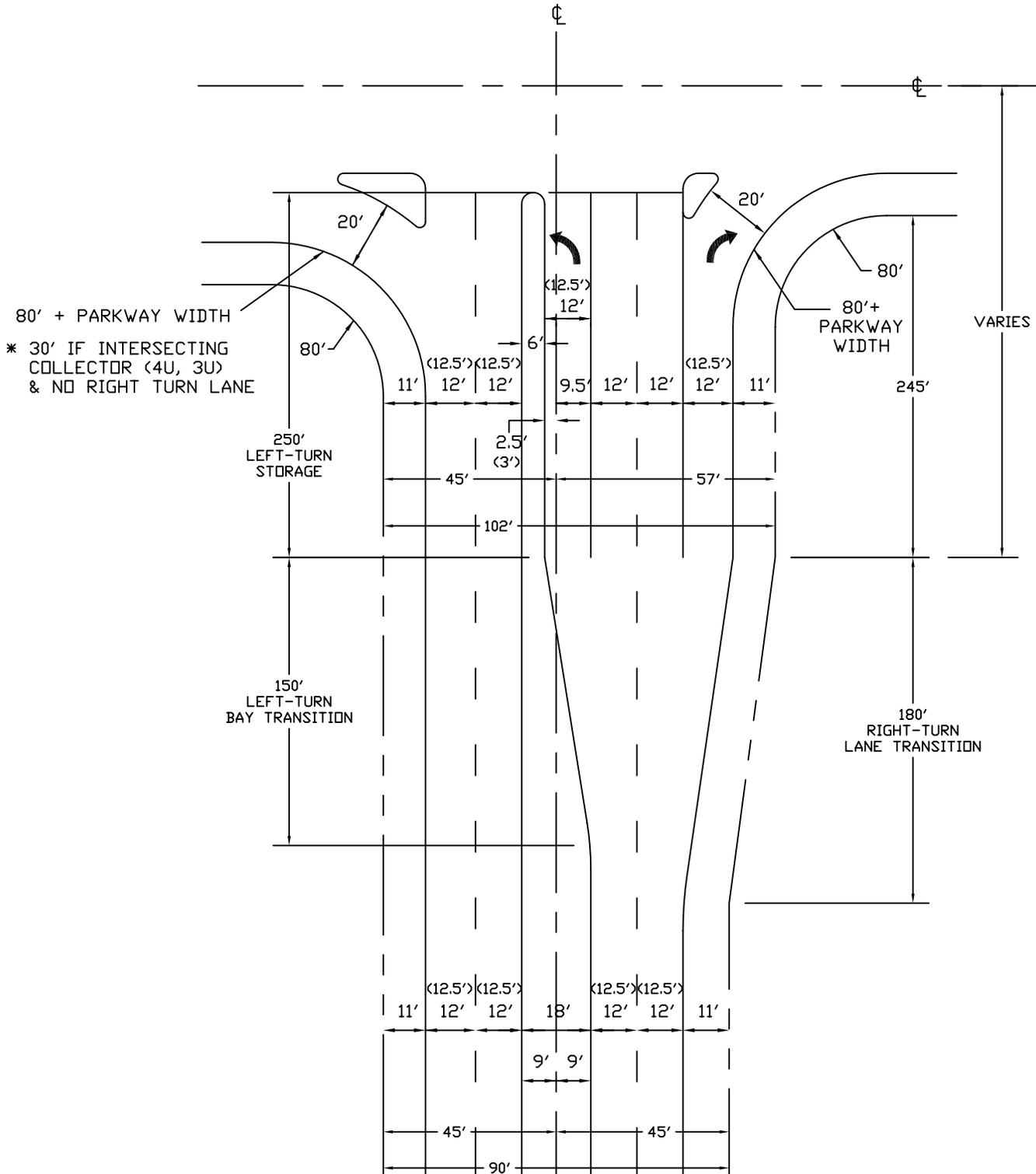


TYPICAL ISLAND DETAIL



# 4 LANE DIVIDED APPROACH

INTERSECTING WITH 5U, 4D, 4U



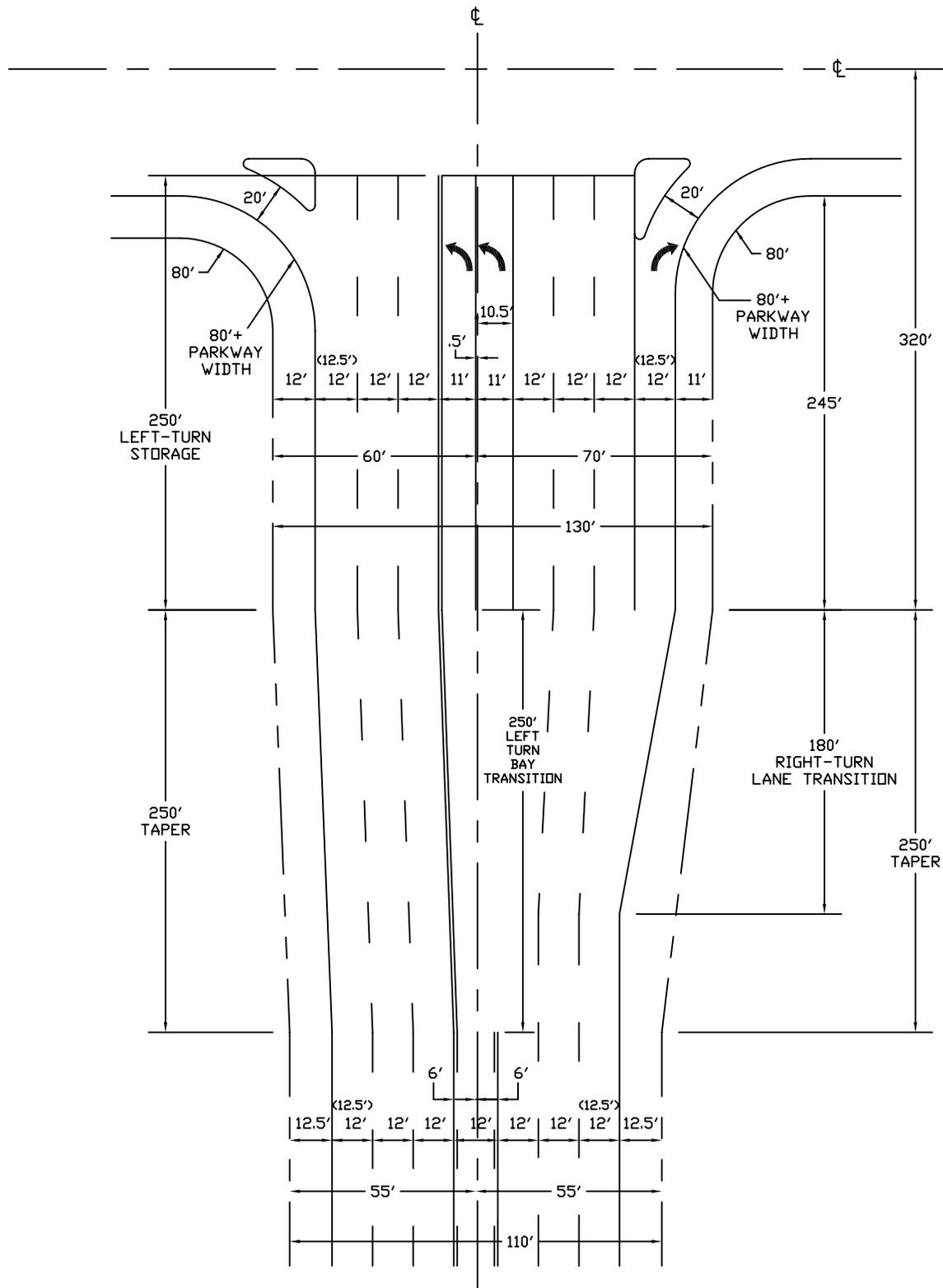
N.T.S.

- \* Lane widths in parentheses ( ) are back of curb dimensions
- \* All transitions shall be designed using reverse curves
- \* Parkway dimension may vary at intersection flare
- \* Islands should be placed 2'-3' from outside edge of through lane traffic



# 7 LANE UNDIVIDED APPROACH

INTERSECTING WITH 7U, 6D, 5U, 4D

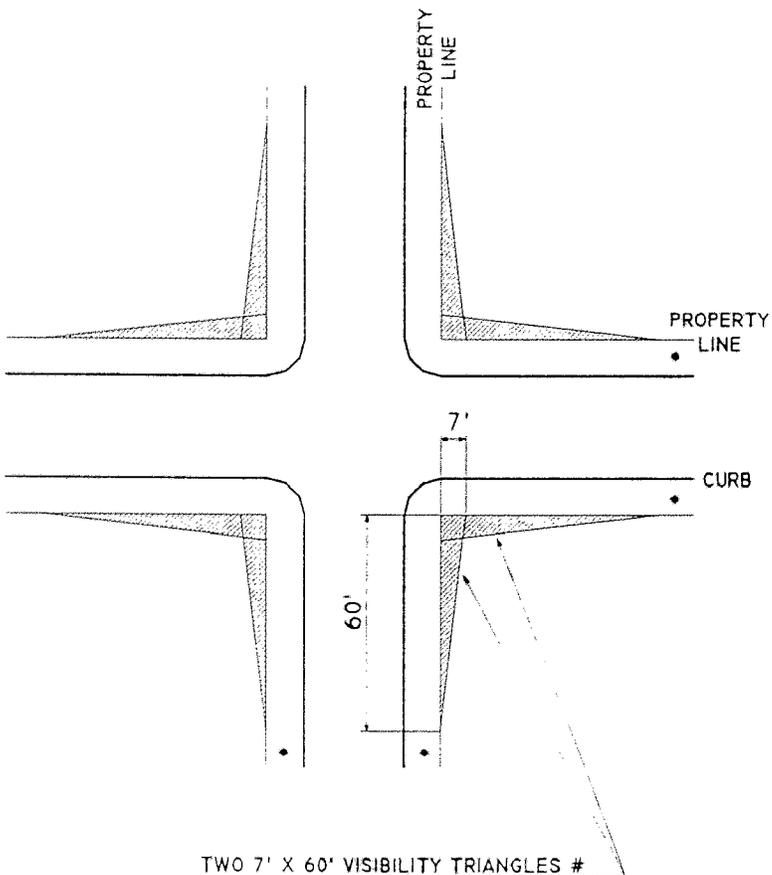


- \* Lane widths in parentheses ( ) are back of curb dimensions
- \* All transitions shall be designed using reverse curves
- \* Parkway dimension may vary at intersection flare
- \* Islands should be placed 2'-3' from outside edge of through lane traffic

N.T.S.

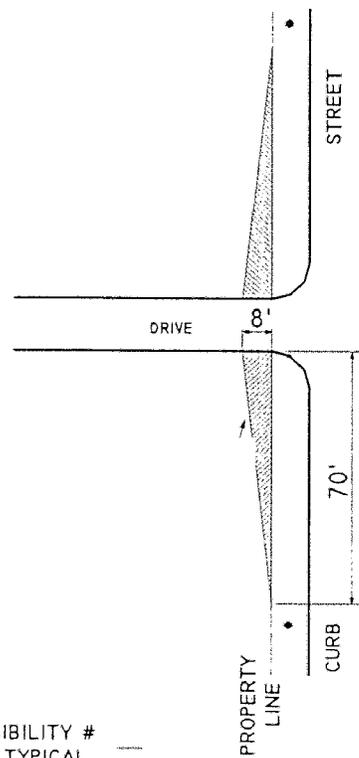
APPENDIX I

Site Distance Criteria



TWO 7' X 60' VISIBILITY TRIANGLES #  
TYPICAL ON ALL 4 CORNERS

DRIVEWAY AT ANY PUBLIC STREET



8' X 70' VISIBILITY #  
TRIANGLES TYPICAL

\* - VARIABLE DISTANCE. THIS DISTANCE IS DEPENDENT UPON HORIZONTAL AND VERTICAL CURVATURE OF THE STREET AND SHALL BE CALCULATED IN ACCORDANCE WITH THE LATEST EDITION OF THE AASHTO HANDBOOK.

# - NOTHING OVER 2' IN HEIGHT, AS MEASURED FROM THE TOP OF THE CURB, IS ALLOWED WITHIN THESE VISIBILITY TRIANGLES.

APPENDIX J

Subdivisions Checklist

**PAVING AND DRAINAGE PLAN CHECK LIST**  
**SUBDIVISIONS**

ITEM	ADDITIONAL INFORMATION
<b>I. Title Sheet</b>	
<b>A. Index-with sheet numbers</b>	
<b>B. Location map</b>	
<b>C. Reference paving and drainage only</b>	
<b>D. Subdivision name</b>	
<b>E. Consultant, developer name and address</b>	
<b>F. City approved benchmark information</b>	
1. Clearly described and shown on plans	
2. Minimum of two per project; use city control information	
<b>II. Coordination with Plat</b>	
<b>A. Copy of filed, or to be filed plat</b>	Ensure plans are consistent with the plat.
1. Verify DRC comments met.	Read DRC comments, just in case another department's affect us.
2. Verify required easements (drainage, access) have been dedicated, either by plat or by separate instrument.	
3. MFF for lots adjacent to creeks/channels	Two feet above fully developed water surface for 100-year storm.
4. MFFs may be established at 1' above TC on the high side of lot for the following:	
a. Opposite of 'T' intersections	Watch side streets with steep grade/high velocity.
b. Outside of curve	Especially if natural ground is lower than curb.
c. Flow in street significant and natural ground is low	
d. Where there is a sudden change in street grade	
e. At low points	
<b>III. General</b>	
<b>A. Standard items (all sheets)</b>	
1. Title block with addition name, sheet number, type of facility (street name, drainage line designation,	

ITEM		ADDITIONAL INFORMATION
etc.)		
2. Scale		
3. North arrow (up or right)		
4. Engineers seal, signature and date		
5. Legend and special drafting symbols		
<b>IV. Paving Sheets – Plan View</b>		
<b>A. General information</b>		
1. Adjoining property information in accordance with recorded plat		
a. Property lines on all lots		
b. Easements-type and size		
c. Block numbers		
d. Lot numbers		
e. Lot dimensions (frontage)		
f. Sheet matchline stationing		
2. Flow arrows, especially at intersections		
3. Street names with beginning and ending stations		
4. Place note on plans stating Traffic Control Plan required prior to construction of tie-ins.		
<b>B. Existing features</b>		
1. Location of existing improvements (should be ghosted)		
a. Paving-type and size		
b. storm sewer		
c. curb inlets		
d. manholes		
e. culverts		
2. Location of existing utilities (ghosted)		
a. Water		
b. Sanitary sewer		
c. Major utilities, such as petroleum pipelines and telephone conduits		

ITEM		ADDITIONAL INFORMATION
<b>C. Proposed streets</b>		For proposed streets connecting to state facility, Form 1058 must be submitted to TxDOT for approval.
1. Pavement information		For proposed streets in SE Arlington, use modified lime specification.
a. Concrete or asphalt		
b. Width (b/b)		
c. ROW width		
2. Baseline/centerline stationing of specific reference points		
a. P.C., P.T., P.R.C., P.C.C.		
b. Intersecting streets		
3. Curve information		
4. Stationing and offset to proposed improvements		
a. Curb inlets		Watch location relative to lot lines (i.e. transitions conflicting with curb return of drives or future streets)-transitions/gutter depressions are 6' up and downstream of inlet.
b. Manholes/junction boxes		
c. Culverts, bridges, headwalls		
e. Median noses/turn lanes		
f. End of pavement		
5. Radius sizes for:		
a. Curb returns		
b. Median noses/turn lanes		
c. Cul-de-sac (min. 39' pavement radius with 8" crown, from high side)		Minimum ROW is 50' radius.
6. Connecting to county type facility		Check to see when the existing street is proposed to be reconstructed.
a. Type of transition (concrete or asphalt)		
b. Show culverts		If a culvert cannot be provided you must have a concrete valley gutter.
c. Provide headwalls or sloped and treatments		
7. Location of brass disk(s) for residential subdivision where MFFs are required		At least 1 for up to 50 lots. Needed in a structure (curb inlet, headwall, monument).
8. Valley gutters		
a. Transverse valleys		Shall not be used in lieu of underground drainage system without DES

ITEM		ADDITIONAL INFORMATION
		approval.
b. Valley gutters at intersections (if asphalt)		8' wide for full width of the street. 25' crown transition in both directions.
9. Sidewalks: Required on all streets except some TxDOT facilities, local rural standard facilities, or cul-de-sacs.		Must meet ADA/TDLR requirements. Check with Parks for sidewalks adjacent to linear parks.
a. Required to be constructed with street paving when not abutting residential lot or when lot backs up to existing improved street where sidewalks do not currently exist.		May request waiver (small subdivisions and adjacent streets that do not have sidewalks and no plans for improvements). If sidewalks are included along a TxDOT facility, they require 5' wide, 4' off the right-of-way line.
b. 4' wide, 1-foot off property line (preferred)		May vary to avoid obstructions such as power poles, fire hydrants, telephone/electric risers. If less than 2' to the curb, sidewalk shall be 6' wide and adjacent to curb.
c. Access ramps		Use COA standard details.
10. Turn lanes/Deceleration lanes/Median Openings		TxDOT will not allow any utilities under pavement.
A. Turn Lanes/Decel Lanes		
a. Match existing street section		Provide typical section.
b. Type of subgrade modification, density-same as street (2 and 3 below are options)		
1. Lime stabilization		Difficult for small areas. If in SE Arlington, use modified specification.
2. Flexible base (at least 6" depth)- TxDOT Type A, Grade 1		
3. Thickened pavement (additional 4") on compacted base		
d. Match cross slope		Offset joint from gutter line.
e. Additional ROW (12') required either by plat or by separate instrument		If by separate instrument, need to notify Building Inspections of additional setback requirements.
f. Verify storage/transition lengths		
B. Median Openings		
a. Requires property owner notifications		
b. Requires construction of left turn lane		
c. Verify spacing requirements		
d. Verify opening width requirements		

ITEM		ADDITIONAL INFORMATION
e. Medians < 8' width, must be in accordance with COA median details		Coordinate with Parks Department.
f. Median landscaping/irrigation (≥ 8' width)		Coordinate with Parks Department.
11. Dead end streets/turnarounds		
a. Dead end streets allowed if < 150' in length.		
1. Install header and barricade		Provide details.
b. Turnarounds required for dead ends 150' & greater		
1. Considered "temporary" until street is extended or permanently cul-de-sac'd		
2. Curb and gutter not required on turnaround		
3. All other design criteria are required		
4. Preferred offsite to development		
5. Easement required (50' radius)		
c. Drainage must be maintained		
1. Detail outfall, grade to drain		
2. Notarized Letters of Permission required		
12. Street lights/markings		Req'd when constructing portions of arterials. Coordinate with Traffic Operations.
13. Private Gated Entry		Coordinate with Fire Dept for approval.
a. Verify turn-around requirements		
b. Verify stacking requirements		
c. May require Decel lane		
d. Submit disk if not using COA standard entry		
<b>V. Paving Sheets - Profile View</b>		
<b>A. Existing features</b>		
1. Profile of existing ground		Watch where significant fill (or even a pond/low area existed) is proposed. Need density tests.
a. Centerline		
b. Right/left property lines		
2. Existing or proposed utilities, with description		

ITEM		ADDITIONAL INFORMATION
a. Water/sanitary sewer		
b. Major utilities, such as petroleum pipelines or telephone conduits		
<b>B. Proposed streets</b>		
1. Top of curb profile		
2. Curb grade/slope		
a. Minimum grade 0.5%		Watch grades around cul-de-sacs, bulbs and vertical curves where an extended portion of the curve will be below 0.5%. This usually occurs in long vertical curves. May consider using a PI or compound curve. One percent required for street where soil PI is $\geq 40$ .
b. Maximum grade		Minor collector and local streets have 8% maximum grade.
c. Start/match line/end elevation		
d. Curb returns and P.I. elevations at intersecting streets		
e. Top of curb elevations shown on 50' stations		
f. High and low point elevations and stations		
g. Maximum side slopes in right-of-way or easement - 6:1		
h. Vertical curve		Watch visibility of intersecting streets & potential drives.
i. Culvert invert or overflow		
<b>VI. Drainage Area Map</b>		
<b>A. Drainage map</b>		
1. Coordinate with Preliminary Drainage Study		
2. Contours (min. 5' interval)		
3. Existing facilities/features (natural or man-made)		
4. Proposed facilities		Analyze downstream systems for capacity of additional developed condition flow. May require detention or offsite improvements. May not worsen downstream problems.
5. Major watershed area, including contributing offsite areas		
6. Drainage areas (min. scale 1" = 200')		
7. Sub areas for mains, laterals, streets – note		

ITEM		ADDITIONAL INFORMATION
drainage area designations		
8. Drainage flow arrows for streets		
9. Show information on adjacent property, such as contours, existing systems, easements, city limits, floodplain/ floodway and creeks		

10. For creeks/channel – See requirements below		
<b>B. Drainage criteria/table</b>		
1. Method of analysis		
2. Drainage area designations		Show sub-areas for curb inlet design.
3. Drainage area acreage		
4. Soil group type		
5. Runoff coefficient(s)		
6. Time of concentration		Time shall reflect fully developed conditions in the upstream watershed.
7. CCa value $\leq 1.0$		
8. Design frequency(s)		
9. Intensity		
10. Flow rate		
<b>C. Street/ROW capacity calculations</b>		
1. Local/minor collectors less than curb deep for 5-year storm		
2. Max. ponded width on minor arterial and major collectors-midpoint of inside lane for 5 yr storm		
3. Max. ponded width on major arterial-keep inside lane dry (5 <sup>th</sup> and 6 <sup>th</sup> lanes) for 5 year storm		
4. Parabolic-vs-rooftop, affects calculations		
5. 'n' value, concrete and asphalt 0.015		
6. 100-year storm contained within ROW		
<b>VII. Drainage Sheets – Underground Systems</b>		Watch low points which are intercepting significant flow. May need to intercept more flow upstream if runoff is leaving the street and creating flooding.

