

# **CITY OF JOSHUA ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS**



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# ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS

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## **PART 1. GENERAL**

### **1.1 PURPOSE**

The purpose of the Engineering Design Standards and Specifications (EDSS) manual is to provide a set of guidelines for designing water, sewer, streets, drainage facilities, and other public improvements, and for preparing construction plans and specifications for such facilities which are to be owned, operated, and/or maintained by the City of Joshua, Texas.

### **1.2 APPLICABILITY**

The scope of the Engineering Design Standards and Specifications manual includes the various design elements, standards, and instructions required for the design of water lines, wastewater lines, streets and arterials, drainage facilities, and other public improvements. These guidelines shall be used by the City and consulting engineers for both public and private developments in the City of Joshua and its extra-territorial jurisdiction (ETJ). This manual also applies to redevelopment and additions to previously developed and subdivided areas. These guidelines shall also be used for plat approval, the issuance of building and earthwork/grading permits, construction plan approval by the City, site plan approval, and for other construction within public right-of-way and easements.

### **1.3 AUTHORIZATION**

The guidelines provided in the manual shall be effective immediately upon adoption by the City of Joshua. The engineer of record shall bear sole responsibility for meeting the engineering standard of care for all aspects of the design, meeting the City's design and construction requirements, and providing a design that is suitable to the site-specific conditions and intended use of the facilities. The design criteria may be modified by administrative action and subsequent City ordinance at such times as may be appropriate.

### **1.4 CORRELATION TO SUBDIVISION ORDINANCE**

The Engineering Design Standards and Specifications manual and City of Joshua Subdivision Ordinance are complementary, and what is required by one document shall be binding as if required by both. In case of conflict between the EDSS manual and the Subdivision Ordinance, the more stringent criteria shall apply.

### **1.5 ADOPTION OF NCTCOG SPECIFICATIONS AND STANDARDS**

The specifications and standards set forth by the latest edition of the North Central Texas Council of Governments (NCTCOG) *Public Works Construction Standards* shall be used for all projects within the City except as modified by this manual. In case of conflict between the NCTCOG standards and the criteria described in this manual, the criteria described in this manual shall take precedence.

## 1.6 WORK IN CITY RIGHTS-OF-WAY AND EASEMENTS

### 1.6.1 Definition

The term "streets", as used in this article shall include but not be restricted to new streets, reworked streets, or street repair. These specifications shall apply to any street construction of any nature installed in or on any public property or easements within the City.

### 1.6.2 Plans

All plans and profiles for the construction of streets shall be reviewed and approved by the City Engineer. After the approval of the City Engineer has been obtained, and so noted on the original plans and profile sheets, five copies of the approved drawings, one of which shall be a reproducible on an approved material, must be furnished to the Public Works Director prior to the commencement of any work.

Plans and profile sheets for new streets and storm sewer construction shall be 11 inches by 17 inches, drawn by and bearing the seal of a Professional Engineer licensed to practice in Texas.

### 1.6.3 Water for Construction

The utility provider will furnish the Contractor water for construction, at the published charges, at a fire hydrant designated by the utility provider. The Contractor, however, will have to furnish whatever hose, tank trucks, valves, wrenches, and whatever else is required for use of this water. The Contractor shall obtain a meter from the utility provider for metering the water used.

### 1.6.4 Signs

The removal and replacement of city street sign posts and signs is the responsibility of the Contractor. The Contractor shall be responsible for all damage to street sign posts and signs within the limits of his operations that remain in place or are removed and replaced. In event street sign posts and signs are damaged or destroyed by the Contractor's operations, they shall be replaced by the Contractor.

### 1.6.5 Existing Utilities and Service Lines

The Contractor shall be responsible for the protection of all existing utilities or service lines crossed or exposed by his construction operations. Where existing utilities or service lines are cut, broken or damaged, the Contractor shall replace or repair the utilities or service lines with the same type of original material and construction, or better, as required by the utility provider.

### 1.6.6 Barricades and Lights

Where the work is carried on in or adjacent to any street, alley or public place, the Contractor shall furnish and erect such, barricades, fences, battery type flasher-markers and danger signals; shall provide such watchmen, and other precautionary measures for the protection of persons or property and of the work as necessary and required by the City's Street Closures, Detours, and Barricades ordinance. From sunset to sunrise the Contractor shall furnish and maintain at least one battery type flasher-marker at each barricade and sufficient number of barricades shall be erected to keep vehicles from being driven on or into any work under construction.

The Contractor will be held responsible for all damage to the work and the public due to failure of barricades, signs, lights, and watchmen to protect it, and whenever evidence is found, of such damage the Engineer may order the damaged portion immediately removed and replaced by the Contractor. The Contractor's responsibility for the maintenance of barricades, signs, and lights and for providing watchmen shall not cease until the project shall have been accepted by the Owner.

#### 1.6.7 Engineer's Authority and Duty

Unless otherwise specified, the Engineer or his representative shall inspect all work specified herein. The Engineer shall have the authority to stop the work whenever such stoppage may be necessary in his opinion for the protection of the public.

#### 1.6.8 Final Cleanup

Upon completion of the work, the Contractor shall clean, remove rubbish, and restore in an acceptable manner all public or private property which has been damaged in any way, and leave the site of work in a neat and presentable condition throughout. Upon completion of any structures, all excess material, cofferdams, temporary structures, and debris resulting from construction shall be removed. Where work is in a stream, all debris shall be removed to the ground line of the stream bed, and channels shall be left unobstructed and in a neat and presentable condition and as directed by the Engineer.

#### 1.6.9 Final Inspection

Whenever the work has been satisfactorily completed and the final cleaning up performed, the Contractor or Developer shall notify the City for a final inspection.

Upon final inspection of the construction, the City Engineer will issue a letter of acceptance to the Contractor with a copy to the Developer if the streets have no defects. If not, a letter detailing what steps must be taken to correct the defects will be sent. The Contractor will be allowed

fifteen (15) days to correct any defects from the date of rejection. Should the Contractor performing work under Paragraph 1.6 fail to remedy said defects, there shall be a penalty of \$500.00 per day from the 16th day until the defects are repaired and accepted.

If the streets are not accepted by the City Engineer, no final building inspections shall be made on houses fronting upon such streets nor shall the houses be occupied.

## **1.7 PERMITS AND BONDS**

### **1.7.1 Acceptance of Work**

Building permits and/or certificates of occupancy for development requiring public improvements by the terms of the standards adopted in this section may be withheld pending final acceptance of such required public improvements, or of design thereof, whichever may be appropriate. Final inspection and acceptance of construction shall be in conformance with Section 1.6.9 - Final Inspection.

### **1.7.2 Permits**

No person shall construct, reconstruct, cut, or repair any street, storm sewer, curb and gutter, or sidewalk, within the City limits or the Extra Territorial Jurisdiction of the City of Joshua without first obtaining from the Public Works Department a permit to do so. No such permit shall be granted unless the two (2) year maintenance bond provided for in Section 1.7.4 be in full force and effect at the time of request for such permit and the doing of the work.

### **1.7.3 Permit Fees**

No person shall be granted a permit to construct, reconstruct, alter, cut, repair, remove or replace any street, storm sewer, curb, and gutter or sidewalk unless and until certain fees to the City for inspection of such work are paid. Such fees are established are established in the Joshua Code of Ordinances Article A2.004 – Street Department Fees.

### **1.7.4 Bond Requirement**

No person shall construct, reconstruct, cut, or repair any street, driveway approach, sidewalk, or storm sewer in the City without executing and delivering to the City a bond payable to the City of Joshua, Johnson County, Texas, from an approved surety company, and in certain sums as follows:

(a) Street construction - \$5,000



(b) 1 Street cut - \$2,500

(c) Driveway approaches - \$2,500

(d) Sidewalks - \$2,500

(e) Storm sewer - \$5,000

Such bond shall be conditioned that all work done in the construction, reconstruction, cut, or repair of any street or storm sewer shall be done in a good and workmanlike manner, and that such person shall faithfully and strictly comply with the specifications and with the terms of the City Code and such ordinances, resolutions or regulations that may be passed by the City Council governing and relating to the construction, reconstruction, cut, or repair of any street or storm sewers, and that the City shall be fully indemnified and be held whole and harmless from any and all costs, expense or damage, whether real or asserted, on account of any injury done to any person or property in the prosecution of such work, or that may arise out of or be occasioned by the performance of such work. Such bond shall be conditioned further that the principal shall, without additional cost to the person for whom the work was done, maintain all streets or storm sewers so constructed, reconstructed, cut or repaired by the principal for a period of two (2) years from the date of final acceptance of such construction, reconstruction cut, or repair to the satisfaction of the engineering department of the City, and shall reconstruct or repair any street or storm sewer to the satisfaction of the engineering department of the City at any time within two (2) years after the final acceptance of the construction, reconstruction, cut, or repair of any street or storm sewer and after ten (10) days notice from the engineering department to reconstruct or repair the same, and that the opinion of the engineering department as to the necessity of such reconstruction or repair shall be binding on the parties thereto.