ITEM		ADDITIONAL INFORMATION
<b>A. Plan view</b>		
1. Label and show size/type (Line 'A'-21" RCP Class III)		RCP required. Minimum size is 18" except for lot grading along rear property line where may be reduced to 12". Plastic pipe may be used if not under paving.
2. Show all easements (offsite and onsite) including easement width. Minimum 15' width for underground system.		Private improvements within easement require Easement Use Agreement or maintenance statement placed on plat. Typically, trees required to satisfy landscape ordinance are not allowed in a public drainage easement.
3. Centerline of storm drain referenced to the easement, ROW, or street centerline		
4. Centerline data		
a. Stationing along centerline of pipe with equations to street paving centerline (if applicable) or stationing along centerline of street with offsets		
b. Beginning/ending station		
c. Bends-required in lieu of curves		Bends and wyes shall be prefabricated. Radius pipe is allowed. Lay schedule shall be provided.
d. Wyes-location, angle of laterals		
e. Junction structures		Provide detail.
f. Collars		Provide detail.
5. Curb inlets- station and designation number		
a. Minimum size is 10 feet.		
b. Recessed required for 38-foot and larger streets		
c. On-grade inlets designed for 5 year event		
d. Low point inlets must capture 25 year event		
e. Include inlet calculation chart		
f. Grate inlets not allowed in public systems		
6. Bar ditch culverts – 5 year design		Provide profile or show flow line/top of pavement elevation.
a. Size		
b. Verify minimum cover		
c. Sloped end treatment/headwall		Type A or Type B headwall or sloped-end section. Provide detail.
7. Proposed creek culverts and bridges – 25 year design		

ITEM		ADDITIONAL INFORMATION
a. Stations and offset ties		
b. Skew angle		
c. Handrail/guardrail		Need for guardrail? Especially on upstream (traffic flow) end.
d. Headwall details		
8. Entrance/outfall structures, including velocity/erosion control.		System shall be extended to flow line of the creek.
a. Type		Gabions are required for permanent erosion control. If a temporary (< 6 months) situation exists, you may consider allowing rock w/filter fabric or "grouted" rock riprap, if the owner requests in writing and will address if a problem occurs.
b. Size/dimensions/cross-section		
c. Toe walls (2' minimum)		
d. Connection details		Provide detail.
9. Location of water and sewer lines		
10. Provide access approximately every 500' or upsize a lateral to at least a 36" pipe.		
11. Laterals-in lieu of main through inlets		
12. Drop/Y type inlets		Grate inlets are not allowed.
a. Need concrete reinforced apron with a min. 2' toe wall on all sides		
b. May be utilized in rear yards to intercept multiple lot to lot drainage situations		12" pipe may be used in rear yards only on a case by case basis.
c. May be utilized to intercept offsite flow		May need to construct swale to direct flow to inlet
d. May need easement by separate instrument if constructed off-site.		
13. Positive Overflow flumes		Evaluate 100-year water surface to establish MFF.
a. Flume shall be constructed of alternative finishes (in lieu of standard concrete finish) to soften appearance.		
b. Minimum size 5' back to back (6" walls)		
c. Cross-section/capacity		
d. Transition vertical walls from sidewalks (overflow flume may begin at sidewalk)		

ITEM		ADDITIONAL INFORMATION
15. Flumes as primary drainage feature		Must have approval from DPW for use as primary drainage feature.
a. Provide calculations for ponded depth at entrance		Ponded depth shall be less than curb height or berms around entrance shall be required to contain flow in street.
b. Need 4:1 flare at entrance		
c. Transition through sidewalks shall be accomplished using plates.		Must meet ADA/TDLR requirements.
1. Must be minimum 3/8" thick		
2. Edges must be reinforced		Have allowed angle iron across the edges on the underside of plate.
3. Ends must be bolted down		
d. Bollards are required for flumes 6' & wider when sidewalk is not constructed.		
e. Provide cross section. Must have an invert with 7% cross slope		
<b>B. General Notes (to be placed on the plans, if applicable)</b>		
1. All bends and wyes should be prefabricated		If a field connection is authorized, the lateral diameter cannot be greater than one half the diameter of the main. Do not allow a field connection when lateral slope is greater than 10%. Provide collar detail.
2. Use only authorized premolded type joint sealer		Omniflex is acceptable.
3. Contact DPW 48 hours prior to construction.		
<b>C. Profile view-mains and laterals</b>		
1. Natural and proposed ground profile over centerline of proposed storm drain		If pipe is placed < 3' deep or if cover is $\geq 13'$ , Class IV pipe is required.
2. For proposed storm drains, including laterals		Extend pipes to flowline of creek.
a. Designation and size/type and class (Line 'A'- Class III 21" RCP)		
b. Length		
c. Grade (slope)-with elevs.-min. 50' intervals		
d. Match soffits (inside top of pipe)		
e. Design flow		
g. Velocity		
h. Hydraulic grade line/water surface		HGL should not be more than 1 pipe size above top of pipe.
i. Shall remain below bottom of subgrade for		

ITEM		ADDITIONAL INFORMATION
systems under paving		
ii. Shall be lower than inlet throat		
iii. Begin at inside top of pipe or HGL of connecting feature, whichever is higher		
i. Outfall structures		
3. Junction box and curb inlet locations		
4. All proposed or existing utilities which cross the proposed storm drain facilities		
5. Creek Culverts		
a. Size of openings		
b. Length		
c. Type of operation under design conditions		Inlet or outlet control? For inlet control, ponded depth at entrance may require revising entrance conditions.
d. Flow line elevations for both ends of culvert		
e. Headwater/tailwater elevation for 25-year and 100-year events		
f. Design frequency		
g. Outfall structure		
h. Grade to drain - indicate size, slope, water surface, velocity, typical section, side slopes 4:1, vegetation, letter of permission for offsite grading.		Need to design as 'non-erosive'. Acceptable slope may vary depending on soil type and the situation, whether sedimentation or erosion is a concern.
6. Flumes/overflow flumes with 25- and 100-year WS		Continue flumes to flow line of creek with gabion transition at outfall and on the edges along the creek bank.
<b>VIII. Drainage Sheets –Concrete Channels</b>		
<b>A. Plan View</b>		
1. Channel lining contains 25-year plus one-foot of freeboard.		
2. Distance from top of channel to easement is 10.0' minimum. No creek buffer req'd.		
3. MFF for lots adjacent to creeks/channels		Two feet above fully developed water surface for 100-year storm.
4. Expansion/contractions, prefer 4:1 or longer		

ITEM		ADDITIONAL INFORMATION
transitions		
5. Curved sections-label PC and PT and account for superelevated water surface		May need to elevate outside wall on curves to contain flow in the channel.
6. Show where typical section is located		
7. Storm drain connections		Need to evaluate impacts. Angle the connection on larger pipes/flows to reduce impacts. May need to elevate opposite wall.
8. Provide an access point for maintenance		May require additional easement.
9. Velocity/erosion control at upstream/downstream end		Use gabions to transition to earthen/natural channel. Provide connection detail.
10. If a FEMA designated floodplain, requires submittal for CLOMR/LOMR.		
<b>B. Profile View</b>		
1. Natural ground elevation along drainage easement both sides		
2. Top of left/right channel		
3. Channel gradient (flowline)		
4. Continuous water surface profile of design flow & 100-year event		Must provide one-foot of freeboard above the 25-year frequency event.
5. Flow and velocity for each change in flowrate/slope		
<b>C. Typical Section</b>		
1. Geometry of cross-section		
a. Invert-bottom must have 10% cross-slope		Minimum bottom width is 6 feet
b. Sides slopes		2:1 is the maximum slope for channel walls. 4:1 is the maximum slope for earthen portion above the concrete lining.
c. Toe walls-min. 18" along top of channel banks; min. 36" at up and downstream ends		Also, if a significant area/flow exists or is proposed toward channel sides, may need to intercept with systems and/or provide deeper toe walls.
d. Weep holes on 15' centers		Provide a 2'x1' trench with washed rock and wrapped in filter fabric along both sides of the entire channel length at the flow line.
e. 6" thick, 3000 psi concrete with #3 bars at 24" centers both ways		
2. Maximum capacity for normal flow condition		
3. Calculations to determine channel capacity,		See Flood Study Requirements

ITEM		ADDITIONAL INFORMATION
including roughness coefficient		
4. Permissible construction and expansion joints; only a vertical joint is permitted at the point where the channel wall meets the bottom		
5. Size, dimensions, and cross-section of permanent erosion control.		
<b>IX. Drainage Sheets – Earthen Channels</b>		
<b>A. Requirements: (based on fully developed watershed)</b>		
1. Channel contains 25 year event plus one foot of freeboard.		
2. Distance from top of channel to easement is 10' minimum (both sides) to account for creek buffer zone.		
3. Show 100-year water surface on plan.		
4. MFF for lots adjacent to creeks/channels		Two feet above fully developed water surface for 100-year storm.
5. Tie-down centerline, top left/right bank.		
6. Expansions/Contractions, prefer 4:1 or longer transitions.		
7. Provide calculations to determine channel capacity, including roughness coefficient		See Flood Study Requirements
8. Show where typical cross-section is located.		
9. Pilot channel with 1" invert		6' minimum bottom width. Change in grade may require drop structure.
a. 6" thick, 3000 psi concrete with #3 bars at 24" centers both ways		
b. Requires transition material between pilot channel and side slopes for erosion control		
10. Erosion protection upstream and downstream at connection/transition to closed system or natural channel.		
11. Vegetated or bio-engineered side slopes		4:1 side slopes
12. Storm drain connections		Need to evaluate impacts. Angle the connection on larger pipes/flows to reduce impacts. May need to armor opposite wall and/or outfall area.

ITEM		ADDITIONAL INFORMATION
13. If a FEMA designated floodplain, requires submittal for CLOMR/LOMR.		
14. Maintenance Agreement required.		
15. Requires supporting documentation with submittal of As-Built letter		See Design Criteria Manual for information.
<b>B. Profile View</b>		
1. Natural ground along drainage easement both sides		
2. Top of left/right channel		
3. Channel gradient (flowline)		
4. Continuous water surface profile of design flow & 100-year event		Must provide one-foot of freeboard above the 25-year frequency event.
5. Flow and velocity for each change in flowrate/slope		
<b>IX. Drainage Sheets–Natural Creeks</b>		
<b>A. Requirements: (based on fully developed watershed)</b>		
1. Easement = 25 year water surface		
2. Creek buffer zone is 25' measured from top of channel bank		
3. Verify Erosion Clear Zone – provide cross sections through curves of channel		
4. Label 100-year water surface on plan and profile		
5. MFF for lots adjacent to creeks		Two feet above fully developed water surface for 100-year storm.
6. Plot of cross-sections		
7. Hydraulic analysis to justify data, include a disk		
8. Tie-in/transition to permanent structures		
9. Storm drain connections		Need to evaluate impacts. Angle the connection on larger pipes/flows to reduce impacts. May need to armor opposite wall and/or outfall area.
10. If a FEMA designated floodplain, requires submittal for CLOMR/LOMR if modifying the floodway.		

ITEM		ADDITIONAL INFORMATION
11. Maintenance Agreement required.		
<b>X. Storage (Detention/Retention)</b>		Notarized Letters of Permission may be required for concentration of flow or offsite grading.
<b>A. Hydrology Data</b>		
1. Pre-development Conditions		
2. Post-development Conditions		
<b>B. Storage Criteria</b>		
1. Minimum storage required equals 25 yr. Post-Development discharge minus Pre Development discharge plus 1 foot freeboard.		Additional storage may be required depending on downstream conditions
2. Provide Inflow/Outflow Hydrographs		Analysis of 5, 25, and 100 year events
3. Provide Routing Chart		Stage/Storage/Discharge Relationship
a. time interval (min)		
b. inflow (cfs)		
c. storage (cu. ft.)		
d. stage (ft)		
e. outflow (cfs)		
<b>C. Plan Requirements</b>		
1. Plan View		
a. Dimension Control		
b. Grading Plan		
c. Pilot Channel		
d. Outlet Structure		Provide construction detail.
2. Cross Sections		
a. Water Surface Elevations		
b. Side slopes		
c. Densities		
d. Outlet Structure		
e. Erosion Control		
<b>D. Requires Maintenance Agreement</b>		
<b>E. Requires supporting documentation with submittal of As-Built letter</b>		See Design Criteria Manual for information.

ITEM		ADDITIONAL INFORMATION
<b>XI. Detail Sheets</b>		
A. Utilize city typical details, if available		
B. All sheets must be sealed, signed, and dated		
C. Are all applicable details shown		Details clearly shown (readable) and have adequate construction information
<b>XII. Lot and Block Grading Plan</b>		
A. Consistent with drainage areas/map?		
1. Prefer to ghost in DA's on plan		
B. Indicate flow arrows on each lot with F.H.A. lot grading type		Type of lot grading is the general intent of the drainage patterns only. If it appears that a significant amount of lot to lot is present, have the engineer provide spot elevations and arrows in lieu of the FHA designation.
1. Check slope along lot lines to ensure flow traverses as intended		
2. No more than 3 lots before constructing system.		Flumes may be required to convey water lot to lot.
a. Utilize berms in rear yards to redirect flow		
b. Use retaining walls/curbs to redirect flow		
c. Utilize drainage systems to intercept flow		
C. Prefer a minimum 2% slope on grass swales		
D. Coordinate grading with adjacent development.		
E.. Provide extra copy to Building Inspections		
<b>XIII. Flood Study General Requirements</b>		
A. Flood studies are required to define easements, determine minimum finished floor elevations, and when modifying the floodway/floodplain.		
B. Refer to Flood Study Requirements in the Design Criteria Manual		
<b>XIV. Miscellaneous</b>		
<b>A. Work within TxDOT ROW</b>		
1. City sends 3 copies of 11" x 17" plans, and a cover letter to the state		
2. Need to include Form 1058 if work includes a		

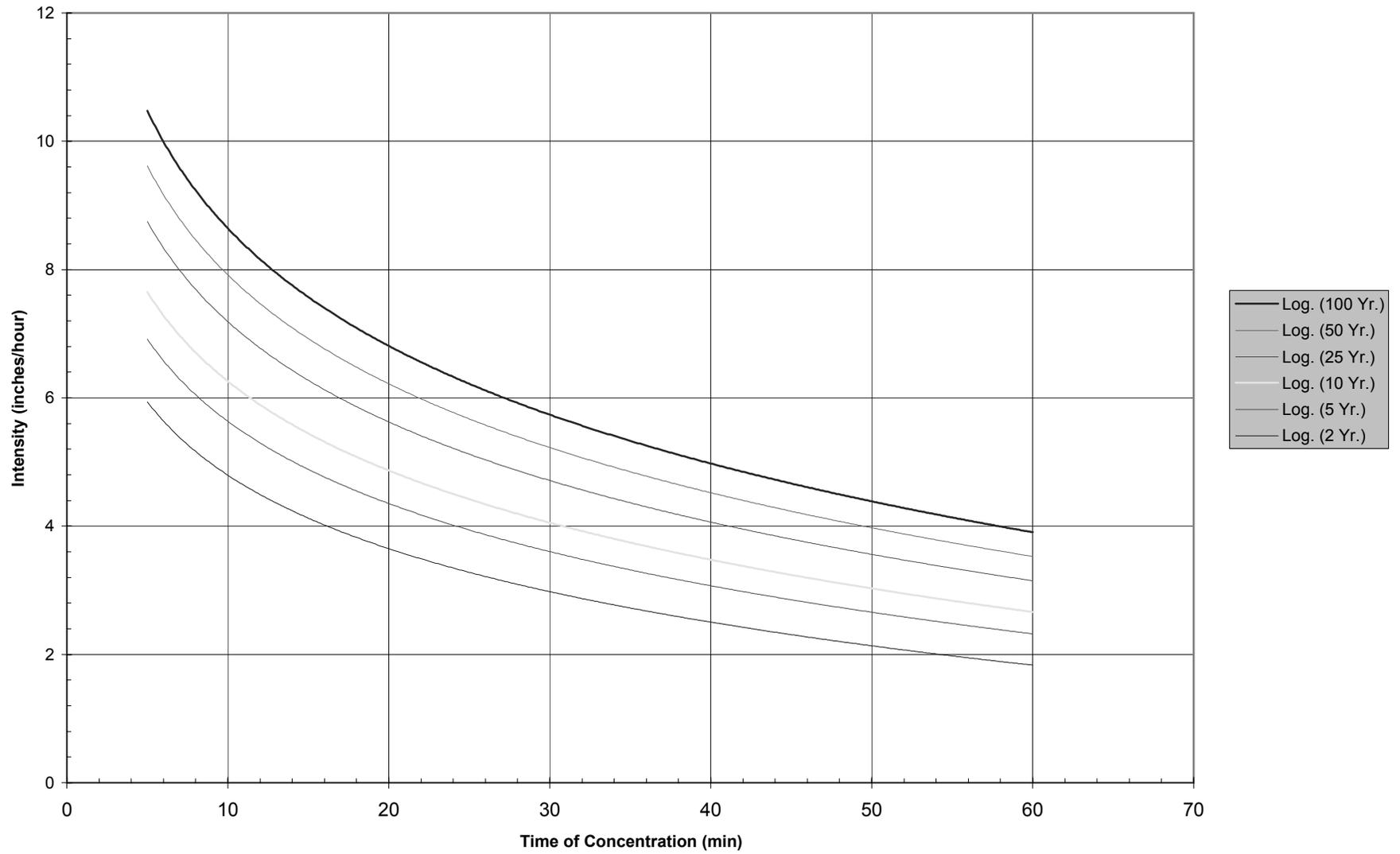
ITEM		ADDITIONAL INFORMATION
public street connection.		
<b>C. Coordinate plans with adjacent street/subdivision plans</b>		
<b>D. Erosion Control</b>		

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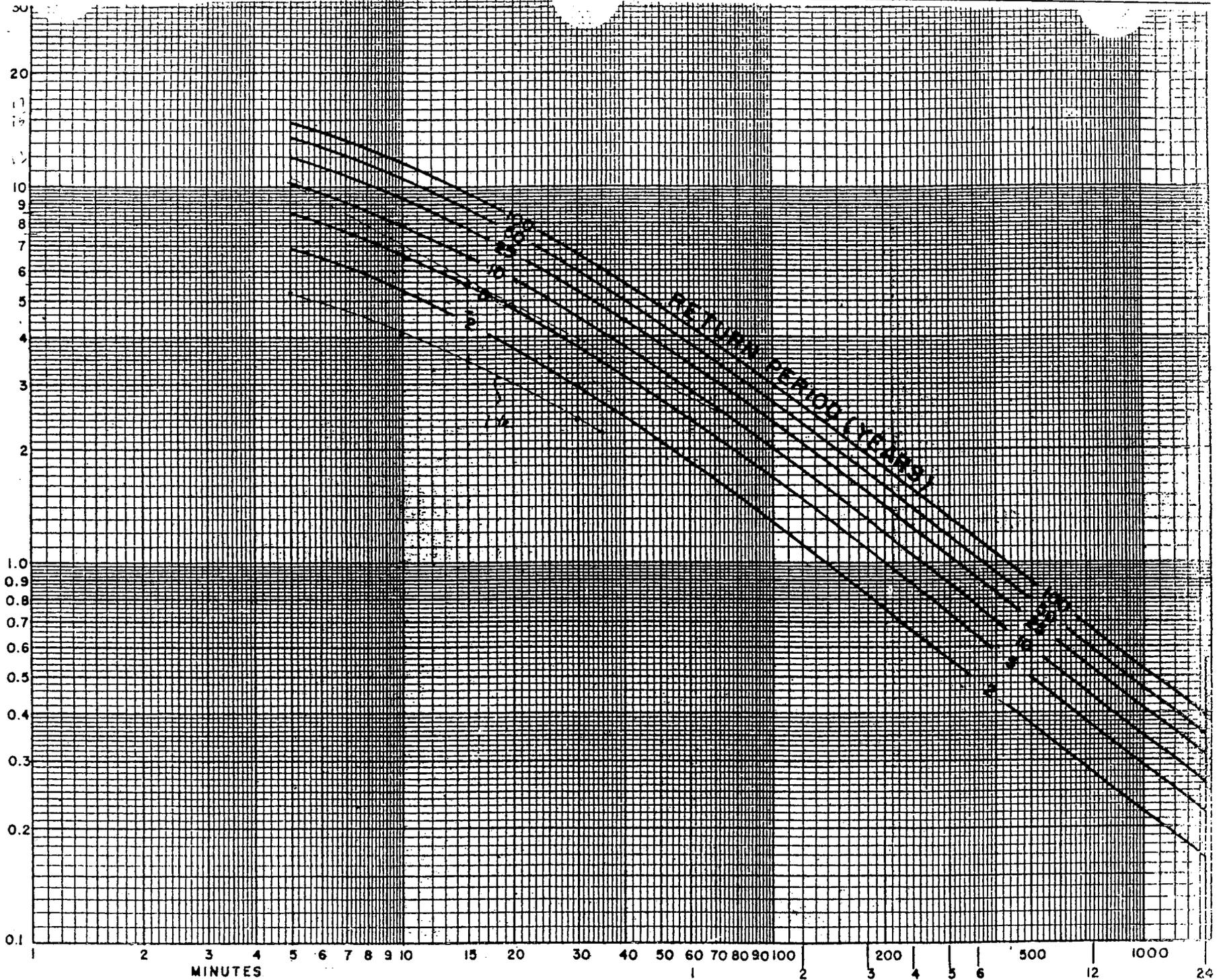
APPENDIX K

Hydro-35 and TP-40

HYDRO 35 REPORT



RAINFALL INTENSITY - INCHES PER HOUR



MINUTES

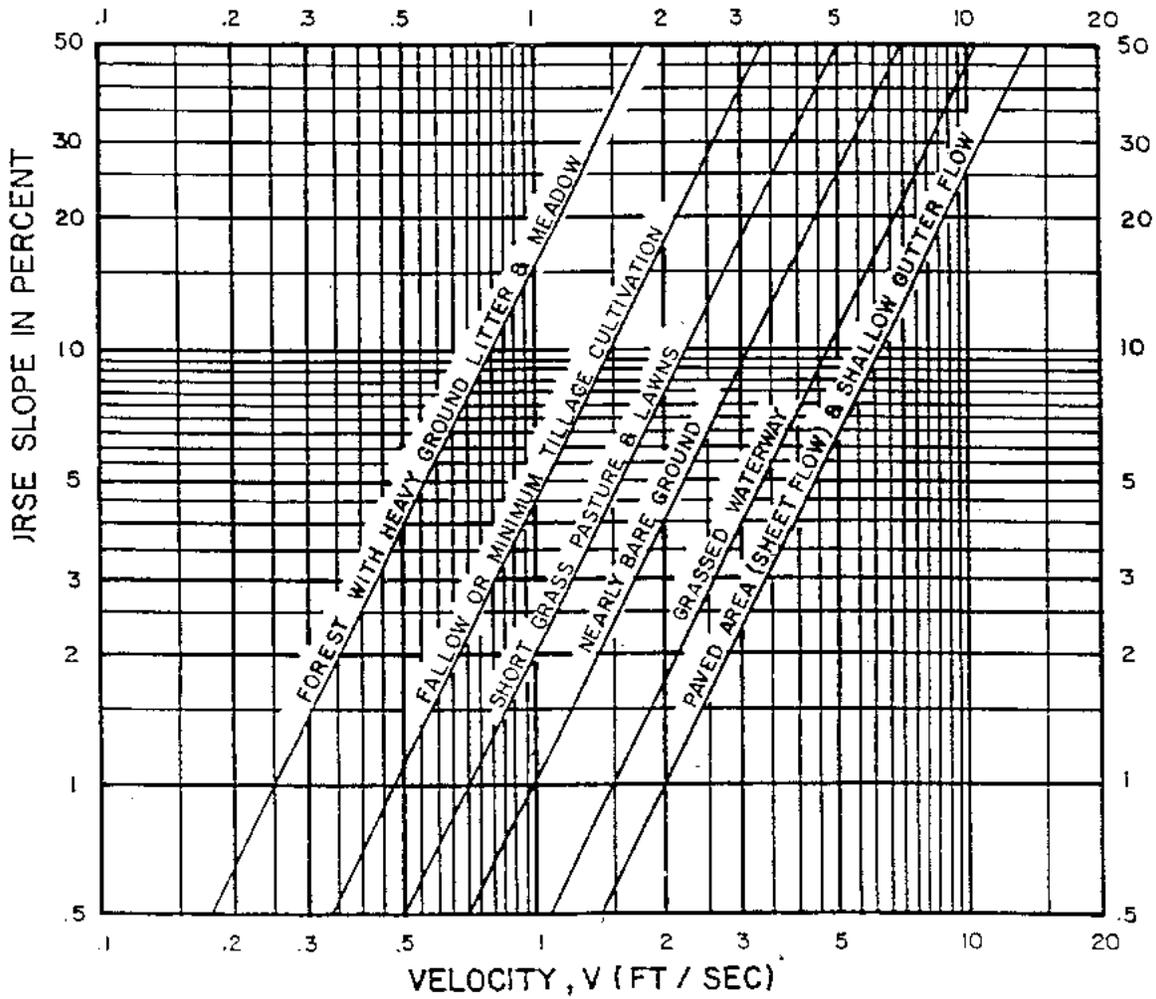
RAINFALL DURATION

HOURS

TP40

## APPENDIX L

### Velocity



BRIDGE DIVISION HYDRAULIC MANUAL  
2-24

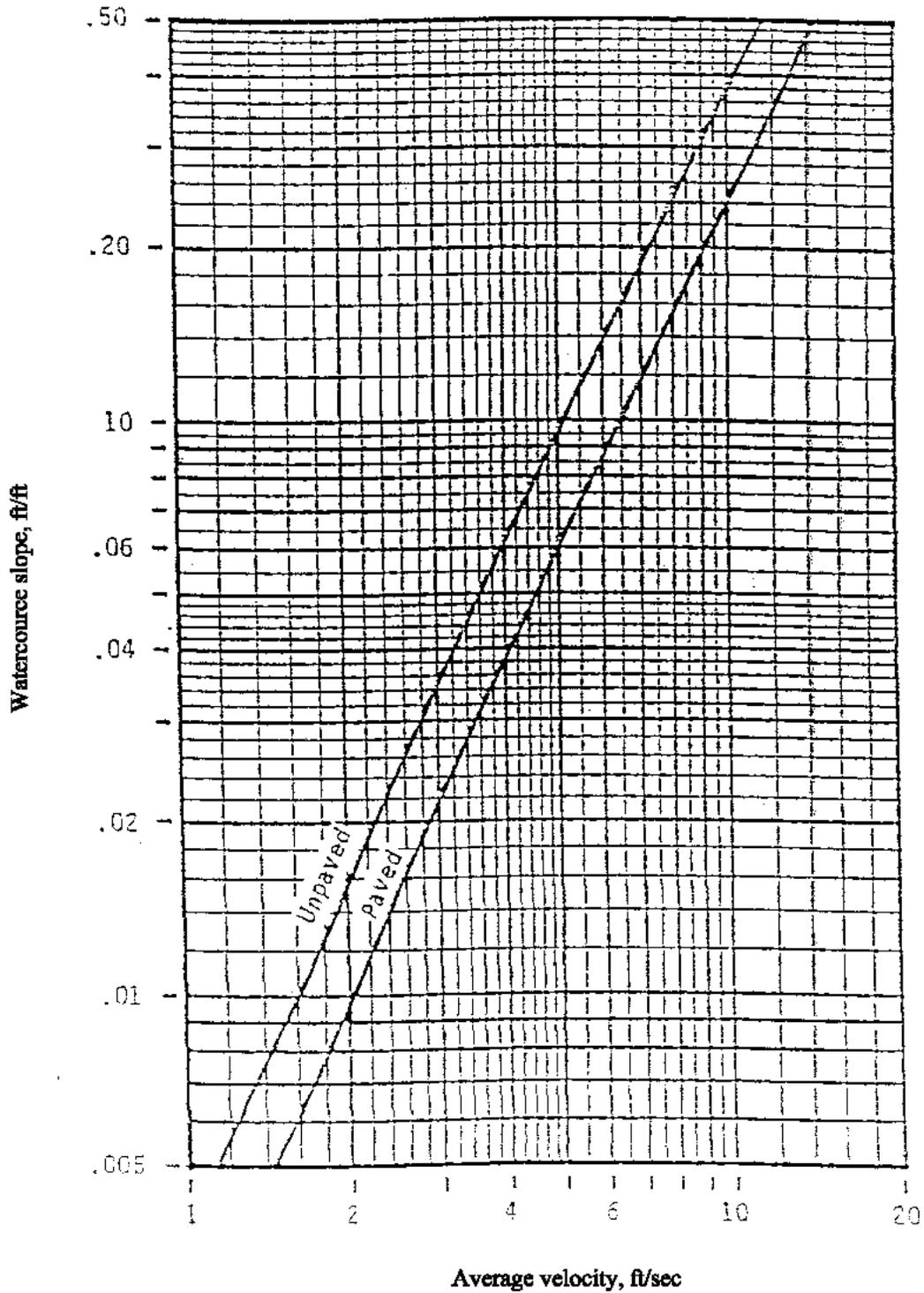
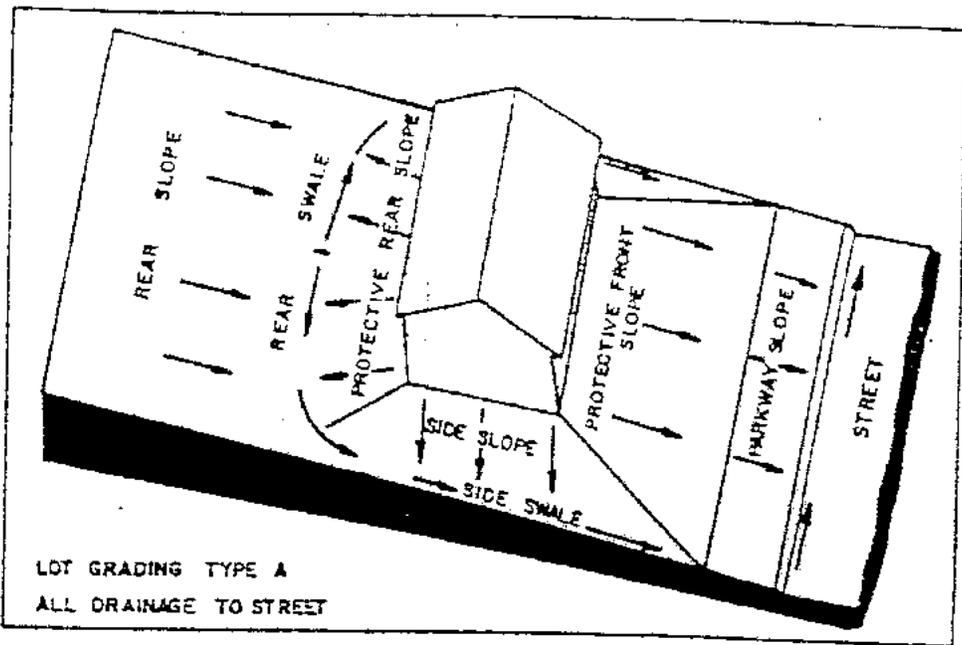


Figure 3-1.-Average velocities for estimating travel time for shallow concentrated flow.

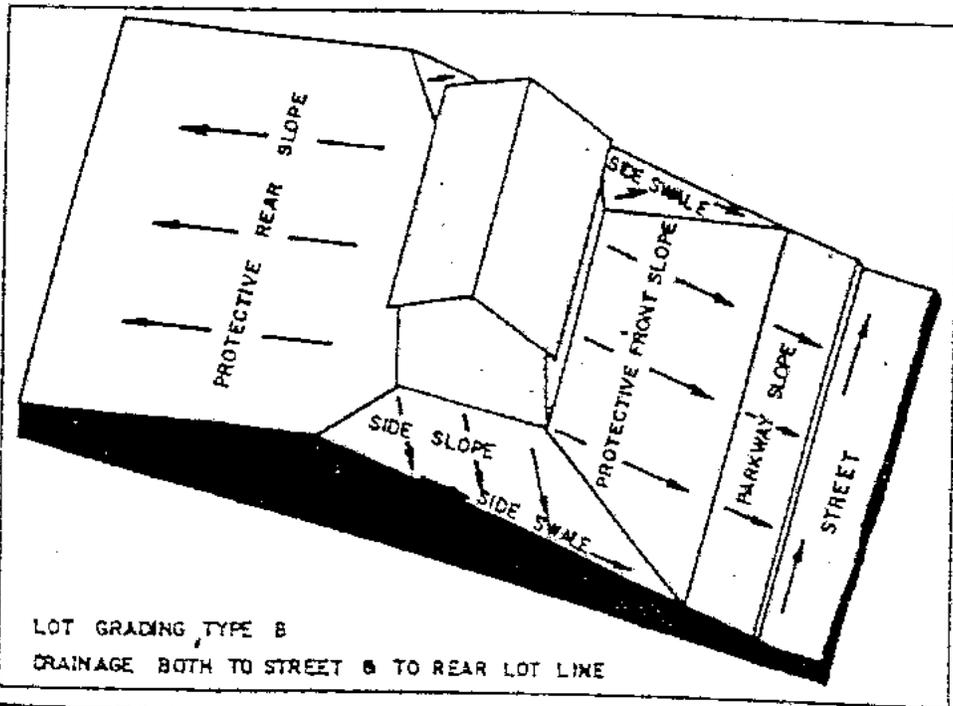
(210-VI-TR-55, Second Ed., June 1986)

APPENDIX M

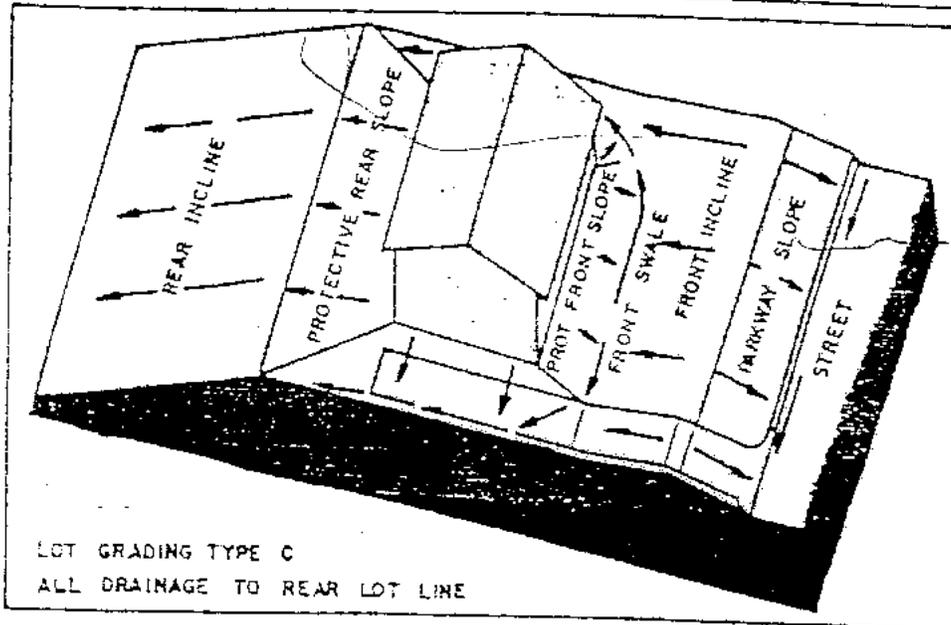
HUD Figures



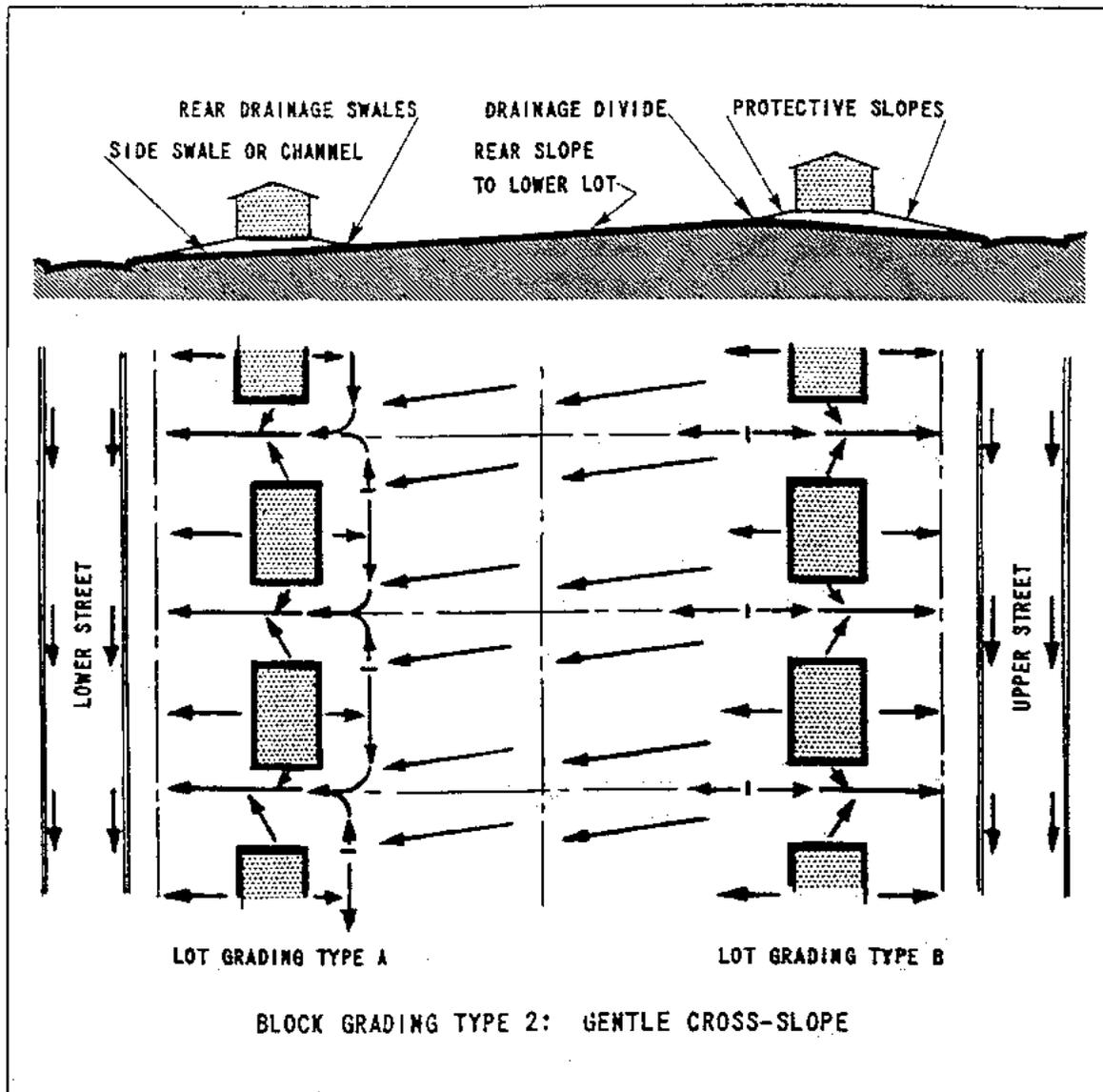
LOT GRADING TYPE A  
ALL DRAINAGE TO STREET



LOT GRADING TYPE B  
DRAINAGE BOTH TO STREET & TO REAR LOT LINE



LOT GRADING TYPE C  
ALL DRAINAGE TO REAR LOT LINE



For Lot Grading Type B which drains both to the street and to the rear lot line, only side-yard swales are needed. They should extend back of the line of the rear building wall; then splash blocks from rear roof downspouts should be placed to direct roof water to the side swales for drainage directly to the abutting street. Thus the amount of water carried on the rear slope to easements or other properties is kept as small as possible. This reduces erosion and disposal problems.