Such bond shall, for the purposes mentioned above, be in force for two (2) years after the final acceptance of any street or storm sewer which is constructed, reconstructed, cut, or repaired and one recovery shall not exhaust the bond, but such bond shall be a continuing obligation against the sureties thereon until the entire amount therein provided for shall have been exhausted. In case the bond shall be decreased on account of any recovery which may be obtained, arising out of the violation of any condition of the same, the City Council shall require, upon notice to it of such fact, an additional bond to be given in accordance with this section in an amount sufficient, when added to the non-exhausted amount of the original bond, to be at all times equal to the sum of the original bond required.

The City may, for itself or for the use and benefit of any person injured or damaged by reason of any defective construction, reconstruction, cut, or repair of any street or storm sewer by any person, maintain suit on such bond in any court having jurisdiction thereof, or suit may be maintained thereon by any person injured or damaged by reason of the failure of any person who shall construct, reconstruct, cut, or repair any street or storm sewer in the City to observe the conditions of such bond.

## **1.8 STREET CUTS**

### **1.8.1 Cut of Improved Streets Prohibited**

No underground utility installation shall be placed under a permanently improved street (concrete with curb and gutter), except by boring or jacking such crossing from curb line to curb line.

### **1.8.2 Exception**

An open cut shall be permitted only with the approval of the Director of Public Works or designated representative in such case as it is impractical to bore or jack under a permanently improved street due to the presence of rock or other obstruction, and the repair of such cut shall be in accordance with these specifications. An open cut shall be permitted only with the approval of the Director of Public Works or designated representative in such case as it is impractical to bore or jack under a permanently improved street due to the presence of rock or other obstruction, and the repair of such cut shall be in accordance with requirements of Section 1.8.4.

### **1.8.3 Cut of Unimproved Streets**

An open cut of an unimproved street (a street that is not concrete with curb and gutter per Article 12.03.002) shall be permitted only with the approval of the Director of Public Works or designated representative. Each unimproved street shall be considered individually on its own merits and shall only be approved if in the best judgement of the Director of Public Works there will be no undesirable consequences or cost to the City.

### **1.8.4 Construction Standards for Street Cuts**

Street Cuts shall be in accordance with NCTCOG Spec. Item 402 - Pavement Cut, Excavation, and Repair and Item 505 – Open Cut-General Conduit Installation. Pavement repair for concrete and asphalt streets shall be in accordance with NCTCOG Standard Details 3070A, 3070B, 3070C, and 3070D or as directed by the Director of Public Works.

Embedment and backfill for utilities shall be in accordance with NCTCOG Spec. Item 504 – Open Cut – Backfill and Item 508 Open Cut-Stormwater Conduit Installation. Installation of water and sanitary sewer lines shall be in accordance with the requirements of the utility provider, however, all utility trenches under street pavement shall be backfilled with flowable fill per NCTCOG Item 504.2.3.4

1.8.5 Supervision and Approval of Work

All work done in construction, reconstruction, cutting, and repairing of streets, driveway approaches, sidewalks, and storm sewer shall be done under the supervision and subject to the direction and approval of the Public Works Department, whose decision shall be final.

1.9 **WORKING HOURS**

No person or construction company shall work on Saturdays, Sundays, or any official holiday observed by the City of Joshua without the expressed written permission of the Director of Public Works or designated representative. No person or construction company shall begin work before 7:00 A.M. or work after 7:00 P.M. on any workday without the expressed written permission of the Director of Public Works or designated representative.

## **PART 2. WATER AND SEWER**

The City of Joshua does not own or operate any water distribution or wastewater collection systems. The City is served by the Johnson County Special Utility District (JCSUD) and the Bethesda Water Supply Corporation for these utilities. The area served by each provider can be determined by contacting the Texas Commission on Environmental Quality (TCEQ). The design of these systems should be coordinated with the facility owner. The requirements of the facility owner are in addition to the requirements below.

### **2.1 WATER**

#### **2.1.1 Capacity Standards**

Water distribution systems should be designed for domestic flow demands in addition to fire flow demands in accordance with PUC/TCEQ regulations. A minimum available fire flow of 1000 gpm shall be provided in all single family areas. A minimum available fire flow of 1500 gpm shall be provided in other areas or where future extensions are expected to serve non-single family properties. The fire chief is authorized to increase or decrease the required available fire flows as authorized by and pursuant to the International Fire Code as adopted at the time of Plat approval. Evidence that the required fire flow will be available shall be presented to the City Engineer before approval of the Preliminary Plat. Where development is proposed in areas of existing service, the available fire flow capacity shall be determined by the provider and provided to the City Engineer and Fire Marshal.

#### **2.1.2 Fire Hydrants**

Fire hydrants shall be installed at each street intersection and at a minimum of five hundred foot spacing along the street in single family areas and three hundred foot spacing in other areas. This requirement applies to extensions of water lines that are 6 inches and larger along existing roads without hydrants.

For single family occupancy, no buildable portion of the lot shall be more than 600 foot hose lay from a hydrant. In other areas, no point of the perimeter of any structure shall be more than 400 foot hose lay from a hydrant. This distance is measured along a fire lane or public roadway if the distance is more than 150 feet. The Fire Marshal may waive or modify these requirements.

Fire hydrants shall be installed no more than 9 feet and no less than 2 feet from the edge of pavement. Hydrants should not be located in sidewalks or within ditches and shall have 3 feet clear on all sides.

#### **2.1.3 Backflow Prevention**

All fire lines are required to have a double gate detector check valve backflow preventer assembly. The maximum length of line from the main to the backflow preventer is 100 feet.

Irrigation systems are required to have a double check valve backflow preventer assembly installed at the meter or tap location.

Backflow prevention assemblies may be required for other installations based on occupancy of the affected facility or as required by code.

## **2.2 SEWER**

### **2.2.1 Capacity Standards**

The sewer service provider is solely responsible to verify adequate capacity is available in their system for any proposed flows. The provider's acceptance of the plans is required to indicate capacity is available.

## **2.3 POLICY ON WELL AND SEPTIC**

In all cases, connection to a public water distribution system is required to provide adequate water service to a property. The property owner and/or service provider are responsible for the extension of service to any location to be considered for development.

Connection must be made to a public wastewater collection system except where proposed lots are a half acre or more in area and approved by the City Engineer. If, under unusual circumstances, a lot is not served by a public water supply then it must be an acre or more in area. On-site sewage facilities must be permitted by the City of Joshua. A plan showing the type of facility and location within the lots must be submitted to the City for review. Rules for permitting, design, and construction of OSSF shall be in accordance with Title 30 TAC, Chapter 285, Subchapters A& D.

## **PART 3. STREETS**

### **3.1 TRAFFIC IMPACT ANALYSIS (TIA) STANDARDS**

The Traffic Impact Analysis Standards supplement the requirements established in the City of Joshua Subdivision Ordinance. These standards outline staff's expectations and facilitate a coordination of the scope, analysis contents, parameters and assumptions of a TIA.

#### **3.1.1 Purpose**

The purpose of a TIA is to assess the effects of specific development activity on the existing and planned roadway system.

#### **3.1.2 When a TIA is Required**

- A. A TIA is required with every application for a proposed development that generates traffic in excess of one thousand (1,000) average daily trips based on data published in the latest edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*; or,
- B. When the City Engineer determines that the characteristics of the proposed subdivision necessitate analysis.
- C. An updated TIA is required with submittal of a final plat if, in the opinion of the City Engineer, the final plat changes significantly (i.e., adds lots, modifies or adds street connections, etc.) from an approved Preliminary Plat.
- D. All or a portion of the requirement for the TIA may be waived by the City Engineer depending upon the size and potential impact of the proposed subdivision and the traffic to be generated. Waivers will be considered on a case-by-case basis upon submittal of a waiver request and corresponding City Engineer review. Technical justification must be provided by the applicant when requesting the waiver.