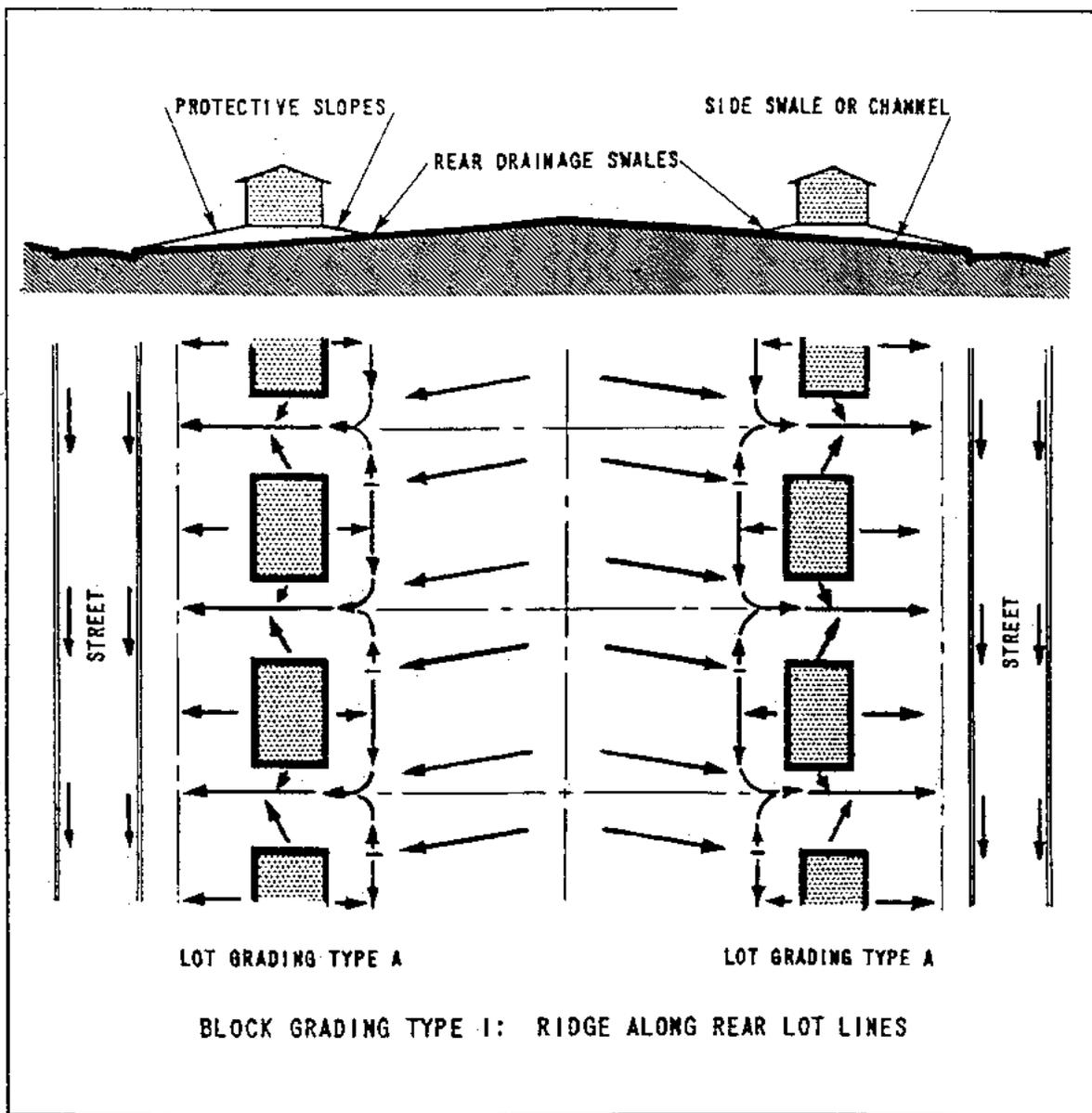
In Lot Grading Type C draining entirely to the rear lot line, front swales are essential to carry surface water from the front yard to side-

yard swales which carry it to the rear for disposal in easements or across other properties. Proper cross-section of the street gutter, curb and parkway strip are essential to stop street water from flowing onto the lot.

Easements and erosion involving Lot Types B and C are discussed above with Block Grading Types 3 and 4.

For lots with steep cross-slopes due to street gradients, similar lot grading types are used, the lot cross-slopes being taken up by walls or steep slopes along side lot lines or by changing grade levels along the front and rear house walls.

Where high slopes occur along side or rear lot



#### BLOCK GRADING TYPES

Block Grading Type 1 has a ridge along rear lot lines and each lot is graded to drain surface water directly to the street independent of other properties. It is the most simple and desirable type of block grading. Topography, however, will often require other block grading types.

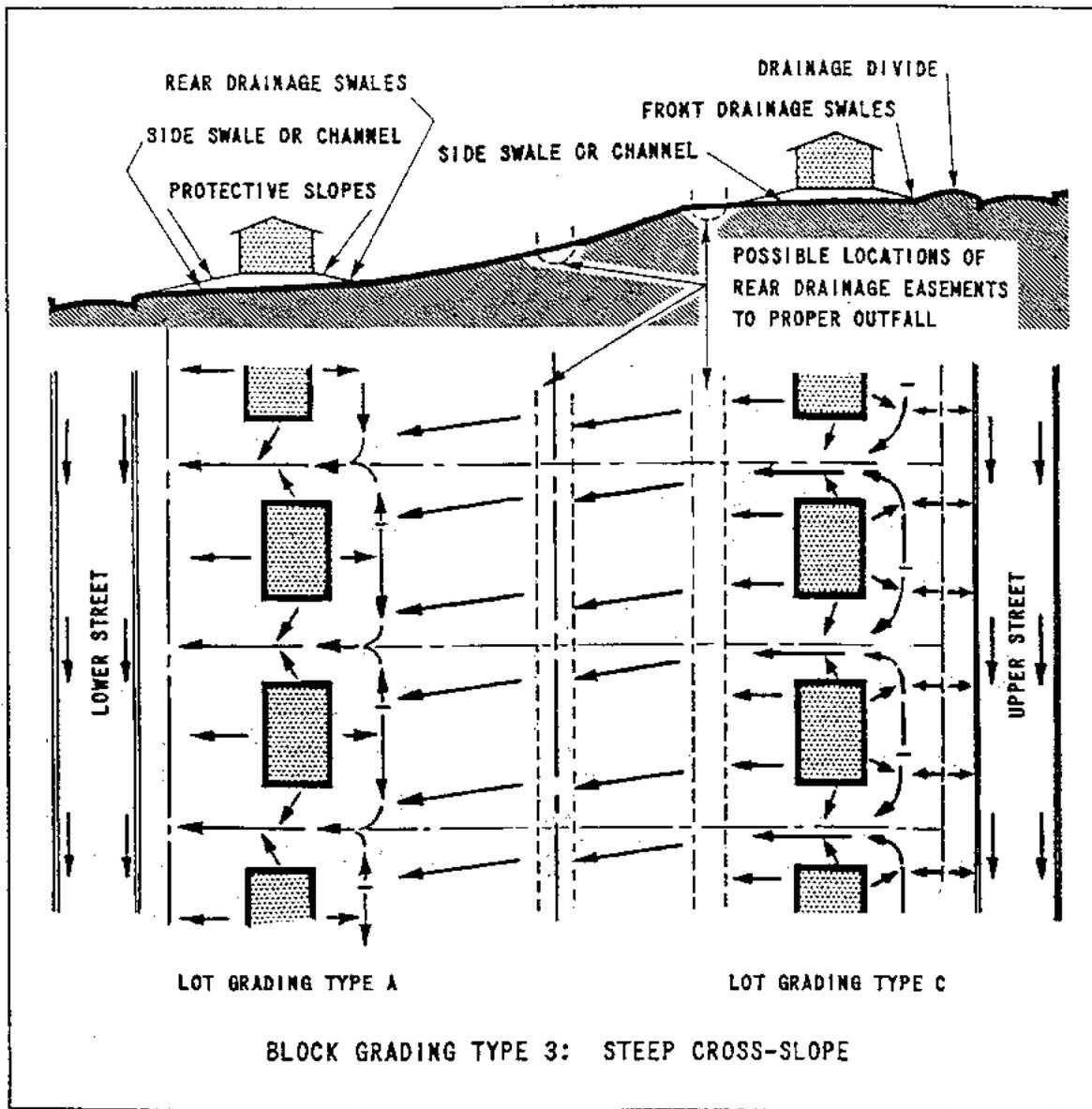
Block Grading Type 2 for a gentle cross-slope involves drainage of some surface water from lots of the high side of the block across the lower tier of lots. Difficulties are not encountered, however, if slopes are gentle and if the water always drains over short routes to the streets and does not concentrate or accumulate

in volume at any point inside the block.

Block Grading Type 3 for steep cross-slopes and Type 4 for a valley along rear lot lines require special provision for block drainage and erosion control.

Erosion is controlled by provision of intercepting drainage swales in easements at the top of the rear lot incline or at intermediate locations along it, and by treatment of the steep slope itself.

Drainage easements in Block Types 3 and 4 must have alignment, width and improvements appropriate for the expected use and maintenance. Assurance of permanent and adequate outfall is essential. The easements must be permanently

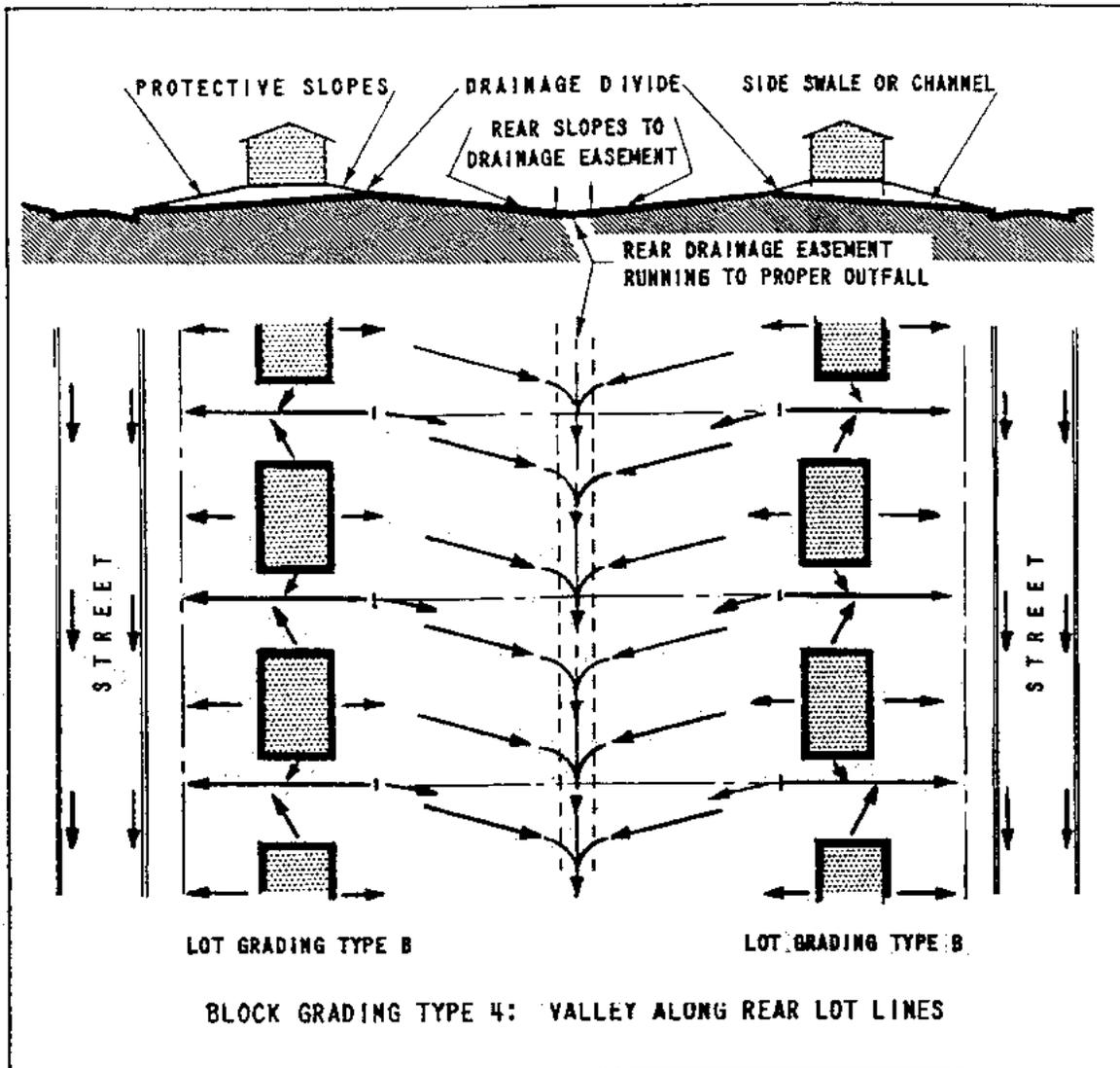


point along the house wall where the outside finish grade controls the floor elevation. In the case of no street curbs, the starting point and elevation should be the normal curb location and the street center-line elevation.

The minimum street-to-floor rise for any lot is found by adding and subtracting the required rises and permitted falls along the lot grading control line for the property. The method is illustrated by the sample computation accompanying each of the three lot grading diagrams. For actual building operations, the relationship should be figured out specifically for each lot or group of typical lots because such factors as building setback,

building depth, lot width and swale gradient may change the relationship considerably.

Minimum gradients for grass swales and other unpaved areas depend upon practical limits on precision in grading and maintaining land surfaces and upon the capacity of the ground to percolate water held back by surface texture and depressions. A gradient of 1/4 inch-per-foot (2%) is a practical minimum in areas subject to ground frost. Flatter gradients are usable, however, where the supplementary ground percolation at all seasons is adequate to prevent any prolonged saturation of soil or standing water. For example, 1/8 inch per foot (1%) is satisfactory on



#### ADJUSTMENTS TO EACH PROPERTY

After the minimum lot grading control line and minimum street-to-floor rise have been determined, they should be adjusted upward as suitable for existing topography and other conditions of each property.

For a house with a basement, check is made of elevations of drains for basement floor and any basement plumbing fixtures. For a house with a crawl space, floor elevation is checked for height of access space and drainage of interior ground (MPS 803-3). For a concrete slab house, floor elevation is checked against excessive depth of fill under the slab (MPS 808-4).

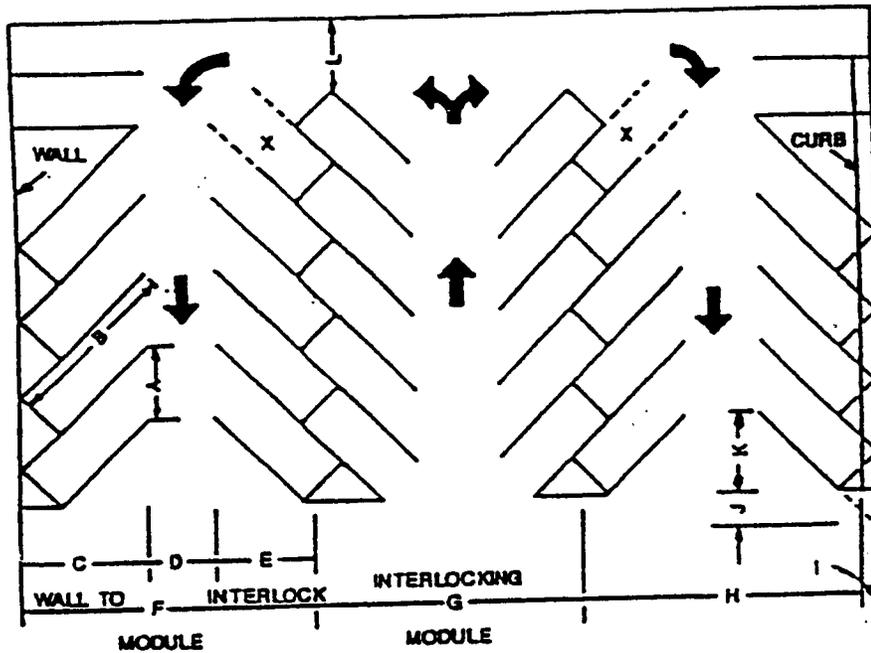
Then general lot grading is checked for feasibility and suitability.

Proposed grades at any necessary additional key points are determined, and all grades are further adjusted as needed. These additional points and adjustments cover such items as grades of walk and driveway, variation of outside finish grade along building walls, width and gradients of usable yard areas, and transition to grades of adjoining properties.

After all key elevations have been properly determined by these adjustments in the planning stage, then execution of good grading on the ground is relatively easy. Care must be taken primarily to set grade stakes correctly at key points and to build and grade to them in accordance with the practices outlined in this data sheet and in the FHA Minimum Property Standards.

APPENDIX N

Parking Lot/Site Layout Design Criteria



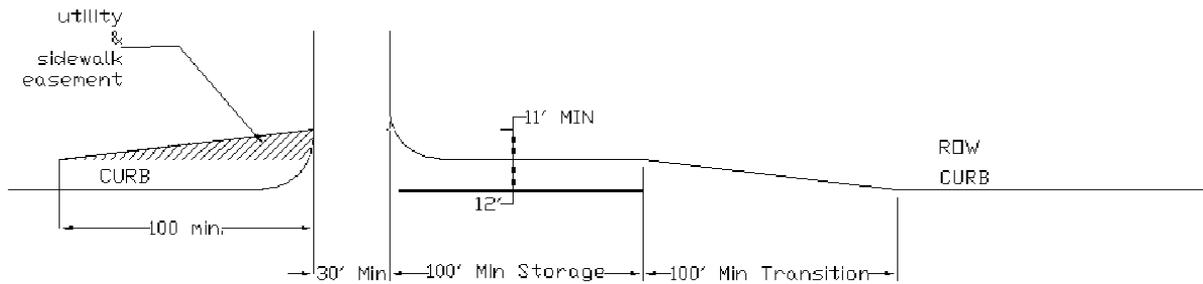
X-STALL NOT ACCESSIBLE IN CERTAIN LAYOUTS

<u>DIMENSION</u>	<u>KEY</u>	<u>0°</u>	<u>30°</u>	<u>45°</u>	<u>60°</u>	<u>75°</u>	<u>90°</u>
Stall width, parallel to aisle	A	9.0	18.0	12.7	10.4	9.3	9.0
Stall length of line	B	24.0	33.6	27.0	23.2	20.4	18.0
Stall depth to wall	C	9.0	16.8	19.1	20.1	19.7	18.0
Aisle width, one way	D	12.0	13.0	13.0	18.0	22.0	24.0
Aisle width, two way		24.0	19.0	20.0	22.0	23.0	24.0
Stall depth, interlock	E	9.0	12.9	15.9	17.9	18.5	18.0
Module, wall to interlock	F	30.0	42.7	48.0	56.0	60.2	60.0
Module, interlocking	G	30.0	38.8	44.7	53.7	59.1	60.0
Module, interlock to curb face	H	30.0	41.7	43.2	51.9	57.1	60.0
Module, curb face to curb face		30.0	40.7	41.7	50.1	55.1	58.0
Bumper overhand (typical)	I	0.0	1.5	1.5	1.8	2.0	2.0
Offset	J	-	9.0	6.3	2.7	0.5	0.0
Setback	K	24.0	15.6	11.0	8.3	5.0	0.0
Cross aisle, one-way	L	18.0	18.0	18.0	18.0	18.0	18.0
Cross aisle, two-way	-	24.0	24.0	24.0	24.0	24.0	24.0

APPENDIX O

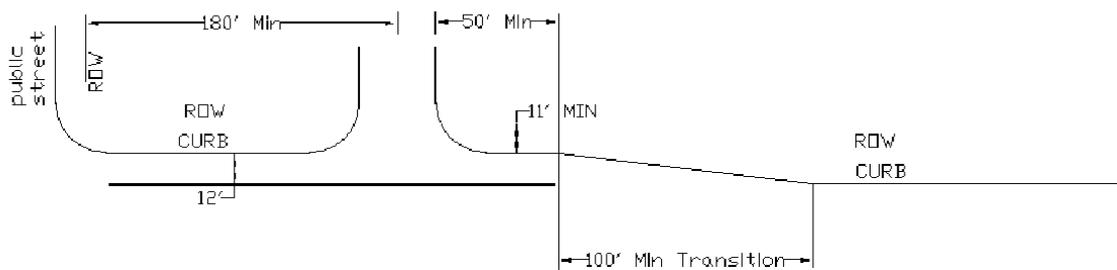
Deceleration Lane Figures

## TYPICAL RIGHT TURN DECELERATION LANE

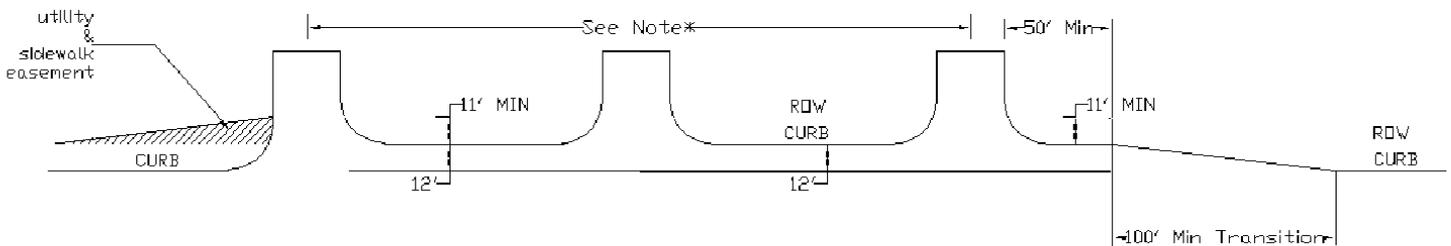


transition and storage length may vary based on use of driveway

## INTERSECTION - RIGHT TURN DECELERATION LANE



## CONTINUOUS DECELERATION LANE



\*A maximum of three driveways can be constructed with a continuous deceleration lane unless the lane is an extension of a right turn lane at an intersection. Max length combination deceleration-right turn lane is 1,320 feet. Driveway spacing shall be as shown in table I.