#### **3.1.3 TIA Requirements**

- A. All elements of the TIA must be prepared under direct supervision of and signed, stamped and dated by a Professional Engineer licensed to practice in the State of Texas with specific expertise in transportation and traffic engineering, preferably certified as a Professional Traffic Operations Engineer.
- B. The analysis is required to contain at a minimum, the following:
  - 1. Traffic Analysis Map
    - a. Land Use, Site and Study Area Boundaries, as defined

- b. Existing and Proposed Site Uses
  - c. Proposed Land Uses on both sides of boundary streets for all parcels within the study area for TIAs where land use is the basis for estimating projected and existing traffic volumes
  - d. Existing and Proposed Roadways and Intersections of boundary streets within the study area of the subject property, including geometrics, traffic signal control, and volumes
  - e. All major driveways and intersecting streets adjacent to the property will be illustrated in sufficient detail to serve the purposes of illustrating traffic function. This may include showing lane widths, traffic islands, medians, sidewalks, curbs, traffic control devices (traffic signs, signals, and pavement markings), and a general description of the existing pavement condition.
  - f. Photographs of adjacent streets of the development and an aerial photograph showing the study area
2. Trip Generation and Design Hour Volumes
- a. A trip generation summary table listing each type of land use, the building size assumed, average trip generation rates used (total daily traffic and a.m./p.m. peaks), and total trips generated shall be provided. Trip generation information is to be based on data published in *Trip Generation*, latest edition, by the Institute of Transportation Engineers (ITE).
  - b. Vehicular trip generation may be discounted in recognition of other reasonable and applicable modes, e.g., transit, pedestrian or bicycles. Trip generation estimates may also be discounted through the recognition of pass by trips and internal site trip satisfaction. All such estimates shall be subject to the approval of the City.
- C. Proposed trip generation calculations for single-story commercial properties shall be based on a floor-to-area (building size to parcel size) ratio of 0.25 or more.
- 1. Trip Distribution (provide figure by Site Exit/Entrance). The estimates for percentage distribution of trips by turning movements to/from the proposed development.
  - 2. Trip Assignment (provide figure by site entrance and boundary street). The direction of approach of site-attracted traffic via the area's street system.
  - 3. Existing and Projected Traffic Volumes (provide figure for each item). Existing traffic volumes are the numbers of vehicles on the streets of interest during the time periods listed below, immediately prior to the beginning of construction of the land development project. Projected traffic volumes are the number of vehicles, excluding the site-generated traffic, on the streets of interest during the time periods listed below, in the build-out year.
    - a. A.M. peak hour site traffic (including turning movements) if significant impact
    - b. P.M. peak hour site traffic (including turning movements)
    - c. Weekend peak hour site traffic (including turning movements)

- d. A.M. peak hour total traffic including site-generated traffic and projected traffic (including turning movements)
  - e. P.M. peak hour total traffic including site-generated traffic and projected traffic (including turning movements)
  - f. Weekend peak hour total traffic including site-generated traffic and projected traffic (including turning movements)
  - g. For special situations where peak traffic typically occurs at non- traditional times, e.g., major sporting venues, entertainment venues, large specialty Christmas stores, etc., any other peak hour necessary for complete analysis (including turning movements)
  - h. Total daily existing traffic for street system in study area
  - i. Total daily existing traffic for street system in study area and new site traffic
  - j. Total daily existing traffic for street system in study area plus new site traffic and projected traffic from build-out of study area land uses
4. Capacity Analysis (provide Analysis Sheets in Appendices)
- a. A capacity analysis shall be conducted for all public streets, intersections and junctions of major driveways with public streets, which are significantly impacted (as designated by the City), by the proposed development within the previously defined study boundary.
  - b. Capacity analysis will follow the principles established in the latest edition of the Transportation Research Board's *Highway Capacity Manual (HCM)*, unless otherwise directed by the City. Capacity will be reported in quantitative terms as expressed in the *HCM* and in terms of traffic level of service.
  - c. Capacity analysis will include traffic queuing estimates for all critical applications where the length of queues is a design parameter, e.g., auxiliary turn lanes and at traffic gates.
5. Level of Service Determination
- a. 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.
  - b. 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 by the City Engineer.
6. Conclusions and Recommendations
- a. The TIA must include a summary of the findings regarding impacts of the proposed development on the existing and proposed street system.
  - b. If the analysis indicates unsatisfactory levels of service or safety problems, a detailed description of proposed improvements to remedy deficiencies and a sketch of each



improvement showing pertinent geometric features shall be included. Assumptions regarding future capacity recommendations shall be approved by the City Engineer.

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

## 7. Other Items

- a. The City Engineer may require other items be included in the TIA in addition to those listed above.

## 3.2 FUNCTIONAL CLASSIFICATION AND STREET DIMENSIONS

This section further defines the functional classifications, street types, and design dimensions defined in the City of Joshua Comprehensive Land Use Plan, the Master Thoroughfare Plan and Subdivision Ordinance.

### 3.2.1 Street Classification

Street classifications and standard dimensions for each street section designation are listed in the following table.

Table 3.1 Street Classifications and Standard Dimensions

Functional Classification	Dimensional Classification	Section Designation	Lane Width (ft) <sup>1</sup>	Pavement Width (ft) <sup>2</sup>	Shoulder Width (ft) <sup>3</sup>	Median Width (ft) <sup>1</sup>	Parkway Width (ft) <sup>2</sup>	Normal ROW (ft)
Principal Arterial	7-Lane Undivided	P7U	6-12	87	n/a	14 <sup>4</sup>	16.5	120
	4-Lane Divided	P4D	4-12	50	n/a	15	18	100
	4-Lane Undivided	P4U	4-12	49	n/a	n/a	15.5	80
Minor Arterial	4-Lane Undivided	M4U	4-11	45	n/a	n/a	17.5	80
Collector	4-Lane Undivided	C4U	4-11	45	n/a	n/a	12.5	70
	2- Lane	C2U	2-18	37	n/a	n/a	11.5	60
	Rural	C2U-R	2-11	28	3	n/a	16	60
Local	Urban	L2U	2-15	31	n/a	n/a	9.5	50
	Rural	L2U-R	2-11	28	3	n/a	11	50

<sup>1</sup> Measured from face of curb

<sup>2</sup> Measured from back of curb or edge of shoulder

<sup>3</sup> Measured from edge of pavement

### 3.3 ACCESS CONTROL

The following standards shall be used in the location of street intersections, median openings, and driveway approaches which affect access to streets from adjoining properties. Section 3.4.2 Street Design Elements provides the geometric design requirements for streets, medians, and driveway approaches.

#### 3.3.1 Intersections and Median Openings

##### A. Intersection Requirements

1. All street intersections along one side of an existing cross-street must, wherever practical, align with existing intersections on the opposite side of the cross street.
2. There shall be a minimum of 2,000 feet between intersections of arterial streets and/or collector streets.
3. Block lengths shall be in accordance with the Subdivision Ordinance.

##### B. Median Opening Requirements

1. Spacing is measured between the centerlines of the median openings.
2. Spacing between median openings should be no more than 1,200 feet.
3. Mid-block median openings and median openings serving non-arterial streets and driveway approaches along a divided thoroughfare should occur no closer than 300 feet.
4. Median openings shall not occur in left turn storage lanes or left turn transition curb areas.
5. Median openings shall be located wherever feasible to serve both sides of the street.
6. Median opening noses are typically 12-15 feet beyond the projection of the curb or driveway edge.
7. Median openings may require the construction of left turn lanes. Typical storage length is 150 feet with 150 feet transition. Storage lengths may be altered based on projected traffic volumes.
8. Existing median openings may be relocated if:
  - a. The existing opening does not provide service to a public or private street.
  - b. The proposed median opening meets the spacing requirements stated herein.
  - c. The existing opening is no longer in use and the owners of the properties being served by the existing opening sign a document requesting or approving the change, and the document is approved by the City Engineer.

- d. If approved, all costs associated with the median opening shall be paid by the Owner/ Developer.

### 3.3.2 Drive Approaches

- A. Streets shall be designed to conform to existing or proposed driveway openings.
- B. Where a residential subdivision will abut or contain an existing or proposed arterial street, driveway access to the thoroughfare is prohibited.
- C. To the greatest extent possible, no more than 20 percent of the total centerline length of a residential collector street may have residential lots fronting onto the collector on each side of the street without construction of a wider alternative section.
- D. Driveway approaches including turnout curb transitions shall be located entirely within the frontage of the property served by the approach.