APPENDIX P

Paving and Drainage Plan Checklist  
Commercial

**PAVING AND DRAINAGE PLAN CHECK LIST**  
**COMMERCIAL**

ITEM	ADDITIONAL INFORMATION
<b>I. Standard Information</b>	
<b>A. Title Block (all sheets)</b>	
<b>1. Legal Description and Address</b>	
<b>2. Consultant, or architect, name and address</b>	
<b>3. Sheet Number</b>	
<b>4. Scale</b>	
<b>5. North Arrow</b>	
<b>6. Engineer's, or architects, seal, signature, and date.</b>	
<b>7. Legend and special drafting symbols</b>	
<b>B. City approved benchmark information</b>	Only required for sites with public improvements and/or MFF requirements.
<b>1. Clearly described and shown on plans</b>	
<b>2. Use city control information</b>	
<b>II. Coordination with Plat</b>	Verify plans are consistent with the plat.
<b>A. Verify DRC comments met.</b>	Read all DRC comments, just in case another department's affect us.
<b>B. Verify required easements (drainage, access) have been dedicated, either by plat or separate instrument.</b>	
<b>C. Verify MFF requirements correspond with plat.</b>	
<b>III. Site Plan / Grading Plan</b>	
<b>A. Existing contours or spot elevations</b>	
<b>B. Proposed contours or spot elevations</b>	May not divert water from natural flow patterns.
<b>C. Proposed grading should correspond with drainage areas.</b>	
<b>D. Verify grading is consistent with adjacent site plans.</b>	Check commercial site grading files.
<b>E. Coordinate with existing CIP plans.</b>	
<b>F. Letter of Permission is required for offsite grading</b>	

ITEM		ADDITIONAL INFORMATION
or concentration of flow.		
G. Verify building setbacks honor future/ultimate right-of-way requirements, especially at intersections.		Coordinate with Building Inspections.
<b>IV. Paving Sheets – Plan View</b>		
A. Drive Approach		Place note on plans stating Traffic Control Plan required prior to construction of the tie-ins.
1. Standard City detail required.		
2. Verify spacing		May require shared access easement with adjacent property.
3. Verify distance to intersection and/or highway ramps		
4. Drive approach shall not be located within 50' of decel lane transition, measured from the radius point of the drive approach to the point of tangency of the transition.		May need to relocate drive or extend decel lane.
4. Drive approach shall not be located within 6 feet upstream or downstream of an existing or proposed inlet, or within 4 feet of a fire hydrant or other surface utility.		
5. Verify radius, slope, and tie-in to existing street.		
6. Throat width		
7. Full-depth saw cut required.		
8. If proposed drive approach creates 4 <sup>th</sup> leg of intersection, signal required.		
9. If shared access easement required, verify drive approach fits within easement		
10. Connecting to County type facility		Temporary asphalt approach allowed when adjacent street is proposed for reconstruction in near future.
a. Show culverts		If a culvert cannot be provided you must have an invert across the approach.
b. Provide headwalls and/or sloped end treatments.		Provide detail.

ITEM		ADDITIONAL INFORMATION
<b>B. Parking</b>		
<b>1. Length/Angle of stall</b>		
<b>2. Travel aisle width</b>		If wheel stops are proposed, increase aisle width by 2 feet.
<b>C. Visibility Triangles</b>		Nothing over 2 feet tall may be located within visibility triangle.
<b>1. Show and dimension triangles on plan</b>		May require additional visibility easement.
<b>2. Consider existing geometry/topography</b>		May require site visit to verify.
<b>3. Check proposed landscape plans.</b>		
<b>D. Sidewalks</b>		Provide standard COA detail.
<b>1. Required for adjacent streets.</b>		If sidewalks are included along a TxDOT facility, they require 5' wide, 4' off the right-of-way line.
<b>2. 4' wide, 1-foot off ROW (preferred)</b>		May vary to avoid obstructions such as power poles, fire hydrants, telephone/electric risers. If less than 2' to the curb, sidewalk shall be 6' wide and adjacent to curb.
<b>3. Access ramps</b>		Provide COA standard details.
<b>E. Turn lanes/deceleration lanes/ Median openings</b>		TxDOT will not allow any utilities under pavement.
<b>1. Turn Lane/Decel Lane Required?</b>		If site generates more than 40 right turns in PM Peak hour, decel lane required. Refer to Trip Generation Manual.
<b>a. Match existing street section</b>		Provide typical section.
<b>b. Type of subgrade modification, density-same as street (2 and 3 below are options)</b>		
<b>1. Lime stabilization</b>		Difficult for small areas. If in SE Arlington, use modified specification.
<b>2. Flexible base (at least 6" depth)-TxDOT Type A, Grade 1</b>		
<b>3. Thickened pavement (additional 4") on compacted base</b>		
<b>d. Match cross slope</b>		Offset joint from gutter line.
<b>e. Additional ROW (12') required either by plat or by separate instrument.</b>		Shall be dedicated by separate instrument if not by plat. Need to notify Building Inspections of additional setback requirements.
<b>f. Verify storage/transition lengths</b>		Drive approach may not be located within 50 feet of transition, may need to extend decel lane. If drive approach is within 180 feet of intersection, decel lane shall be extended to the intersection.

ITEM		ADDITIONAL INFORMATION
<b>2. Median Openings</b>		
<b>a. Requires property owner notifications</b>		
<b>b. Requires construction of left turn lane</b>		
<b>c. Verify spacing requirements</b>		
<b>d. Verify opening width requirements</b>		
<b>e. Medians &lt; 8' width, must be in accordance with COA median details</b>		Coordinate with Parks Department.
<b>f. Median landscaping/irrigation (≥ 8' width)</b>		Coordinate with Parks Department.
<b>3. Requires 3-party contracts</b>		
<b>F. Gated Entry Requests</b>		Coordinate with Fire Dept.
<b>1. Verify turn-around requirements</b>		
<b>2. Verify stacking requirements</b>		
<b>3. May require Decel lane</b>		
<b>4. Submit disk if not using COA standard entry</b>		
<b>V. Drainage Area Map</b>		
<b>A. Drainage map</b>		
<b>1. Coordinate with Preliminary Drainage Study</b>		
<b>2. Contours (min. 5' interval)</b>		
<b>3. Existing facilities/features (natural or man-made)</b>		
<b>4. Proposed facilities</b>		Analyze downstream systems for capacity of additional developed condition flow. May require detention or offsite improvements. May not worsen downstream problems.
<b>5. Major watershed area, including contributing offsite areas</b>		
<b>6. Drainage areas (min. scale 1" = 200')</b>		
<b>7. Sub areas for mains, laterals – for public systems</b>		
<b>8. Drainage flow arrows for site</b>		
<b>9. Show information on adjacent property, such as contours, existing systems, easements,</b>		

ITEM		ADDITIONAL INFORMATION
city limits, floodplain/ floodway and creeks		
10. For creek/channel, See requirements below.		
<b>B. Drainage criteria/table</b>		
1. Method of analysis		Modified Rational Method.
2. Drainage area designations		
3. Drainage area acreage		
4. Soil group type		
5. Runoff coefficient(s)		For commercial sites, C is greater than or equal to 0.96.
6. Time of concentration		Time shall reflect fully developed conditions in the upstream watershed.
7. CCa value $\leq 1.0$		
8. Design frequency(s)		
9. Intensity		
10. Flow rate		
<b>VI. Drainage Sheets – Underground Systems</b>		
<b>A. Plan view – Public System</b>		Any system crossing property lines is considered public and shall be contained within a public drainage easement.
1. Label and show size/type (Line 'A'-21" RCP Class III)		Minimum size is 18". Must be RCP. Plastic pipe may be used for private system.
2. Show all easements (offsite and onsite) including easement width. Minimum 15' width for underground system.		Private improvements within easement require Easement Use Agreement or maintenance statement placed on plat. Typically, trees required to satisfy landscape ordinance are not allowed in a public drainage easement.
3. Centerline of storm drain referenced to the easement, or ROW		
4. Centerline data		
a. Stationing along centerline of pipe		
b. Beginning/ending stations		
c. Bends-required in lieu of curves		Bends and wyes shall be prefabricated. Radius pipe is allowed. Lay schedule shall be provided.
d. Wyes-location, angle of laterals		

ITEM		ADDITIONAL INFORMATION
e. Junction structures		Provide detail.
f. Collars		Provide standard COA detail.
5. Connection of private storm drain to public system.		Try to require site drainage to be intercepted on-site and connected to an existing public system.
a. Verify main designed to accept flows.		
b. Prefabricated wyes required.		Field connection allowed when lateral diameter is less than one half the diameter of the main and slope of lateral is less than 10%. Provide standard COA collar detail.
c. Requires DPW inspection.		3-way contracts not required.
6. Bar ditch culverts – 5 year design		Provide profile or show flow line/top of pavement elevations.
a. Size		
b. Verify minimum cover		
c. Sloped end treatment/headwall		Type A or Type B headwall or sloped-end section. Provide detail.
7. Proposed creek culverts and bridges – 25 year design		
a. Station and offset ties		
b. Skew angle		
c. Handrail/guardrail		Need for guardrail? Especially on upstream (traffic flow) end. Provide details.
d. Headwall		Provide detail.
8. Entrance/outfall structures, including velocity/erosion control.		System shall be extended to flow line of the creek.
a. Type		Gabions are required for permanent erosion control. If a temporary (< 6 months) situation exists (for phased construction), you may consider allowing rock w/filter fabric or "grouted" rock riprap, if the owner requests in writing and will address if a problem occurs.
b. Size/dimensions/cross-section		
c. Toe walls (2' minimum)		
d. Connection to headwall		Provide detail.
9. Drop/Y type inlets		Grate inlets are not allowed as part of public system. Provide detail.
a. Need concrete reinforced apron with a min. 2' toe wall on all sides		
b. May need easement by separate		May need to construct swale to direct flow to inlet

ITEM		ADDITIONAL INFORMATION
<b>instrument if constructed off-site.</b>		
<b>10. Flumes as primary drainage feature</b>		Must have approval from DPW for use as primary drainage feature.
<b>a. Provide calculations for ponded depth at entrance</b>		
<b>b. Need 4:1 flare at entrance</b>		
<b>c. Transition through sidewalks shall be accomplished using plates.</b>		Must meet ADA/TDLR requirements.
<b>1. Must be minimum 3/8" thick</b>		
<b>2. Edges must be reinforced</b>		Have allowed angle iron across the edges on the underside of plate.
<b>3. Ends must be bolted down</b>		
<b>d. Bollards are required for flumes 6' &amp; wider when sidewalk is not constructed.</b>		
<b>e. Provide cross section - Must have an invert with 7% cross slope</b>		
<b>B. General Notes (placed on plans; as applicable)</b>		
<b>1. All bends and wyes should be prefabricated</b>		If a field connection is authorized, the lateral diameter cannot be greater than one half the diameter of the main. Do not allow a field connection when lateral slope is greater than 10%. Provide collar detail.
<b>2. Use only authorized premolded type joint sealer</b>		Omniflex is acceptable.
<b>3. Contact DPW 48 hours prior to construction.</b>		
<b>C. Profile view-Public Underground Systems</b>		
<b>1. Natural and proposed ground profile over centerline of proposed storm drain</b>		If pipe is placed < 3' deep or if cover is ≥ 13', Class IV pipe is required.
<b>2. For proposed public systems</b>		Extend pipes to flowline of creek.
<b>a. Designation and size/type and class (Line 'A'-21" Class III RCP)</b>		
<b>b. Length</b>		
<b>c. Grade (slope)-with elevs.-min. 50' intervals</b>		
<b>d. Match soffits (inside top of pipe)</b>		

ITEM		ADDITIONAL INFORMATION
e. Design flow		
f. Velocity		
g. Hydraulic grade line/water surface		HGL should not be more than 1 pipe size above top of pipe.
i. Shall remain below bottom of subgrade for systems under paving		
ii. Shall be lower than inlet throat		
iii. Begin at inside top of pipe or HGL of connecting feature, whichever is higher		
h. Outfall structures		
3. Junction box or lateral connection locations		
4. All proposed or existing utilities which cross the proposed public system		
5. Creek Culverts		
a. Size of openings		
b. Length		
c. Type of operation under design conditions		Inlet or outlet control? For inlet control, ponded depth at entrance may require revising entrance conditions.
d. Flow line elevations for both ends of culvert		
e. Headwater/tailwater elevation for 25-year and 100-year events		
f. Design frequency		Design for 25 year, evaluate 100 year.
g. Outfall structure		
h. Grade to drain - indicate size, slope, water surface, velocity, typical section, side slopes 4:1, vegetation, letter of permission for offsite grading.		Need to design as 'non-erosive'. Acceptable slope may vary depending on soil type and the situation, whether sedimentation or erosion is a concern.
6. Flumes with 25- and 100-year WS		Continue flumes to flow line of creek with gabion transition at outfall and on the edges along the creek bank.
<b>VII. Drainage Sheets –Concrete Channels</b>		

ITEM		ADDITIONAL INFORMATION
<b>A. Plan View</b>		
1. Channel lining contains 25-year plus one-foot of freeboard.		
2. Distance from top of channel to easement is 10.0' minimum. No creek buffer req'd.		
3. MFF for lots adjacent to creeks/channels		Two feet above fully developed water surface for 100-year storm.
4. Expansion/contractions, prefer 4:1 or longer transitions		
5. Curved sections-label PC and PT and account for superelevated water surface		May need to elevate outside wall on curves to contain flow in the channel.
6. Show where typical section is located		
7. Storm drain connections		Need to evaluate impacts. Angle the connection on larger pipes/flows to reduce impacts. May need to elevate opposite wall.
8. Provide an access point for maintenance		May require additional easement.
9. Velocity/erosion control at upstream/downstream end		Use gabions to transition to earthen/natural channel. Provide connection detail.
10. If a FEMA designated floodplain, requires submittal for CLOMR/LOMR.		
<b>B. Profile View</b>		
1. Natural ground along drainage easement both sides		
2. Top of left/right channel		
3. Channel gradient (flowline)		
4. Continuous water surface profile of design flow & 100-year event		Must provide one-foot of freeboard above the 25-year frequency event.
5. Flow and velocity for each change in flowrate/slope		
<b>C. Typical Section</b>		
1. Geometry of cross-section		
a. Invert-bottom must have 10% cross-slope		Minimum bottom width allowed is 6 feet.
b. Sides slopes		2:1 is the maximum slope for concrete channel walls. 4:1 is the maximum slope for earthen portion above the concrete lining.

ITEM		ADDITIONAL INFORMATION
c. Toe walls-min. 18" along top of channel banks; min. 36" at up and downstream ends		Also, if a significant area/flow exists or is proposed toward channel sides, may need to intercept with systems and/or provide deeper toe walls.
d. Weep holes on 15' centers		Provide a 2'x1' trench with washed rock and wrapped in filter fabric along both sides of the entire channel length at the flow line.
e. 6" thick, 3000 psi concrete with #3 bars at 24" centers both ways		
2. Maximum capacity for normal flow condition		
3. Provide calculations to determine channel capacity, including roughness coefficient		See Flood Study Requirements
4. Permissible construction and expansion joints; only a vertical joint is permitted at the point where the channel wall meets the bottom		
5. Size, dimensions, and cross-section of permanent erosion control.		
<b>VIII. Drainage Sheets – Earthen Channels</b>		
<b>A. Requirements: (based on fully developed watershed)</b>		
1. Channel contains 25 year event plus one foot of freeboard.		
2. Distance from top of channel to easement is 10' minimum (both sides) to account for creek buffer zone.		
3. Show 100-year water surface on plan.		
4. MFF for lots adjacent to creeks/channels		Two feet above fully developed water surface for 100-year storm.
5. Tie-down centerline, top left/right bank.		
6. Expansions/Contractions, prefer 4:1 or longer transitions.		
7. Provide calculations to determine channel capacity, including roughness coefficient		See Flood Study Requirements
8. Show where typical cross-section is located.		
9. Pilot channel with 1" invert		6' minimum bottom width. Change in grade may require drop structure.

ITEM		ADDITIONAL INFORMATION
a. 6" thick, 3000 psi concrete with #3 bars at 24" centers both ways		
b. Requires transition material between pilot channel and side slopes for erosion control		
10. Erosion protection upstream and downstream at connection/transition to closed system or natural channel.		
11. Vegetated or bio-engineered side slopes		4:1 side slopes
12. Storm drain connections		Need to evaluate impacts. Angle the connection on larger pipes/flows to reduce impacts. May need to armor opposite wall and/or outfall area.
13. If a FEMA designated floodplain, requires submittal for CLOMR/LOMR.		
14. Maintenance Agreement required.		
15. Requires supporting documentation with submittal of As-Built letter		See Design Criteria Manual for information.
<b>B. Profile View</b>		
1. Natural ground along drainage easement both sides		
2. Top of left/right channel		
3. Channel gradient (flowline)		
4. Continuous water surface profile of design flow & 100-year event		Must provide one-foot of freeboard above the 25-year frequency event.
5. Flow and velocity for each change in flowrate/slope		
<b>IX. Drainage Sheets–Natural Creeks</b>		
<b>A. Requirements: (based on fully developed watershed)</b>		
1. Easement = 25 year water surface		
2. Creek buffer zone is 25' measured from top of channel bank		
3. Verify Erosion Clear Zone – provide cross sections through curves of channel		
4. Label 100-year water surface on plan and		

ITEM		ADDITIONAL INFORMATION
profile		
5. MFF for lots adjacent to creeks		Two feet above fully developed water surface for 100-year storm.
6. Plot of cross-sections		
7. Backwater analysis to justify data, include a disk		
8. Tie-in/transition to permanent structures		
9. Storm drain connections		Need to evaluate impacts. Angle the connection on larger pipes/flows to reduce impacts. May need to armor opposite wall and/or outfall area.
10. If a FEMA designated floodplain, requires submittal for CLOMR/LOMR if modifying the floodway.		
11. Maintenance Agreement required.		
<b>X. Storage (Detention/Retention)</b>		Notarized Letters of Permission may be required for concentration of flow or offsite grading.
A. Hydrology Data		
1. Pre-development Conditions		
2. Post-development Conditions		
B. Storage Criteria		
1. Minimum storage required equals 25 yr. Post-Development discharge minus Pre Development discharge plus 1 foot freeboard.		Additional storage may be required depending on downstream conditions
2. Provide Inflow/Outflow Hydrographs		Analysis of 5, 25, and 100 year events
3. Provide Routing Chart		Stage/Storage/Discharge Relationship
a. time interval (min)		
b. inflow (cfs)		
c. storage (cu. ft.)		
d. stage (ft)		
e. outflow (cfs)		
C. Plan Requirements		
1. Plan View		

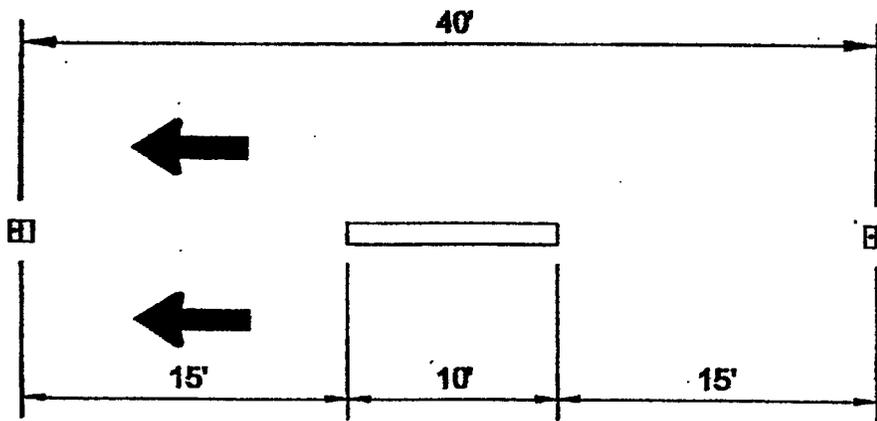
ITEM		ADDITIONAL INFORMATION
a. Dimension Control		
b. Grading Plan		
c. Pilot Channel		
d. Outlet Structure		Provide construction detail.
2. Cross Sections (Elevation)		
a. Water Surface Elevations		
b. Side slopes		
c. Densities		
d. Outlet Structure		
e. Erosion Control		
<b>D. Miscellaneous</b>		
1. Maintenance Agreement required.		
2. Requires supporting documentation with submittal of As-Built letter		See Design Criteria Manual for information.
<b>XI. Detail Sheets</b>		
A. Utilize standard COA details, if available		
B. All sheets must be sealed, signed, and dated		
C. Are all applicable details included?		Details clearly shown (readable) and have adequate construction information
<b>XII. Flood Study General Requirements</b>		
A. Flood studies are required to define easements, determine minimum finished floor elevations, and when modifying the floodway/floodplain.		
B. Refer to Flood Study Requirements in the Design Criteria Manual		
<b>XIII. Miscellaneous</b>		
A. Work within TxDOT ROW		
1. City sends 3 copies of 11" x 17" plans, and a cover letter to the state for approval.		