## 3.4 **GEOMETRIC DESIGN**

### 3.4.1 Design Criteria

All engineering designs shall be based on national standards and best practices. The American Association of State Highway and Transportation Officials (AASHTO) published *A Policy on Geometric Design of Highways and Streets*, referred to as the AASHTO Green Book. This manual is updated periodically and contains design considerations and criteria applicable to roadway design. The AASHTO Green Book shall be used for guidance for designing geometrics, including intersection design, and other street features. The National Association of City Transportation Officials (NACTO) *Urban Street Design Guide* shall be considered where AASHTO does not fully address city street issues. Roadway designs should comply with the following standards.

#### A. Intersections Standards

- 1. An intersection shall not have more than four street approaches.
- 2. No offset is permitted at intersections of two thoroughfares.
- 3. When conditions require the centerlines of local streets to be offset, a minimum of 125 feet offset distance is required for local street intersections and 200 feet offset distance for thoroughfare street intersections. Centerline offsets less than the minimum must be approved by the City Engineer. Offsets greater than the minimum may be required by the City Engineer when necessary for traffic safety.
- 4. No street intersecting an arterial street should vary from a 90-degree angle of intersection by more than 5 degrees. Streets intersecting collector streets should not vary from a 90-degree angle of intersection by more than 10 degrees. All other street intersections should not vary from a 90 degree angle of intersection by more than 15 degrees.

## B. Design Speed

1. All streets shall be designed to accommodate the design speeds in the following table.

Table 3.2: Street Type Design Speed

Functional Classification	Section Designation	Design Speed (MPH)
Principal Arterial	P7U	50
	P4D	45
	P4U	45
Minor Arterial	M4U	45
Collector	C4U	40
	C2U	35
	C2U-R	35
Local	L2U	30
	L2U-R	30

## C. Horizontal and Vertical Control

1. Horizontal Control - All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System.
2. Vertical Control - Vertical control shall be tied to NGVD 29.

## D. Minimum Radius

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

<u>Street Types</u>	<u>Min Radius</u>
Arterial / Arterial	30 feet
Arterial / Collector	30 feet
Arterial / Local	30 feet
Collector / Collector	30 feet
Collector / Local	30 feet
Local / Local	20 feet

2. The minimum radius from the face of curb on a cul-de-sac shall be 40 ft.

## E. Sight Distance

At controlled or uncontrolled intersections of any public street, sight triangles (visibility triangles) are required. The sight triangle shall be the triangle made by extending 25 feet along each property line from the property corner at an intersection. Within this triangle there shall be no tree, shrub, plant, sign, soil, fence, retainer wall or other view obstruction having a height greater than 2 feet. This height shall be measured above a line drawn between the top of curb or edge of pavement of both streets at the point where the referenced line intersects the top of curb or edge of pavement.

An intersection sight distance analysis in accordance with the AASHTO Green Book (the chapter titled *Intersections*) should be undertaken to confirm that sufficient stopping distance is available.

Additional sight distance may be required based on topography, roadway curvature, vegetation or other sight hindrance. The AASHTO Green Book describes the process the designer should follow to determine whether a vehicle entering or crossing an intersection from a minor road can see, and be seen by, a vehicle on the major road when there is an obstruction, such as a change in the vertical profile of the road, in time to avoid a collision (section titled *Identification of Sight Obstructions within Sight Triangles*).

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 Engineer.

### 3.4.2 Street Design Elements

#### A. Horizontal Alignment

1. The curvilinear requirements in the Subdivision Ordinance must be accommodated.
2. The following minimum centerline radii shall be used in the design of all street construction.

<u>Street Type</u>	<u>Min Centerline Radius</u>
Arterial	1040 feet
4-lane Collector	765 feet
2-lane Collector	510 feet
Local	335 feet
Cul-de-sacs	50 feet radius to right-of-way line

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

<u>Street Type</u>	<u>Min Tangent Length</u>
Arterial	100 feet
4-lane Collector	100 feet
2-lane Collector	50 feet
Local	As approved by City Engineer

4. Major collector or arterial roadways intersecting other major 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 City Engineer.

<u>Street Type</u>	<u>Intersecting with</u>	<u>Min Approach Tangent</u>
Arterial	Arterial	200 feet
4-lane Collector	Arterial	150 feet
4-lane Collector	4-lane Collector	100 feet

## B. Vertical Alignment

1. All streets shall be designed and constructed to a minimum grade of 0.5%; unless 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%
Collector	8.0%
Local	10.0%

2. 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 K, where  $K = \text{curve length (L)} / \text{algebraic difference in grade (A)}$ . Grade changes where the algebraic percent difference is one percent or less are not required to use vertical curves for design speeds less than or equal to 45 mph.

<u>Street Type</u>	<u>Design Speed</u>	<u>Crest Curves (K)</u>	<u>Sag Curves (K)</u>
Arterial	45	65	80
4-lane Collector	40	45	65
2-lane Collector	35	30	50
Local	30	20	40

3. The following maximum intersection grades involving arterial and 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	4-lane Collector	3%	300 feet
4-lane Collector	Arterial	3%	200 feet
4-lane Collector	4-lane Collector	3%	200 feet
2-lane Collector/Local	Arterial/Collector	4%	150 feet

4. No valleys across arterials or collectors will be allowed. To accomplish a smooth transition, cross-fall toward the median of one lane of each thoroughfare may be required. The use of storm drainage inlets in the median shall be avoided if possible.

## C. Street Cross Section

For curbed streets, the right-of-way shall be graded to drain to the street at a typical slope of 1/4 inch per foot. Street back slopes and embankment slopes shall not be steeper than 3:1. Streets shall typically be rooftop crowned with 2 percent cross slope unless otherwise approved by the City Engineer.

## D. Sidewalks

1. All sidewalks shall conform to state regulations for barrier free construction.
2. Sidewalks shall be at least 4 feet wide in residential subdivisions and at least 5 feet wide in non-residential subdivisions and along arterials and collectors.
3. Sidewalks shall not be located within ditches.
4. One foot of width shall be added to all sidewalks abutting retaining walls.

#### E. Medians

1. The standard median width is 16 feet with a 6-foot-wide median in left turn lanes as measured from face of curb to face of curb.
2. All median areas which are less than 8 feet wide shall be paved with 4-inch-thick non-reinforced concrete median pavement. Alternate paving materials and designs may be used upon approval of the City Engineer.
3. Fall or rise in curb elevations across medians shall not exceed 1/2 inch per foot at any paving station. Differentials in curb elevations on narrow median strips will vary from 0 to 3 inches.

#### F. Driveway and Curb Openings

Design of driveways shall comply with applicable requirements of the City of Joshua Subdivision Ordinance and this manual.

1. Driveways should intersect streets at or near 90 degrees.
2. The driveway edge should be located equal to or greater than 5 feet from each side of the property line.
3. No portion of any driveway should be located within 3 feet of any fire hydrant, electrical pole, or any other surface public utility.
4. Driveways shall be designed with a sidewalk crossing meeting accessibility requirements.
5. The minimum driveway grade within the street right-of-way is set using 1/4 inch per foot (2 percent) rise above the top of curb to the property line. The elevation of a driveway at the right-of-way line shall be no lower than the top of curb to ensure proper street drainage is maintained.
6. The grade break at the gutter line, and at any point within 10 feet of the gutter line, must not exceed 12 percent in order to avoid car bumper drag from occurring. Streets with a 1/4 inch per foot crossfall to the gutter (-2 percent) will limit the maximum approach grade to 10 percent.
7. Driveway connections to rural road sections across bar ditches shall be installed in accordance with the following: The culvert shall be sized by the owner's engineer. The minimum culvert size is 15 inches and shall be reinforced concrete. For thoroughfares, the maximum slope from the edge of driveway to the top of culvert pipe shall be 6:1 and the end of the pipe shall have sloped end treatment. Positive grading shall be provided upstream and downstream so that

drainage can flow through the culvert without ponding. Rural driveways shall have a minimum width along the pavement edge of 18 feet to facilitate turning movements.

8. Throat width at right-of-way shall be as follows:

Residential – 12-25 feet  
 Commercial – 25-35 feet  
 Industrial – 25-35 feet

9. Minimum curb radius shall be as follows:

Residential – 5 feet  
 Commercial – 10 feet  
 Industrial – 15 feet

10. Minimum centerline spacing of driveways shall be as follows:

<u>Type Street</u>	<u>Residential</u>	<u>Commercial</u>	<u>Industrial</u>
Arterial	n/a	100 feet	100 feet
4-lane Collector	100 feet	100 feet	100 feet
2-lane Collector	15 feet	45 feet	55 feet
Local	15 feet	45 feet	55 feet

11. Minimum distance from driveway to intersection shall be as follows (measured from the nearest driveway edge to the projected curb line of the intersecting street):

<u>Type Street</u>	<u>All Driveways</u>
Arterial / Arterial or 4-lane Collector	55 feet
Arterial / 2-lane Collector	40 feet
Collector / Local	40 feet
Local / Local	30 feet

#### 3.4.3 Accessibility Requirements

All plans and specifications for the construction or alteration of public buildings and facilities, privately owned buildings and facilities and pedestrian facilities must be in compliance with the Texas Accessibility Standards (TAS) and must conform to the standards required by regulations issued by the Texas Department of Licensing and Regulation (TDLR), under the Architectural Barriers Act, codified as Article 9102, Texas Civil Statutes.

### 3.5 PAVEMENT STRUCTURE DESIGN

#### 3.5.1 Pavement Design

All new roadways within the City of Joshua shall be constructed of reinforced Portland cement concrete or hot mix asphalt concrete pavements. The use of RAP (Reclaimed Asphalt Pavement) and RAS (Recycled Asphalt Shingles) is not allowed. Work and materials shall be in accordance with the North Central Texas Council of Governments *Public Works Construction Standards*, current edition. The following is minimum required pavement thickness for pavement and subgrade



requirements for certain soil conditions for various street and thoroughfare types. Alternative pavement designs, if used, shall be performed in accordance with the Texas Department of Transportation (TXDOT) *Pavement Manual*, current edition.

### 3.5.2 Temporary Turnaround Pavement

Temporary turnarounds shall be constructed with a minimum section of 2" asphalt on 8" flex base. The subgrade shall be treated with lime or cement, as appropriate, to a minimum depth of 6".

Table 3.3 Minimum Pavement and Subgrade Thickness

Facility Type	Section Designation	Concrete Pavement			Asphalt Pavement			
		Concrete Thickness <sup>1</sup>	Subgrade Thickness		Asphalt Thickness <sup>4</sup>	Subgrade Thickness		
			if P.I. ≤ 15, Cement Treat <sup>2</sup>	if P.I. > 15, Lime Treat <sup>3</sup>		Flex Base <sup>5</sup>	if P.I. ≤ 15, Cement Treat <sup>2</sup>	if P.I. > 15, Lime Treat <sup>3</sup>
Principal Arterial	P7U	9"	10"	10"	3.5"	14"	10"	10"
	P4D & P4U	8"	10"	10"	3.5"	12"	10"	10"
Minor Arterial	M4U	8"	10"	10"	3.5"	12"	10"	10"
Collector	C4U	7"	8"	8"	3"	10"	8"	8"
	C2U & C2U-R	6"	6"	6"	2"	8"	8"	8"
Local	All Sections	6"	6"	6"	n/a	n/a	n/a	n/a
Driveways	All sections	6"	6"	6"	n/a	n/a	n/a	n/a

<sup>1</sup>NCTCOG Class C with 3,600 psi 28 day compressive strength.

<sup>2</sup>Minimum 3% by dry unit weight of Portland cement.

<sup>3</sup>Minimum 6% by dry unit weight of hydrated lime.

<sup>4</sup>NCTCOG Type D asphaltic concrete fine surface course.

<sup>5</sup>Crushed limestone compacted to 95% standard proctor density at optimum moisture.

### 3.5.3 Geotechnical Investigation

- A. A geotechnical investigation must be performed for all new developments containing public streets. The investigation must be based on samples obtained from drilling or from excavations on the site. The geotechnical investigation must be performed by a qualified geotechnical firm. A report with findings and recommendations must be prepared and shall bear the seal of a Professional Engineer licensed in the State of Texas. As a minimum, the study must address the following:

1. General soil and groundwater conditions

2. Earthwork recommendations
  3. Recommendations for pavement subgrade treatment type, depth, and concentration
  4. Guidelines for concrete and / or HMA pavement construction
- B. Samples must be tested in a laboratory. Tests must include as a minimum:

1. Moisture content and soil identification
2. Liquid and plastic limit determination
3. Unit weight determination
4. Eades and Grim lime series tests
5. Soluble sulfate tests

#### 3.5.4 Pavement Widening

Pavement widening projects may require a special pavement analysis and alternate pavement subgrade design. If the subgrade soil P.I. exceeds 20, a special pavement analysis shall be performed by the designer and, if warranted, the designer shall perform a special pavement subgrade design. When existing pavement sections are widened or when old pavement is removed and replaced with a widened section, differential upward pavement deflections can occur over short distances in a transverse direction (across the width) due to non-uniformity of subgrade moisture conditions.

- A. Sample borings shall be drilled along the proposed alignment to determine the differential in potential vertical rise (PVR) value between the existing paved and unpaved areas:
1. Sample borings shall be drilled on 1,000 foot spacing along the existing pavement and 500 foot spacing along the proposed (unpaved) area.
  2. Moisture content tests, hand penetrometer tests and swell tests shall be performed to determine the differential soil PVR along the proposed alignment.
- B. If the differential PVR exceeds 2 inches, the designer shall propose an alternate pavement subgrade design that shall reduce the differential PVR to less than two 2 inches.

#### 3.5.5 Pavers and Other Materials

Special paving treatments can be selected from a range of options including unit concrete pavers, bricks, textured and colored concrete, natural stone pavers, and concrete with exposed or special aggregate or other finish treatments. Design detailing must address the needs of ADA and TAS compliance in areas of crosswalks or walkways. In all locations within public rights-of-way, the materials must perform for the serviceable life of the street without significant degradation or requiring ongoing maintenance by the City.

### 3.6 PERMANENT PAVEMENT MARKINGS AND SIGNAGE

Permanent pavement markings and signage shall be installed in accordance with the *Texas Manual on Uniform Traffic Control Devices* (TMUTCD), current edition, and the direction of the City Engineer.

### 3.7 LANDSCAPING SYSTEMS

The following standards shall be used for landscaping public rights-of-way. These requirements do not replace those required by Zoning or other ordinances.

#### 3.7.1 Requirements

- A. All unpaved public medians and parkways shall be landscaped with a minimum of 4 inches of topsoil, sodded or seeded and irrigated with a properly designed and installed system.
- B. Minimum landscape requirements will be established by the City.
- C. Trees or upright plantings must not be planted within 30 feet of intersections or utility poles. The City may require greater setback for safety based on line-of-sight issues.
- D. An 8-inch wide concrete mow strip shall be installed between all planting beds and grassed areas.
- E. No plantings or irrigation facilities shall be permitted within median areas 5 feet or less in width or in median noses.
- F. Seeded or sodded areas of medians shall be bermed a minimum of 6 inches.
- G. Only trees with a mature height less than 30 feet may be planted closer than 20 feet either side of an overhead line. No trees shall be directly under utility lines.
- H. Trees to be planted within the medians of divided roadways that are ultimately planned for widening by constructing additional lanes in the median shall not be planted within the path of future lanes. Trees shall not be planted within 5 feet of existing or proposed curbs. Future lane widening shall be shown on the landscape plans.
- I. Trees shall not be planted within 5 feet of existing or proposed water lines or within easements.
- J. Irrigation systems in public rights-of-way shall be designed by an individual with a valid irrigation license granted by the State of Texas.

#### 3.7.2 Metering

All water usage shall be metered and paid for by the developer until landscaping is accepted by the City. Developers shall pay all fees required by the water provider, including impact fees/system development fees for any water meter to be installed.

## 3.8 STREET LIGHTING REQUIREMENTS

Streetlights shall be designed and installed in accordance with the following criteria:

### 3.8.1 Street Lighting Type

- A. All lights will be 100 watt high pressure sodium mounted on a galvanized steel pole using underground wiring at a minimum 25 foot height above the roadway surface for local streets and 30 foot for collectors and arterials.
- B. Street lighting shall be designed for thoroughfares to meet the lighting criteria in the latest version of the Illuminating Engineering Society (IES) Roadway Lighting Report 8 and the latest version of the National Electric Code (NEC).
- C. Decorative lights may be approved on a case by case basis.