ITEM		ADDITIONAL INFORMATION
2. Need to include Form 1058 if work includes a public street connection.		
<b>B. Cell Towers</b>		Coordinate with Airport Manager.
1. Provide elevation of top of tower based on Mean Sea Level.		
2. Verify top of tower is below height restriction for location. Check both Arlington and Grand Prairie.		See Height Restriction Maps
<b>C. Changeable Message Signs</b>		
1. Requires ZBA approval		
2. Letter height based on sight distance: Height = 1 inch per 36 feet of sight distance		Minimum letter height 10” for non-freeway, 18” for freeway use.
3. Sight distance from AASHTO manual (based on speed limit of roadway)		Use upper end of range to be conservative.
4. No scrolling/flashing messages allowed		

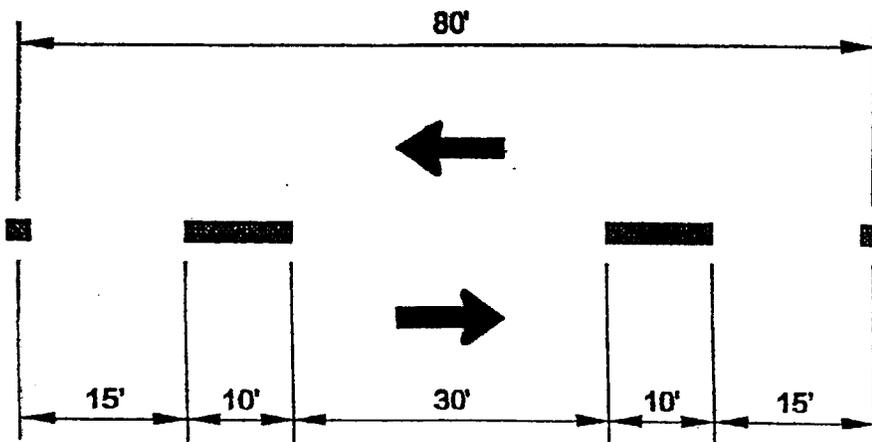
## APPENDIX Q

### Raised Pavement Marking Configurations

PAVEMENT MARKING SYMBOL LEGEND	
	YELLOW STRIPE
	WHITE STRIPE
	TWO-WAY YELLOW RAISED PAVEMENT MARKER
	WHITE / RED RAISED PAVEMENT MARKER
	ONE-WAY YELLOW RAISED PAVEMENT MARKER
	DIRECTIONAL ARROW
	PAVEMENT ARROW



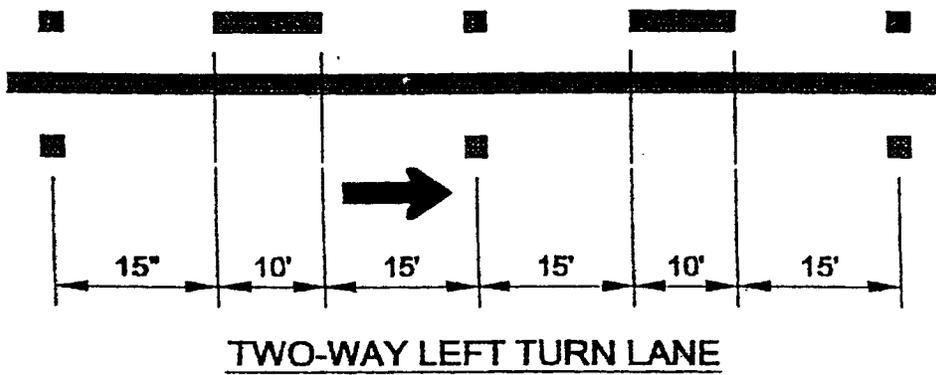
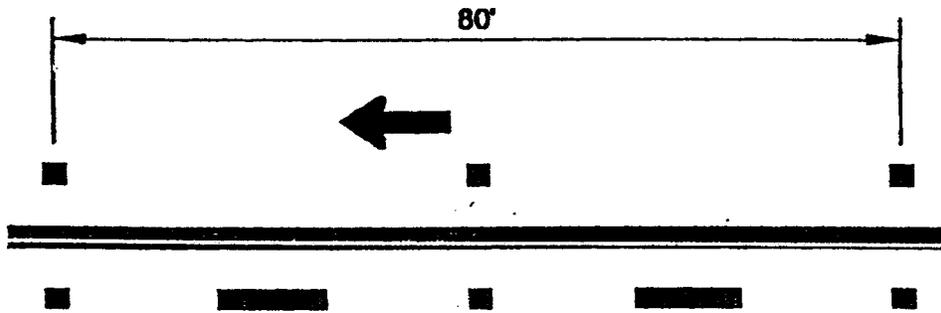
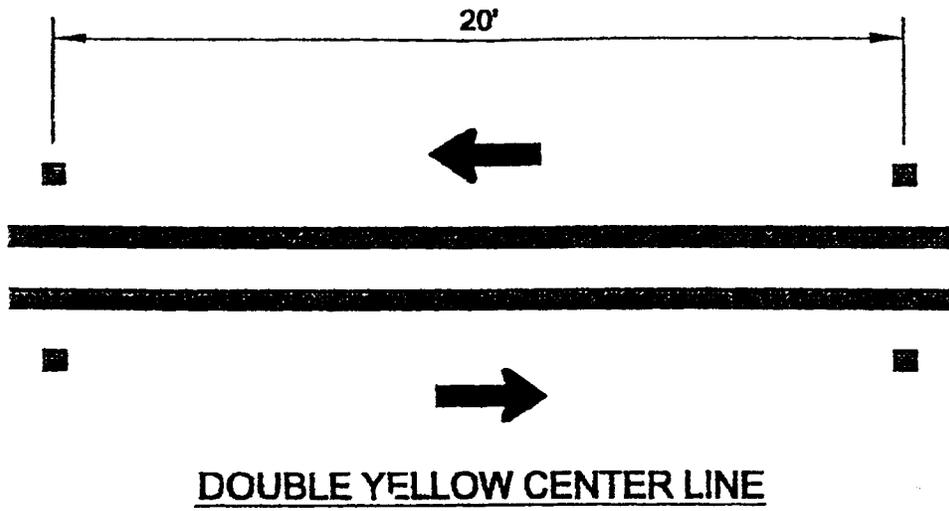
LANE LINE



CENTER LINE

**RAISED PAVEMENT MARKER CONFIGURATIONS**

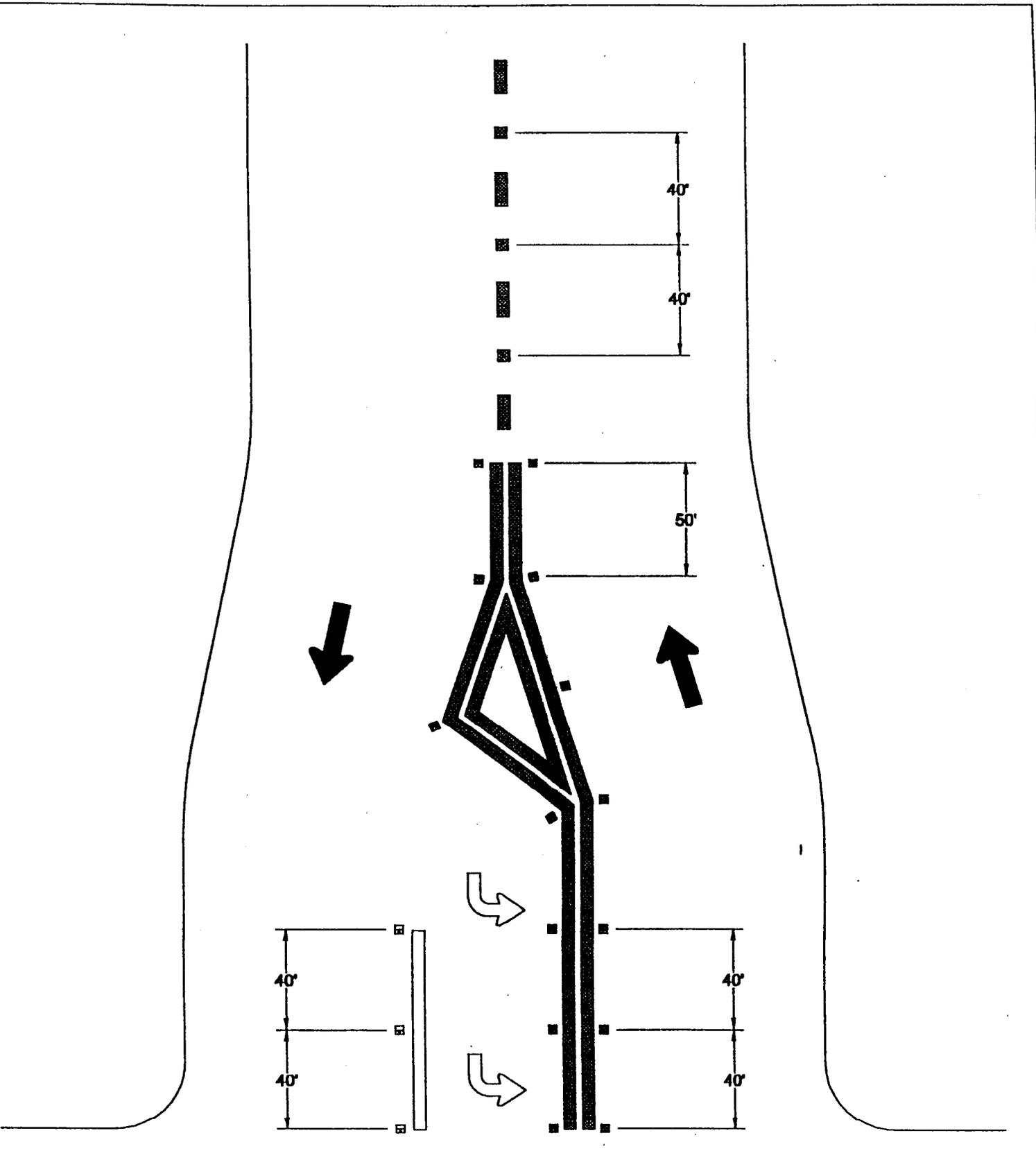
FIGURE 4-3



SEE PREVIOUS PAGE FOR LEGEND

**RAISED PAVEMENT MARKER CONFIGURATIONS**

FIGURE 4-3



LEFT TURN LANE

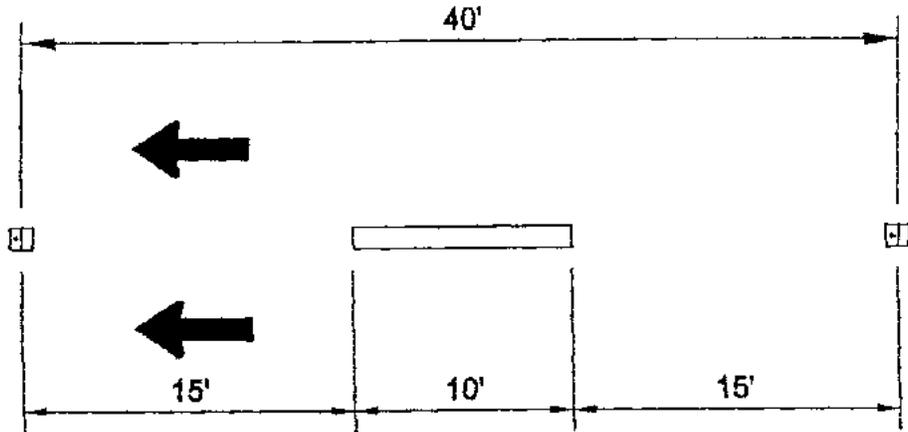
**RAISED PAVEMENT MARKER CONFIGURATIONS**

**FIGURE 4-3**

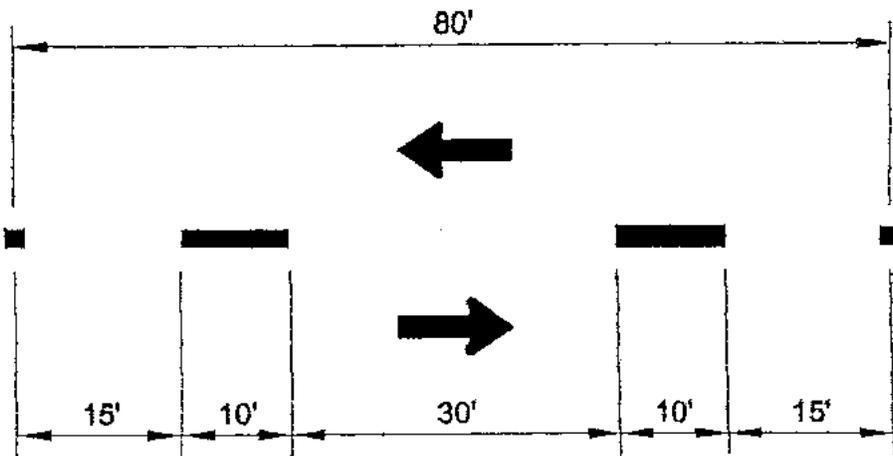
APPENDIX R

Typical Line Patterns

PAVEMENT MARKING SYMBOL LEGEND	
	YELLOW STRIPE, 4" WIDE
	WHITE STRIPE, 4" WIDE
	TWO-WAY REFLECTIVE YELLOW MARKER
	REFLECTIVE WHITE / RED MARKER
	DIRECTIONAL ARROW



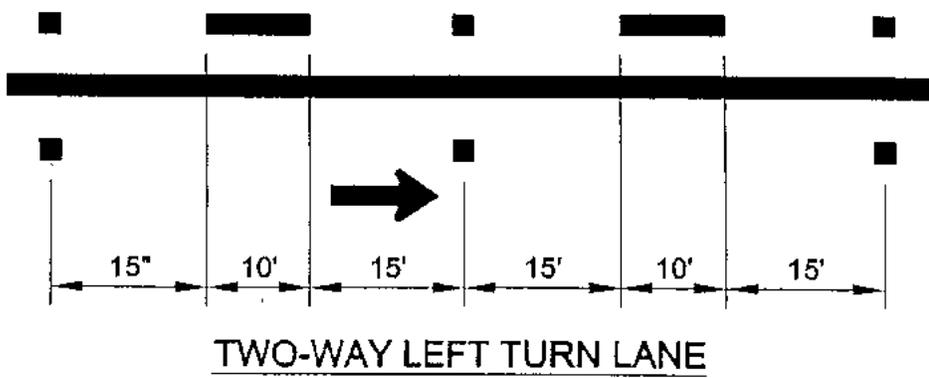
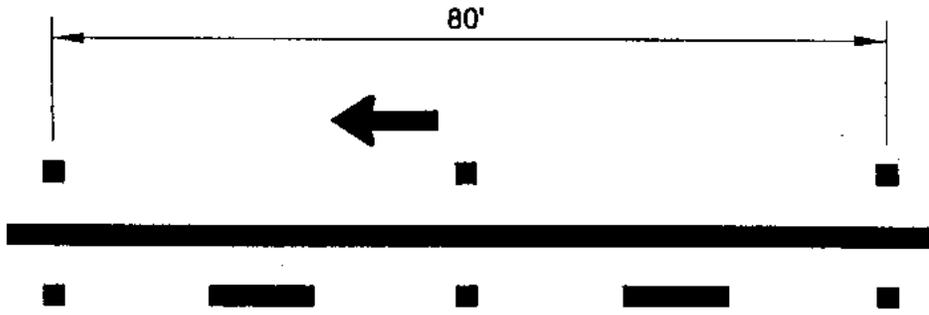
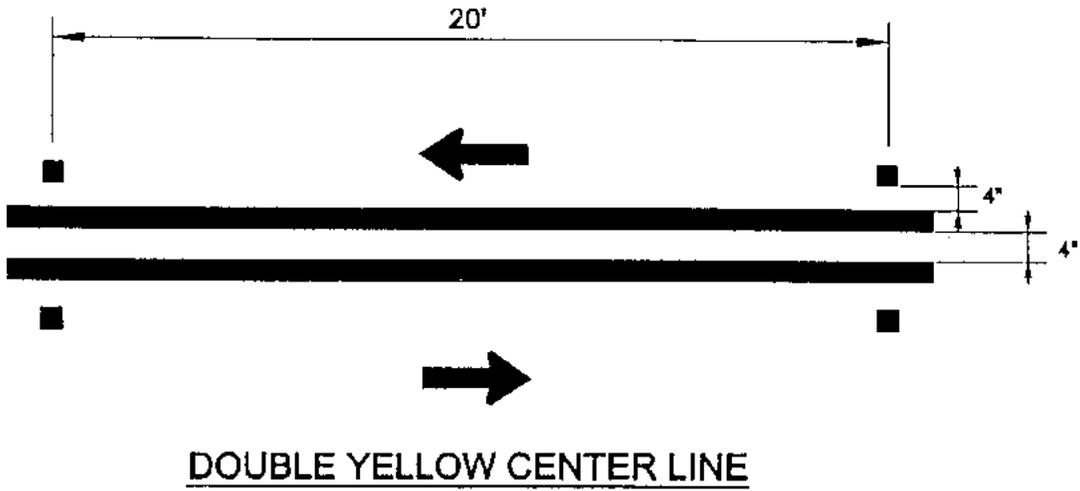
LANE LINE



CENTER LINE

LANE MARKING CONFIGURATIONS

FIGURE 2



SEE PREVIOUS PAGE FOR LEGEND

**LANE MARKING CONFIGURATIONS**

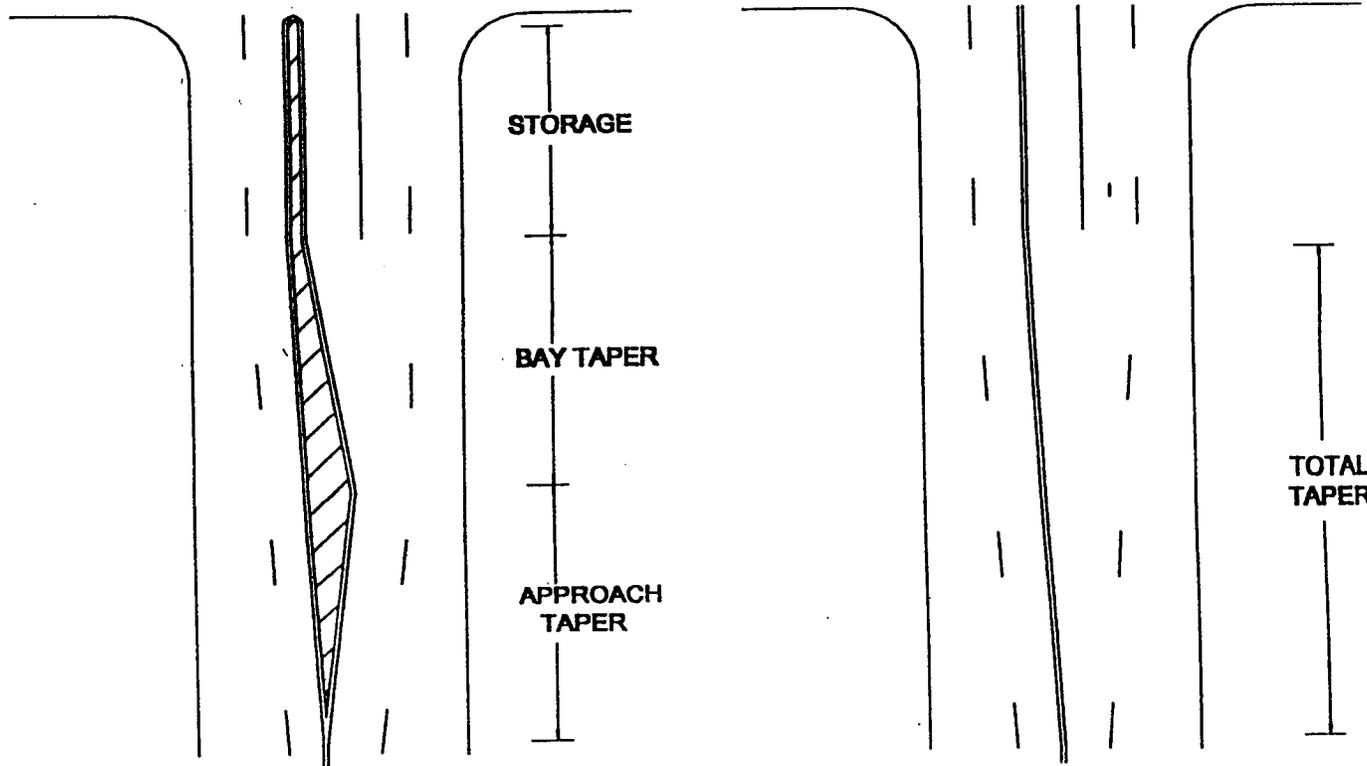
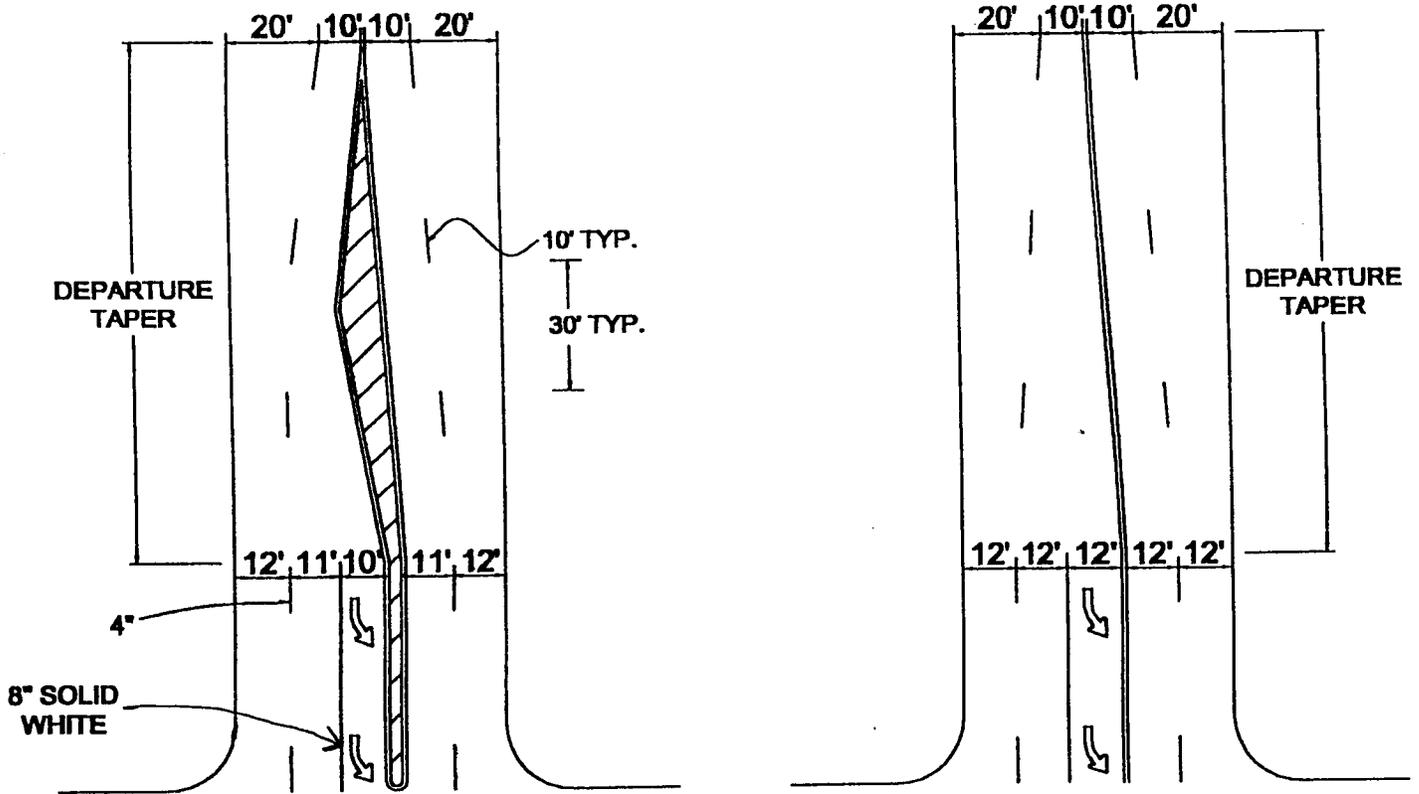
FIGURE 3