### 3.8.2 Placement and Spacing

- A. Lights will be placed at all street intersections except at thoroughfares where median lighting is existing.
- B. Lights will be spaced a maximum of 600 feet along local and collector streets. Lights will be spaced a maximum of 200 feet along arterial streets.
- C. Additional lights may be required for intersections, in cul-de-sacs, and where curves or grades require additional lighting.
- D. All cul-de-sacs longer than 200 feet from centerline of street to center point of cul-de-sac shall have a light at the street intersection and at the end of the cul-de-sac.
- E. Lights shall be placed so as to gain the maximum use of existing and proposed physical characteristics.
- F. Electric service to the streetlight shall be underground.
- G. Streetlights shall not be constructed in conflict with the sidewalk.

## PART 4. DRAINAGE

### 4.1 ADOPTION OF *iSWM TECHNICAL MANUAL*

The City of Joshua hereby adopts the methodologies and standards included in the NCTCOG *iSWM Technical Manual* for all drainage analysis and design within the boundary of the City and within its extraterritorial jurisdiction (ETJ). Clarifications and modifications to the *iSWM Technical Manual* shall be applied as indicated in the following sections.

### 4.2 ANALYSIS CRITERIA

The following section describes specific requirements for drainage analysis to supplement the techniques and methods described in the Hydrology and Hydraulics sections of the *iSWM Technical Manual*.

#### 4.2.1 Peak Runoff

The Rational Method ( $Q=CIA$ ) shall be used for calculating peak runoff from watersheds of 200 acres or less. For watersheds of more than 200 acres, methods generating runoff hydrographs shall be used.

##### A. Runoff Coefficients

The runoff coefficient shall be determined for each drainage area based on a weighted average of the land uses listed below.

Table 4.1: Runoff Coefficient Values

Land Use	C value
Single Family Residential ( $\geq 3/4$ acre lots)	0.45
Single Family Residential (1/2 acre lots)	0.55
Single Family Residential (1/8 acre lots)	0.65
Multi-Family Residential	0.75
Commercial	0.85
Industrial	0.85
Parks and Undeveloped Areas	0.30

Runoff coefficients other than those listed above may be used if justified by the development site plan and approved by the City Engineer. Composite runoff coefficients will be determined by direct proportion when more than one land use exists within a drainage area.  $C_f$  factors shall not be applied to the runoff coefficients.

##### B. Intensity

Rainfall intensity shall be determined using the rainfall data for Johnson County from the Hydrology section of the *iSWM Technical Manual*.

C. Time of Concentration

The time of concentration may be calculated using methods other than those described in the *iSWM Technical Manual* with the approval of the City Engineer. The minimum time of concentration shall be 15 minutes for residential and undeveloped areas and 10 minutes for commercial and industrial areas.

4.2.2 Downstream Assessment

A downstream discharge assessment shall be performed to confirm that the proposed development does not result in increased flooding or increased erosion potential in areas downstream of the development when compared to the existing condition.

The assessment shall extend from the outfall of the proposed development to a point downstream where the discharge from the proposed development no longer has a significant impact on the downstream system. For sites draining a watershed less than or equal to 100 acres at a proposed outfall, the downstream assessment may use the 10 percent rule of thumb as described in the *iSWM Technical Manual* or a detailed study in order to determine the zone of influence. For all other watersheds, the zone of influence will be defined by a detailed hydrologic and hydraulic analysis.

For site outfalls with less than or equal to 25 acres of proposed development with proposed detention, a downstream assessment is not required. The detention design must only demonstrate the increase in discharge due to the proposed development is mitigated to existing conditions at the outfall.

The downstream assessment must demonstrate that the following conditions are met with the proposed development:

- A. No new or increased flooding (0.00 feet) of existing structures
- B. No increase greater than 0.1 feet in 1-, 5-, 25- and 100-year creek flood elevations over existing roadways
- C. No increase greater than 0.1 feet in 1-, 5-, 25- and 100-year creek flood elevations, unless contained in existing channel, roadway, drainage easement, and/or right-of-way
- D. No increase greater than 5 percent in 1-, 5-, 25- and 100-year velocities in existing creeks and channels unless it can be demonstrated that this condition does not cause an adverse effect and is accepted by the City Engineer

- E. No increase in downstream discharges caused by the proposed development that, in combination with existing discharges would result in the design capacity of the downstream storm drainage system or existing ROW to become exceeded for any of the design events.

The developer shall provide all supporting calculations to confirm that the above criteria have been satisfied for the limits of the study. If the existing drainage systems do not have capacity to convey the increased runoff from the development, additional stormwater infrastructure will be necessary to discharge runoff without causing new or increased flooding or erosion potential downstream of the proposed development.

F. Acceptable Outfall Conditions

No development may outfall concentrated discharge on adjacent property unless discharged into a public or private drainage system or existing defined swale, channel, or creek. Where drainage features are available to receive concentrated runoff, the design storm shall be collected on-site and conveyed to the feature. When offsite grading is required or the development discharges concentrated flow on an adjacent property without a receiving feature as described above, a notarized letter of permission from the affected property owner(s) shall be required. This letter shall be filed in the County records.

#### 4.3 DESIGN CRITERIA

The following section describes specific criteria for storm drain, detention ponds, channels, culverts, and bridges.

##### 4.3.1 Design Storm Frequencies

Capacity requirements for the storm drainage facilities in the City of Joshua are as follows:

Table 4.2: Design Frequencies

Facility Type	Design Frequency (Years)
Street Right of Way in Combination with Storm Drain	100
Sump Inlets	100
On-Grade Inlets and Street Section with Curb and Gutter	5
Permanent Bar Ditch and Associated Culverts	5
Detention Ponds	1, 5, 25, 100
Channels and Creeks	100
Culverts and Bridges	100

At least one lane shall remain dry during the 5-year storm for all collector streets, and at least one lane in each direction shall remain dry during the 5-year storm for all arterial streets. For all other streets with curb and gutter, the flow in the street during a 5-year storm shall not exceed curb

height. On all streets, 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.

For streets with bar ditches, the 100-year storm shall be contained within the right-of-way and the flow shall not exceed the street crown elevation. Culverts under driveways shall be designed to carry the 5-year storm at a minimum, but larger ditches and culvert may be required to convey the 100-year storm within the right-of-way.

#### 4.3.2 Offsite Areas

In all cases, drainage facilities should be designed for fully developed upstream conditions. Where future runoff must be calculated for undeveloped lands with no planned development, the City of Joshua Future Land Use Plan identified in the City of Joshua Comprehensive Plan shall be used.

#### 4.3.3 Storm Drain Requirements

The following section describes specific requirements for the design of storm drain systems.

##### A. HGL Requirements

The hydraulic grade line (HGL) for the pipe discharge resulting from the 100-year event pipe and the associated calculation worksheets shall be shown on the plans and shall be demonstrated to be below the road gutter elevation. For systems located outside of pavement, the HGL shall be at least 1.5 foot below ground level. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher. For systems that begin at an outfall the engineer should determine the appropriate starting HGL based on an investigation of downstream hydraulic features.

##### B. Pipe

Underground systems shall be constructed with a minimum Class III reinforced concrete pipe. A higher class of pipe may be required with shallow or deep construction. Alternative pipe materials (e.g. HDPE, PP, PVC etc.) shall not be allowed under street pavement but may be allowed in other installation conditions with approval of the City Engineer or Public Works Director.

A minimum size of 18 inches shall be used for all storm drain. A typical minimum depth of 3 feet of cover from the gutter to top of pipe shall be used to allow utility services to cross above the pipe.

All pipe bends and fittings shall be prefabricated. All connections to existing systems shall be made with a collar or prefabricated fitting. Radius pipe is allowed and shall be placed in accordance with the manufacturer's standards and requirements. Pulled joints may not be used to achieve the pipe curvature.

##### C. Manholes



For storm drain lines of 48 inch diameter and smaller, manhole access shall be provided every 600 feet to provide access into the closed system. For larger storm drain lines, required spacing for manhole access shall be determined by the City Engineer but generally should not exceed 1,000 feet. Additional manholes should be provided at the junctions of trunk mains.

#### D. Inlets

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all curbed streets with more than two travel lanes. 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.

#### E. Intake and Outfall Structures

Headwalls or sloped end treatment shall be constructed at all storm drain intakes and outlets. Storm drain systems that outfall to a creek shall be extended to the flowline of the creek or shall have an engineered drop structure. All outfalls should be evaluated for erosion protection as described in the *iSWM Technical Manual*. Headwalls in areas accessible to pedestrians and/or vehicles should include an appropriate guardrail.

#### F. Easements

Storm drain easements shall be a minimum of 15 feet in width with at least 5 feet of distance between the outside of the pipe and the easement line.

### 4.3.4 Detention Pond Requirements

The following section describes specific requirements for detention ponds in the City of Joshua. These requirements apply to the design of both private and public facilities.

#### A. Design Criteria

Detention basins shall be analyzed for the 1-, 5-, 25-, and 100-year storm events. Ponds shall be designed to limit the peak rate of discharge from the basin for the design storm events to a rate which will not cause an increase in downstream flooding or erosion potential.

Grass-lined sloped sides for detention basins shall not be steeper than 4H:1V for ease of maintenance. All detention basins shall be stabilized against erosion. Detention basins shall be designed to be maintainable by mechanized equipment. Level access routes for equipment shall be provided to all parts of the pond.

Due to the difficulty in coordinating the effective operation of multiple ponds and changing upstream conditions, ponds may not be constructed in-line with the water course. Exceptions will

be allowed where the entire drainage area is contained within a single development or the pond is a component of a master planned drainage system approved by the City.

Private detention ponds must be designed in accordance with good engineering practices and reviewed and inspected by the City. Maintenance for private detention ponds shall be the responsibility of the developer/owner. Access shall be provided to all private drainage facilities where there may be a public safety concern for inspection by the City. Detention ponds may not be used to meet park dedication requirements.

Impoundment of surface waters may require a water rights permit from the TCEQ. For the approval of ponds which retain water a completed permit or written documentation stating that a permit is not required must be provided.

#### B. Design Calculations

The Modified Rational Formula shall only be used for detention basin design for drainage areas of 25 acres or less. Modified Rational calculations shall be performed using the method described in the *iSWM Technical Manual*. A routed hydrograph method shall be used for watersheds larger than 25 acres. Various hydrograph methods and computer programs are available. Hydrograph study requirements shall be approved by the City Engineer.

Storage volume and outlet discharge calculations shall be provided for all storm events and shown on the construction plans along with tabulated stage-storage-discharge values. Outlet discharge calculations shall take into account backwater conditions at the outlet structure. For detailed calculations of unit hydrograph studies, a separate report shall be provided. A minimum of 1 foot of freeboard shall be added to the design water surface elevation to set the minimum pond top of bank.

#### C. Safety Requirements

An emergency spillway shall be provided for ponds with an embankment greater than or equal to 4 feet above adjacent grade. The spillway should be located at or above the 100-year maximum storage elevation with adequate capacity to convey the fully developed 100-year storm, assuming blockage of the storm drain outlet with six inches of freeboard. Ready access to the emergency spillway system shall also be provided. Spillway requirements must also meet all appropriate state and federal criteria. Design calculations shall be provided for all spillways.

Fencing is required around all ponds with vertical walls or steep side slopes to provide fall protection. The engineer should consider additional fencing based on site conditions to protect the public from any safety hazards.

Detention basins which retain water shall have a level safety ledge extending 3 feet into the basin from the shoreline and 2 feet below the normal water depth.

#### 4.3.5 Channel Requirements

The following section describes specific requirements for channels in the City of Joshua.

#### A. Design Criteria

Large drainage channels are generally not considered acceptable for new public drainage systems. Drainage shall be conveyed in a pipe except where calculations demonstrate that a storm drain greater than 72 inch in diameter would be necessary to convey the required flow. In most cases where pipe construction is infeasible creeks should be left in a natural state. If approved by the City Engineer, grass-lined engineered channels are acceptable. A concrete pilot channel shall be provided where feasible. Channel side slopes ranging from 3:1 to 4:1 are acceptable, although it is recommended that 4:1 side slopes be implemented when possible. Where channel top widths would exceed 60 feet it will be required to leave the creek in a natural state. Concrete lined channels shall only be acceptable for minor channels where approved by the City Engineer.

All channels shall be designed to convey the design flow with a minimum of one foot of freeboard. Channels shall also be designed to resist erosion from the design discharge as described in the *iSWM Technical Manual*. Alternate materials such as concrete and gabions may be used to protect portions of the channel from erosion as necessary. Additionally, in areas where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be required to provide stability.

#### B. Erosion Hazard Zones

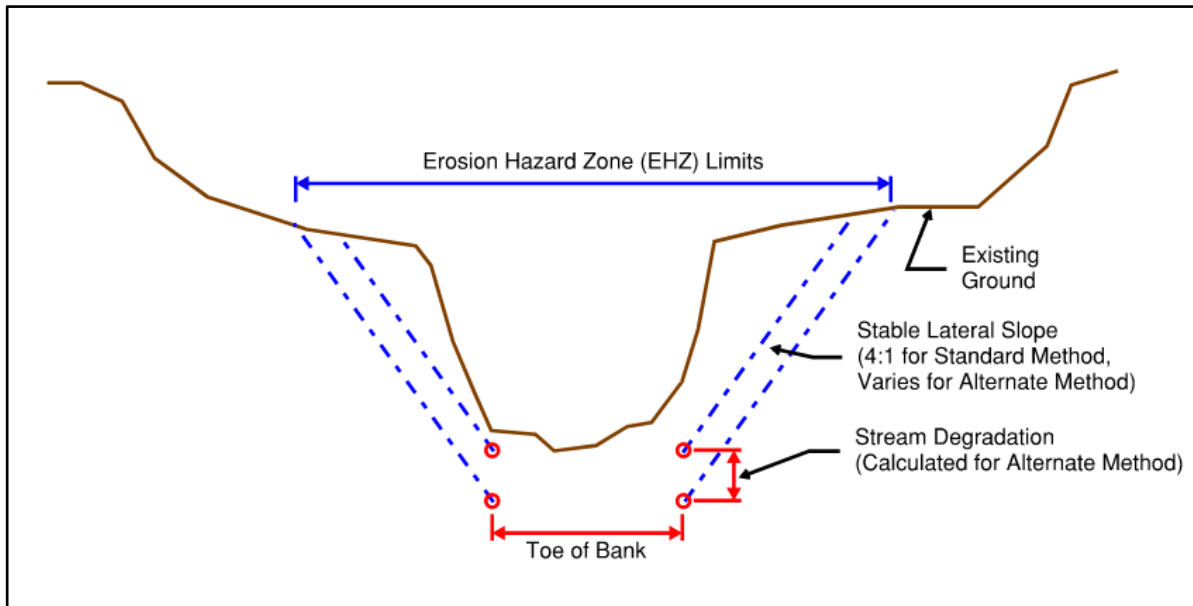
An erosion hazard zone (EHZ) shall be delineated for any development adjacent to a natural drainage feature. The erosion hazard zone shall be defined as the horizontal area encompassed by projecting the existing toe of the bank on a 4:1 slope to the natural ground elevation as shown in Figure 4.1. Detailed topographic data such as field survey must be used when developing the EHZ. Alternatively, the EHZ can be delineated based on a detailed study of the expected long-term longitudinal stream degradation and lateral slope stability based on the steps described below.

1. Long-term Longitudinal Stream Degradation: The estimated equilibrium slope shall be calculated from the nearest downstream hardpoint such as road crossing or drop structure. The equilibrium slope shall be calculated using three “degradation as limited by a stable slope” computations: Meyer-Peter Muller, Schoklitsch, and Lane’s *Tractive Force* (Pemberton and Lara, 1984). The average of these results shall be used to estimate the potential downcutting. Results differing from others by at least an order of magnitude should not be included in the average. The potential downcutting depth shall be calculated along the stream from the equilibrium slope to determine the degradation depth.
2. Lateral Slope Stability: Lateral slopes must be defined based on global stability calculations performed by a licensed engineer that specializes in geotechnical engineering. The minimum acceptable global factor of safety shall be 1.5. The EHZ is determined by locating the

intersection of the current top of each bank and the estimated downcutting depth, and then projecting the stable lateral slope from this point to natural ground.

3. The EHZ analysis should be based on a hydraulic model developed by a Professional Engineer and representative bedload sediment samples or pebble counts from each stream reach.
4. Deviations from the methodology to determine the EHZ or the use of slope stabilizing techniques to increase the lateral slope must be supported by engineering calculations and requires the approval of the City Engineer.

Figure 4.1: Erosion Hazard Zone Determination



#### C. Channel and Floodplain Easements

Channel easements shall have a minimum of 10 feet between the top of the channel bank and the easement line on both sides of the channel to provide room for maintenance. It must be demonstrated that any channel which carries public runoff is maintainable and that access to and along the channel is provided.