APPENDIX S

Left Turn Channelization

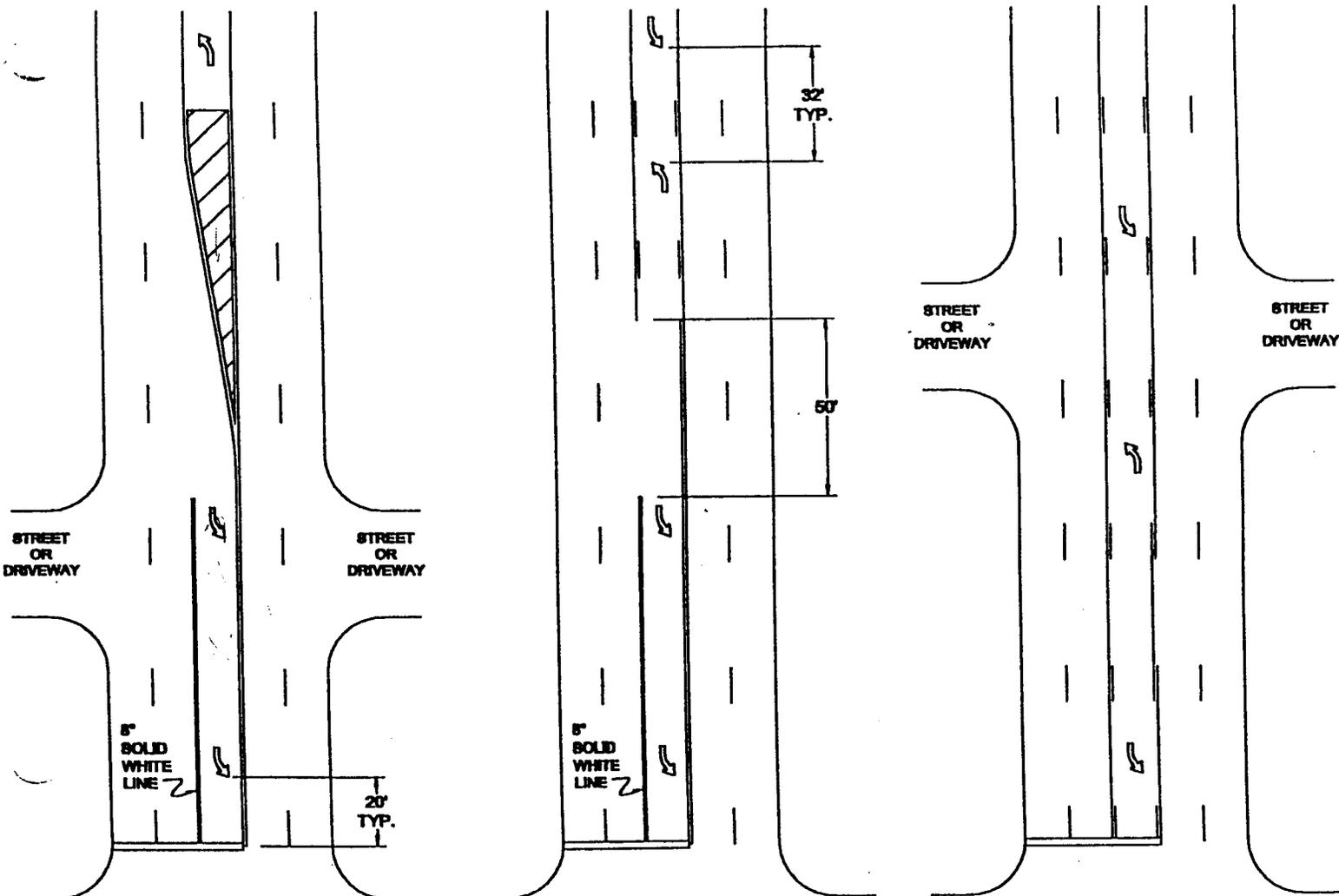
STANDARD

ALTERNATE



LEFT TURN CHANNELIZATION

FIGURE 4-1



**ARTERIAL/ARTERIAL  
INTERSECTIONS OR  
INTERSECTIONS WITH  
CONFLICTING HIGH  
VOLUME DRIVEWAYS**

**STANDARD**

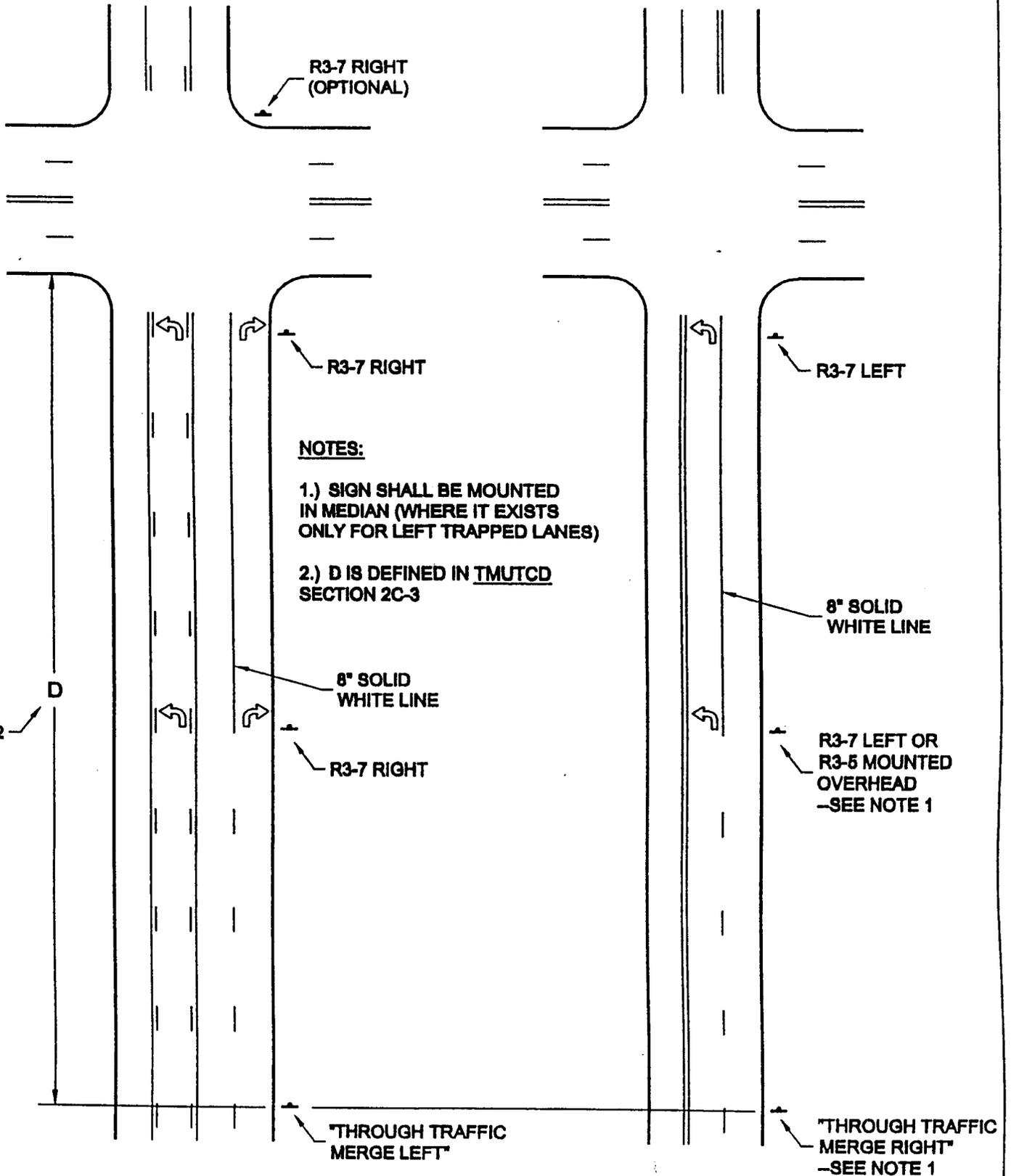
**LOW VOLUME  
CROSS ROAD**

**CONTINUOUS LEFT TURN LANE CHANNELIZATION**

FIGURE 4-2

**RIGHT LANE TRAPPED**

**LEFT LANE TRAPPED**

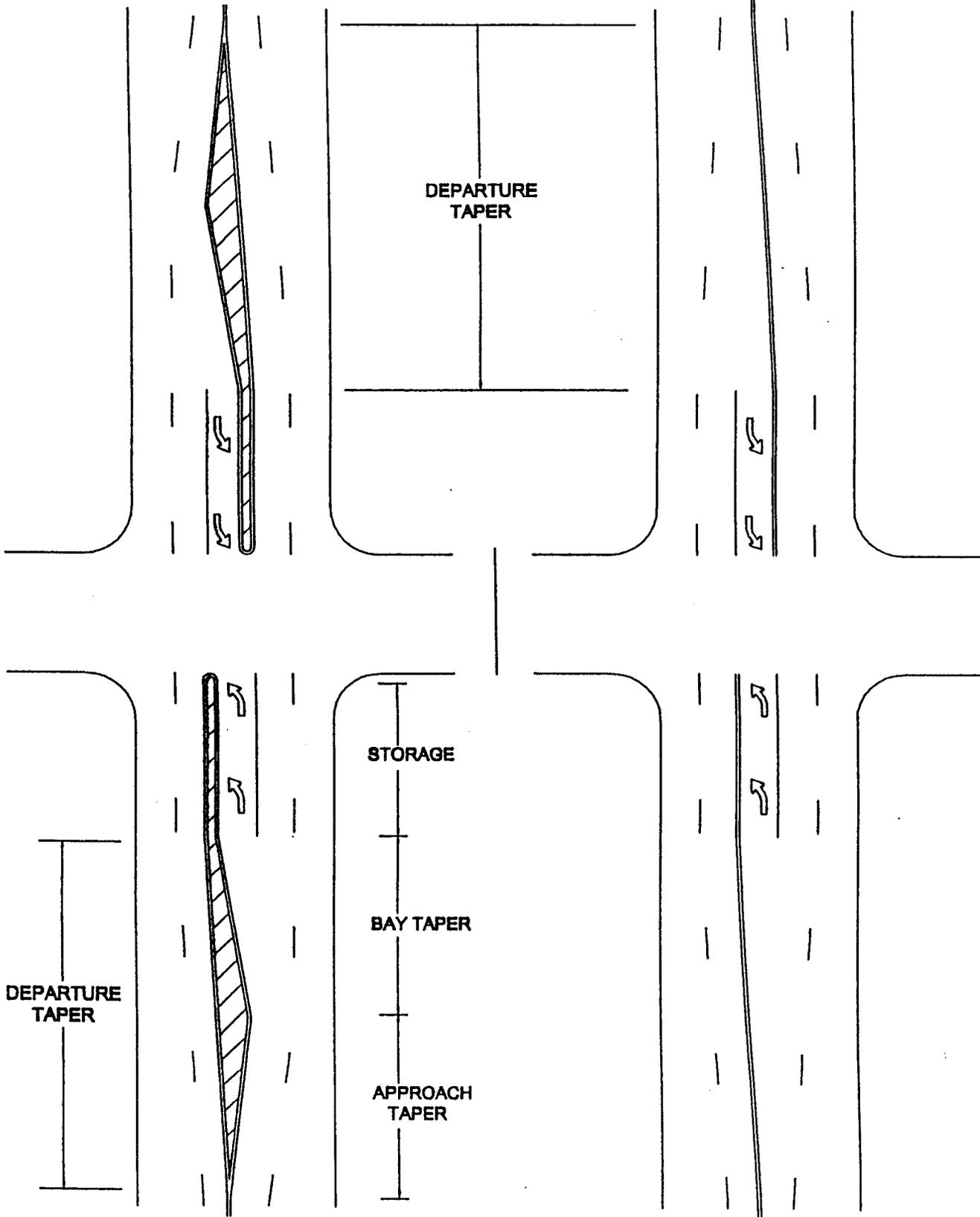


**TRAPPED TURNS**

**FIGURE 4**

STANDARD

ALTERNATE



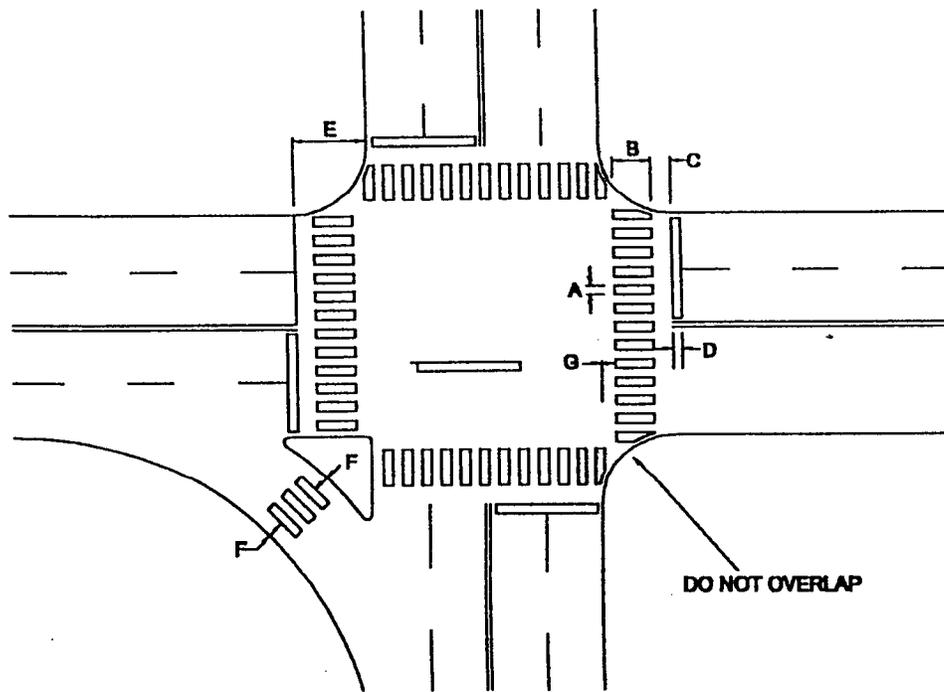
**LEFT TURN CHANNELIZATION**

FIGURE 7

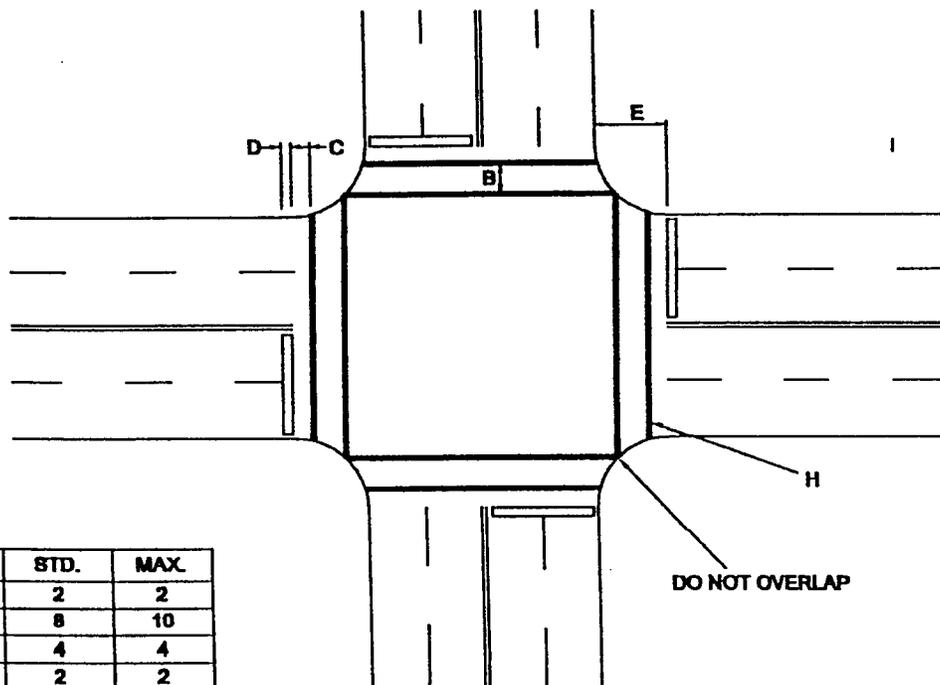
## APPENDIX T

### Non-Longitudinal Markings

## STANDARD CROSSWALK AND STOP BAR MARKINGS AT INTERSECTIONS WITH SCHOOL CROSSINGS



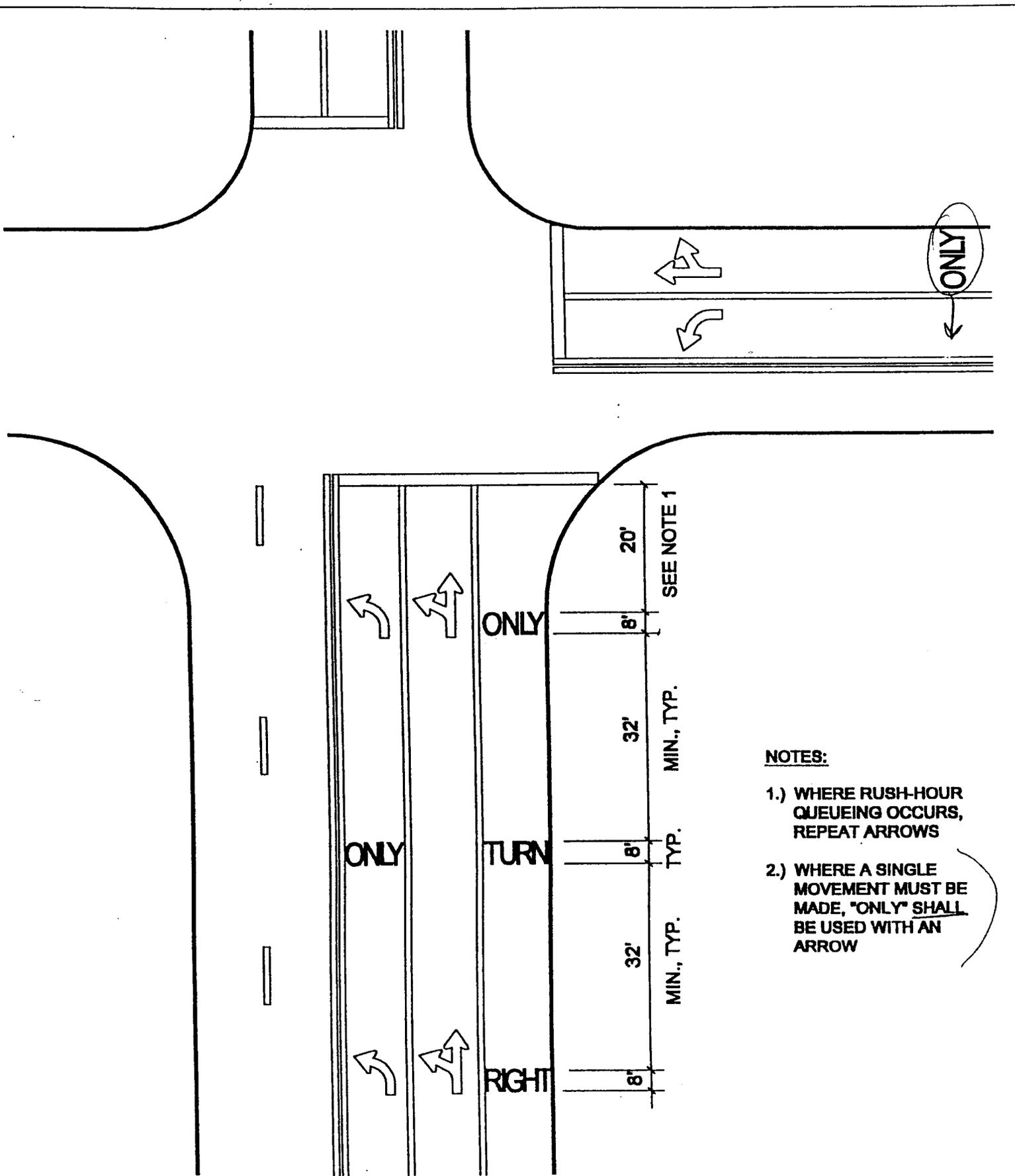
## STANDARD CROSSWALK AND STOP BAR MARKINGS AT INTERSECTIONS



DIMENSIONS	MIN.	STD.	MAX.
A	1	2	2
B	6	8	10
C	4	4	4
D	1	2	2
E	4	16	30
F		3.5	
G	3		
H		1	

ALL NUMBERS SHOWN ARE IN FEET

FIGURE 4-6

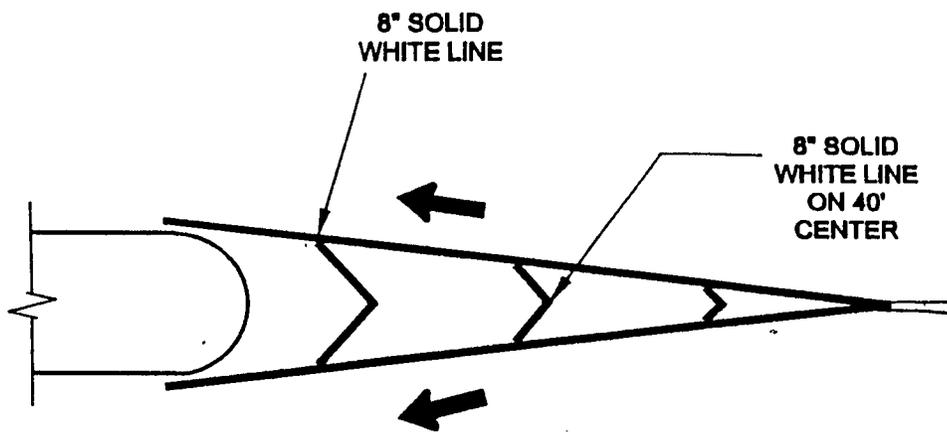


**NOTES:**

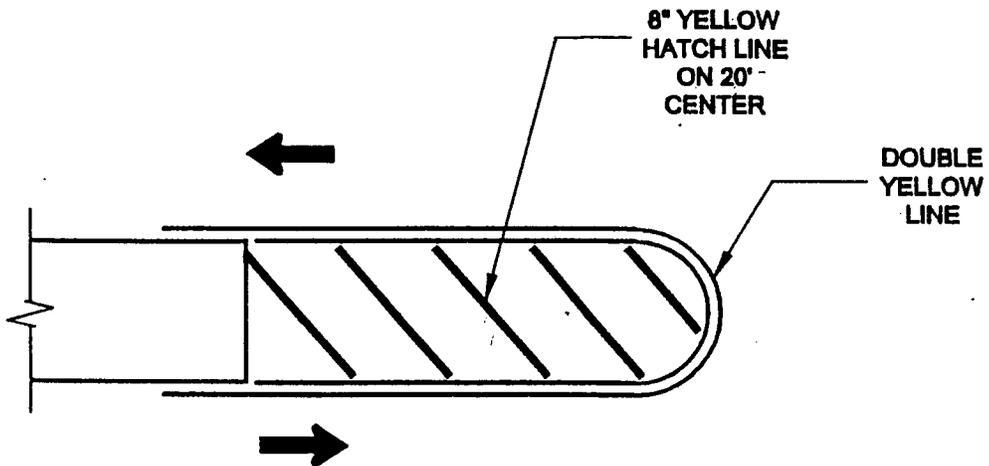
- 1.) WHERE RUSH-HOUR QUEUEING OCCURS, REPEAT ARROWS
- 2.) WHERE A SINGLE MOVEMENT MUST BE MADE, "ONLY" SHALL BE USED WITH AN ARROW

**PAVEMENT WORDS AND SYMBOLS**

FIGURE 4-8



SEPARATION OF LANES



MEDIAN EXTENSION

GORE MARKINGS

FIGURE 5

APPENDIX U

Capital Street Project Checklists

# CONCEPTUAL PLANS REVIEW CHECKLIST

Date: \_\_\_\_\_

Project Number: \_\_\_\_\_

Project Name: \_\_\_\_\_

Consultant: \_\_\_\_\_

Item	Check If Included	Comments
1. Scale: 1" = 200' (min.)		
2. Alignment of Existing Roadway		
3. Alignment of Proposed Roadway		
• include lane layout for Transportation		
4. Preliminary Curve Data		
5. Location of Existing/Proposed D/W		
6. Location of Trees (> 6")		
7. Preliminary Drainage Information:		
• drainage areas		
• existing storm sewer (location/size)		
• proposed storm sewer (location/size)		
• approximate discharges		
8. Existing ROW Line		
9. Proposed ROW Line		
10. Pavement Section		
11. Show Major Utility Conflicts (i.e., Transmission Gas Lines and TU Towers)		
• transition length		

• dual left = (dictated by

Item	Check If Included	Comments
Transportation)		
<ul style="list-style-type: none"> <li>• storage length</li> </ul>		
12. Median/Median Openings		
13. Auxilliary Lanes (dictated by		
Transportation)		

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10/03/02

# CONSTRUCTION PLAN REVIEW CHECKLIST

(This checklist shall be used in conjunction with the Design Criteria Manual)

ITEM	CHECK IF INCLUDED	COMMENTS
<b>A. MISCELLANEOUS</b>		
<ul style="list-style-type: none"> <li>• If Preliminary, stamp review, sign and date with registration number of engineer. If Final, stamp final with seal, date and signature of design engineer (all sheets)</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Title block</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Scale</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• North arrows</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Legend</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Plan size: 22" x 34"</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Required Scale: 1" = 5' vertical 1" = 20' horizontal</li> </ul>	<input type="checkbox"/>	
<b>B. TITLE SHEET (Use COA Standard)</b>		
<b>C. TYPICAL PAVING SECTIONS</b> (use COA Standard where applicable)		
1. Typical Section for each road	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Lt. R.O.W. line/Rt. R.O.W. line and dimension</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Lt. B/C-Rt. B/C and dimension</li> </ul>		
<ul style="list-style-type: none"> <li>• Pavement width</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Lane width (11' or 12')</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• Median width</li> </ul>	<input type="checkbox"/>	
<ul style="list-style-type: none"> <li>• B/C to R.O.W. dimension</li> </ul>	<input type="checkbox"/>	

ITEM	CHECK IF INCLUDED	COMMENTS
<ul style="list-style-type: none"> <li>• R.O.W. to S/W dimension</li> </ul>		
<ul style="list-style-type: none"> <li>• S/W</li> </ul>		
<ul style="list-style-type: none"> <li>• Slopes (Provide cross sections where slopes deviate from the following criteria)</li> </ul>		
<ul style="list-style-type: none"> <li>a. roadway cross slope</li> </ul>		
<ul style="list-style-type: none"> <li>b. R.O.W. to sidewalk</li> </ul>		
<ul style="list-style-type: none"> <li>- 4:1 (preferable)</li> </ul>		
<ul style="list-style-type: none"> <li>- 3:1 (w/engineer approval)</li> </ul>		
<ul style="list-style-type: none"> <li>c. 1/4"/ft. across S/W = (0.0208 ft/ft)</li> </ul>		
<ul style="list-style-type: none"> <li>d. S/W to B/C 6:1 (preferred); 4:1 (max)</li> </ul>		
<ul style="list-style-type: none"> <li>• Pavement type/thickness</li> </ul>		
<ul style="list-style-type: none"> <li>• Subgrade type/thickness (based on Geotech report)</li> </ul>		
2. HMAC Transitions-thickness		
<b>D. PAVING PLANS SHEETS</b>		
1. Plan View (Scale: 1" = 20')		
<ul style="list-style-type: none"> <li>• Property lines, block number/tract, lot number, survey name</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing easements w/type and size (drainage, slope, construction)</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing R.O.W. lines and dimension</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing edge of pavement</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing trees/shrubs (≥6") within R.O.W., or drainage, slope or temp. constr. easement</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing structures w/in 20' of existing/proposed R.O.W.</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing inlets and size</li> </ul>		

ITEM	CHECK IF INCLUDED	COMMENTS
<ul style="list-style-type: none"> <li>• Existing manholes, vaults</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing culverts and size</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing utilities (gas, cable, phone, electric, traffic, water/sewer, streetlight transmission lines) poles, fire hydrants, driveways, mailboxes, fences</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing street names</li> </ul>		
<ul style="list-style-type: none"> <li>• Stationing along centerline</li> </ul>		
<ul style="list-style-type: none"> <li>• Matchline stations</li> </ul>		
<ul style="list-style-type: none"> <li>• Control monumentation (coordinates, CL ties, offset, elev.)/benchmarks</li> </ul>		
<ul style="list-style-type: none"> <li>• Intersecting street station and bearing</li> </ul>		
<ul style="list-style-type: none"> <li>• Curve information:</li> </ul>		
<ul style="list-style-type: none"> <li>a. centerline and/or curbline curve data (ID number, radius, tangent, central angle, curve length, bearing)</li> </ul>		
<ul style="list-style-type: none"> <li>b. PC, PT, PI, PRC, PCC ties to CL</li> </ul>		
<ul style="list-style-type: none"> <li>• Minimum CL radii</li> </ul>		
<ul style="list-style-type: none"> <li>• Minimum tangent between curves</li> </ul>		
<ul style="list-style-type: none"> <li>• Minimum approach tangent</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed curb line and type of pavement and pavement dimension B/C to B/C</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed curb return tied to CL with elev. for:</li> </ul>		
<ul style="list-style-type: none"> <li>a. streets</li> </ul>		
<ul style="list-style-type: none"> <li>b. driveways</li> </ul>		
<ul style="list-style-type: none"> <li>c. median noses</li> </ul>		
<ul style="list-style-type: none"> <li>d. turn lanes</li> </ul>		
<ul style="list-style-type: none"> <li>• Minimum radius for curb returns at intersections</li> </ul>		

ITEM	CHECK IF INCLUDED	COMMENTS
<ul style="list-style-type: none"> <li>• Median Openings               <ul style="list-style-type: none"> <li>- required storage/transition lengths – coordinate with Transportation</li> </ul> </li> </ul>		
<ul style="list-style-type: none"> <li>• Median noses (Use Standard detail - includes pavers)</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed sidewalk location and width</li> </ul>		
<ul style="list-style-type: none"> <li>• Curb ramp locations and types (See COA Standard Detail Sheet)</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed inlets (CL station, size, type, number)</li> </ul>		
<ul style="list-style-type: none"> <li>a. recessed inlets - concrete roadway <math>\geq 38'</math></li> </ul>		
<ul style="list-style-type: none"> <li>b. curb inlet - asphalt roadway</li> </ul>		
<ul style="list-style-type: none"> <li>• Show proposed centerline of storm drain system (ghosted)</li> </ul>		
<ul style="list-style-type: none"> <li>• Show flow arrows when needed to clarify drainage</li> </ul>		
<ul style="list-style-type: none"> <li>• Include fiber optic conduit</li> </ul>		
<ul style="list-style-type: none"> <li>• Driveways</li> </ul>		
<ul style="list-style-type: none"> <li>a. CL station</li> </ul>		
<ul style="list-style-type: none"> <li>b. min. width (commercial/ residential)</li> </ul>		
<ul style="list-style-type: none"> <li>c. curb radius (commercial/residential)</li> </ul>		
<ul style="list-style-type: none"> <li>d. min. spacing between driveways (commercial/residential)</li> </ul>		
<ul style="list-style-type: none"> <li>e. min. distance from intersection (commercial/residential)</li> </ul>		
<ul style="list-style-type: none"> <li>f. min. approach grade</li> </ul>		
<ul style="list-style-type: none"> <li>• Street cut repair in accordance w/policy</li> </ul>		
<ul style="list-style-type: none"> <li>• Right-of-way requirements</li> </ul>		

ITEM	CHECK IF INCLUDED	COMMENTS
<ul style="list-style-type: none"> <li>• Visibility triangles               <ul style="list-style-type: none"> <li>- show existing from adjacent plats</li> <li>- show required visibility triangles based on design speed</li> </ul> </li> </ul>		
2. Profile View (Scale: 1" = 20" horizontal 1" = 5' vertical)		
<ul style="list-style-type: none"> <li>• Existing ground at centerline, and left and right proposed R.O.W. line</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed curb line and grade</li> </ul>		
a. min. grade = 0.5% (1% for PI ≥40)		
b. max. grade		
c. can use a P.I., if change in grade is less than 1%		
d. project start and project end elevation (tie into existing pavement)		
e. PVI station and elevation with intersecting streets		
f. elevation every 50 feet		
g. high and low point elev. and stations		
<ul style="list-style-type: none"> <li>• Vertical curves</li> </ul>		
a. Minimum K values		
b. elevation, PVC, PVI, PVT, and stations		
<ul style="list-style-type: none"> <li>• Maximum grades at intersections</li> </ul>		
<b>E. DRAINAGE MAP AND CALCULATION SHEETS</b>		
<ul style="list-style-type: none"> <li>• Drainage map (Min. Scale: 1" = 200')</li> </ul>		
a. contours every 5', existing and proposed roads, storm drains, inlets and culverts		
b. drainage areas		

ITEM	CHECK IF INCLUDED	COMMENTS
c. flow arrows		
<ul style="list-style-type: none"> <li>• Calculation sheets (calculations provided for each drainage area)</li> </ul>		
1. Design Discharge		
a. method of analysis		
b. drainage area acreage		
c. soil type		
d. runoff coefficient (C)		
e. time of concentration		
f. intensity		
g. antecedent precipitation factor (Ca)		
h. flows (Q <sub>5</sub> , Q <sub>25</sub> , Q <sub>100</sub> )		
2. Inlet calculations		
3. HECII or HEC-RAS analysis for open channels and creeks		
<b>F. DRAINAGE PLANS (Scale: 1" = 20')</b>		
1. Plan view (Existing features from paving plan sheets should be shown)		
<ul style="list-style-type: none"> <li>• Proposed Easement Width (15' min)</li> </ul>		
<ul style="list-style-type: none"> <li>• Centerline Data of Storm Drain</li> </ul>		
a. stationing along centerline		
b. beginning/ending station		
<ul style="list-style-type: none"> <li>• Stations, offsets, FL elev., number at</li> </ul>		
a. manholes, inlets, bends, wyes, special structures		
<ul style="list-style-type: none"> <li>• Provide access to pipe every 500' (MH or 36" laterals)</li> </ul>		
<ul style="list-style-type: none"> <li>• Drainage flow arrows</li> </ul>		
2. Profile View (Scale: 1" = 20' horizontal 1" = 5' vertical)		

ITEM	CHECK IF INCLUDED	COMMENTS
<ul style="list-style-type: none"> <li>• Existing/proposed surface over CL of proposed storm drain</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed storm drains</li> </ul>		
<ul style="list-style-type: none"> <li>a. size, length, grade, class, outfall headwall (min 18" RCP)</li> </ul>		
<ul style="list-style-type: none"> <li>b. check hydraulic grade line (HGL) calculations:</li> </ul>		
<ul style="list-style-type: none"> <li>1) friction slope</li> </ul>		
<ul style="list-style-type: none"> <li>2) headlosses</li> </ul>		
<ul style="list-style-type: none"> <li>3) verify starting point of HGL</li> </ul>		
<ul style="list-style-type: none"> <li>4) elevation of HGL at inlets (do not allow HGL higher than gutter at inlet)</li> </ul>		
<ul style="list-style-type: none"> <li>c. Prefab 'Y' and bends required</li> </ul>		
<ul style="list-style-type: none"> <li>d. preferred pipe min. grade is 0.5%</li> </ul>		
<ul style="list-style-type: none"> <li>e. capacity, velocity, friction slope [Q<sub>5</sub> on grade; Q<sub>25</sub> low point]</li> </ul>		
<ul style="list-style-type: none"> <li>• Proposed storm drain manhole location with FL elev. and station (use Type I, II, III or IV unless special situation)</li> </ul>		
<ul style="list-style-type: none"> <li>• Utilities that parallel or cross storm drain facilities</li> </ul>		
<ul style="list-style-type: none"> <li>• Culverts</li> </ul>		
<ul style="list-style-type: none"> <li>a. size of openings, length</li> </ul>		
<ul style="list-style-type: none"> <li>b. type of operation under design conditions</li> </ul>		
<ul style="list-style-type: none"> <li>c. F.L. elevations - both ends</li> </ul>		
<ul style="list-style-type: none"> <li>d. headwater and tailwater elevations</li> </ul>		
<ul style="list-style-type: none"> <li>e. design frequency</li> </ul>		
<ul style="list-style-type: none"> <li>f. type of headwalls, top elev. of headwall</li> </ul>		

ITEM	CHECK IF INCLUDED	COMMENTS
- make sure parapet wall is 1' above T/C, adjust headwall quantity/ include 2-rail handrail detail		
- handrail requires 12" thick headwall		
g. inlet, outlet velocity		
h. standard and non-standard detail sheets		
• Bridge details		
a. make sure entire cross-section for bent detail is shown		
b. make sure details are provided on riprap (i.e., top, toe of slope, etc.)		
c. wider widths required for linear parkway, pedestrian facility		
• Open channels		
a. typical channel x-section		
b. type and thickness of lining (min. 5")		
c. 1' freeboard		
d. N.G. elevation at C.L. and easement line		
e. channel bottom slope (F.L. every 50 feet)		
f. top of proposed channel		
g. water surface profile for design frequency storms		
h. design flow, velocity		
i. depth of flow at design discharge		
j. actual capacity of lined channel		
k. method of determining design discharge		

ITEM	CHECK IF INCLUDED	COMMENTS
l. roughness coefficient of lining		
m. permissible construction, expansion joints		
n. upstream, downstream toewalls		
o. provide access ramp to concrete channels		
<ul style="list-style-type: none"> <li>• Permanent erosion control at outfalls</li> </ul>		
<b>G. DETAIL SHEETS</b>		
<b>H. ROADWAY CROSS SECTIONS</b>		
<ul style="list-style-type: none"> <li>• Scale: 1" = 5' vertical</li> </ul>		
<ul style="list-style-type: none"> <li>• 1" = 20' horizontal</li> </ul>		
<ul style="list-style-type: none"> <li>• Cross section every 50'</li> </ul>		
<ul style="list-style-type: none"> <li>• Existing and proposed ground surface</li> </ul>		
<ul style="list-style-type: none"> <li>• Extend cross section 10' beyond right-of-way line</li> </ul>		
<ul style="list-style-type: none"> <li>• Show proposed meeting existing ground</li> </ul>		
<ul style="list-style-type: none"> <li>• Show R.O.W. and easement limits</li> </ul>		
<ul style="list-style-type: none"> <li>• Provide earthwork calculation table</li> </ul>		
<b>I. STREET LIGHT DESIGN</b>		
<b>J. PAVEMENT MARKINGS</b>		
<b>K. LANDSCAPING</b>		
<b>L. IRRIGATION PLANS</b>		
<b>M. BID PROPOSAL/ENGINEER'S ESTIMATE</b>		

ITEM	CHECK IF INCLUDED	COMMENTS
<ul style="list-style-type: none"> <li>• Estimate for preliminary plans</li> </ul>		
<ul style="list-style-type: none"> <li>- Use S.Y. for sidewalks</li> </ul>		
<ul style="list-style-type: none"> <li>- See AS coding list for others</li> </ul>		
<ul style="list-style-type: none"> <li>- Use current unit prices from similar projects</li> </ul>		
<ul style="list-style-type: none"> <li>• Estimate and proposal for final plans</li> </ul>		
<b>N. SPECIAL SPECIFICATIONS</b>		

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Revised 9/26/02