Natural creeks shall have a dedicated drainage easement encompassing the greater of the area of the 100-year fully developed floodplain and the EHZ. If no fully developed floodplain is currently identified for the area of development, one shall be delineated by the developer. Where appropriate models are unavailable, the City Engineer may allow the 500-year floodplain shown on the Effective FEMA Flood Insurance Rate Map to be used for this purpose. In areas of low risk, the City Engineer may accept a conservative estimate of the floodplain based on engineering judgement. No development, including fencing, shall be located within the easement. The

easement should not be included in newly subdivided residential lots, but rather fully encompassed in a homeowners association maintained common area. For non-residential areas, the area is to be fully encompassed by a private drainage easement or within a property owners association maintained common area.

#### 4.3.6 Culvert and Bridge Requirements

The following section describes specific requirements for culverts and bridges in the City of Joshua.

##### A. Design Criteria

All culverts shall have headwalls at the upstream and downstream ends. Culverts should be designed to have one foot of freeboard measured from the top of the curb or edge of pavement at the road low point. Bridges should be studied for scour potential and scour mitigation measures shall be incorporated. The low chord on the bridge structure shall be at least one foot above the 100-year water surface elevation. All headwall and bridge structures should provide appropriate guardrails to protect pedestrian and vehicular traffic.

#### 4.3.7 Lot Grading Standards

The following grading standards shall be met for residential subdivisions in the City of Joshua consisting of half acre lots or smaller.

##### A. Grading Plan Requirements

All residential subdivisions are required to provide a grading plan designed so as to avoid concentration of runoff onto lots. The grading plan shall show proposed spot elevations at each property corner, at grade break points, and finished pad elevations. One foot contours showing existing and proposed elevations shall also be shown unless this requirement is waived by the City Engineer.

##### B. Lot-to-Lot Runoff

Lots should be graded such that no lot drains across another where feasible. In no case shall more than one lot drain through another. In unusual situations where multiple lots must drain through another, an engineered swale or other conveyance improvement and drainage easement should be provided where approved by the City Engineer.

##### C. Lot Grading Requirements

Lot grading shall conform to the following standards:

1. Lots shall be graded away from the pad at a minimum slope of 5 percent for a distance of 10 feet in all directions (or to the lot line).

2. Front or rear swales should be provided where necessary to carry runoff around the pad.
3. Side lot line and front or rear swales shall have a minimum slope of 1 percent although higher slopes are preferred where feasible.
4. Side lot line swales must have a minimum depth of 3 inches at its shallowest point (and a typical depth exceeding 6 inches) below the lowest adjacent pad elevation. Where steep grade between lots makes this infeasible, a retaining wall shall be constructed to reduce the grade differential such that a conforming swale can be constructed on the higher lot.
5. Slopes shall not exceed 4:1 on residential lots unless approved by the City Engineer. A typical max slope of 10 percent should be used.

## **PART 5. APPENDICES**

## 5.1 APPENDIX A – ENGINEERING FILE SUBMISSION GUIDELINES

The following are guidelines for submitting digital files of engineering plans approved through the review process. Any submittals not complete and in conformance to the specified guidelines will not be accepted and may result in the delay in the release of permits and construction.

### 5.1.1 Media

- A. Submittals may be made over the internet or delivered to the city saved on a device compatible with city computers, hereinafter called Submittal.
- B. The Submittal shall be labeled with ALL of the following information:
  - 1. Name of the engineering consultant company submitting the plans
  - 2. Project name
  - 3. City plat file number
  - 4. Newly assigned address or if not available;
  - 5. City Block number
  - 6. Effective Date (seal date)
  - 7. Notate if plans are Revisions to Final (RTF)

### 5.1.2 Submittal Content

- A. The Submittal shall contain ALL of the following data files in Portable Document Format (PDF):
  - 1. Combined full set of approved engineering plans, complete with the most current version of the preliminary plat or, if approved, final plat.
  - 2. Separated single PDF file of each approved engineering plan sheet.
  - 3. Copy of the executed transmittal letter accompanying the submittal.
  - 4. Note: A compressed and self-extracting file type (.ZIP) is acceptable IF individual files are too large in size.

### 5.1.3 File Naming Convention

- A. Files of engineering plans and drawings shall use the following naming convention:
  - 1. Combined full set:
- B. City assigned project number\_Project Name\_Final Full Set
- C. Example: 1234\_City Park Apartments\_Final Full Set



1. Single and separated drawings:

D. City assigned project number\_Project Name\_Sheet Number\_Sheet Name

E. Example: 1234\_City Park Apartments\_C001\_Paving Plan

1. Revision to Final drawings:

F. City assigned project number\_Project Name\_Sheet Number\_Sheet Name\_RTF

G. Example: 1234\_City Park Apartments\_C001\_Paving Plan\_RTF

H. If more than one RTF has occurred, please indicate which version it is, e.g., RTF2, RTF3

## 5.2 APPENDIX B – ENGINEERING SUBMISSION GUIDELINES & PLAN REVIEW CHECKLIST

Project Name: \_\_\_\_\_  
City Plan File # (Plat #): \_\_\_\_\_  
Zoning (or PD/SUP #, if applicable): \_\_\_\_\_  
Engineering Consulting Firm: \_\_\_\_\_  
Engineer-of-Record: \_\_\_\_\_, PE  
Date: \_\_\_\_\_

### **Plan Format, General Standards & Helpful Links**

#### ☐ General Sheet Order for Plan Submission

- Cover Sheet **(Always Required)**
- General Notes
- Preliminary or Final Recorded Plat **(Always Required)**
- Existing Conditions Plan / Topographic Survey **(Always Required)**
- Demolition Plan
- Site Layout or Dimension Control Plan **(Always Required)**
- Paving Plan (& Profile, where applicable)
- Grading Plan **(Always Required)**
- Existing Drainage Area Map **(Always Required)**
- Proposed Drainage Area Map **(Always Required)**
- Drainage Calculations **(Always Required)**
- Storm Drain Plan (& Profile, where applicable)
- Erosion Control Plan
- Construction Details

- ☐ All plans should be printed on 11" x 17" size paper, landscape orientation, clear, legible, and to scale. Engineer scales: 1" = 10', 20', 30', 40', or 50'. Larger scales may be used for overall/indexing sheets. No Architectural Scales.

North orientation should generally face to the top or right-hand side of sheet.

The following information should be included on **ALL** sheets:

- Engineering Firm Name & Registration #, Address, and Phone Number
- Engineer's Seal or preliminary statement as approved by the Board of Professional Engineers
- Surveying Firm Name & Registration #, Address, and Phone Number
- Developer's Name, Address, and Phone Number
- Owner's Name, Address, and Phone Number
- Plat File#: \_\_\_\_\_

- ☐ Please refer to the information below to answer questions in the following checklist.

- City of Joshua Engineering Design Standards and Specifications (EDSS)
- North Central Texas Council of Governments (NCTCOG) Construction Standards, latest edition
- City of Joshua Planning & Development Website

<https://www.cityofjoshuatx.us/departments/planning-development/>

- Johnson County Special Utilities District - <https://www.jcsud.com/>
- FEMA Flood Map Service Center – <https://msc.fema.gov/portal>

### **Engineering Check List**

1. Have plans been submitted to Johnson County Special Utilities District for review and approval?

\_\_\_\_\_ Yes

\_\_\_\_\_ No \*\* Please note that Engineering plan review is divided into two separate sections: Paving/Drainage Engineering (City of Joshua) and Water/Wastewater Engineering (JCSUD). Each section has its own submittal requirements, review check lists and review fees. Contact JCSUD for additional information on Water/Wastewater Engineering submittal.

2. Is the property being platted?

\_\_\_\_\_ Yes – What is the Preliminary Plat number?

\_\_\_\_\_ No – Property is already platted: \_\_\_\_\_ N/A

3. Is the property being re-zoned?

\_\_\_\_\_ Yes – Zoning classification changed from to

\_\_\_\_\_ No

4. Is there a PD or Specific Use Permit (SUP) related to this development?

\_\_\_\_\_ Yes

Submit highlighted sections of the conditions of the PD/SUP. List any conditions regarding sidewalks, paving and/or drainage:

5. Has any part of the site ever been used as a cemetery?

\_\_\_\_\_ Yes – Additional conditions may need to be met prior to plan approval.

\_\_\_\_\_ No

6. Has any part of the site ever been part of a “brown field” and/or a landfill in the past?

\_\_\_\_\_ Yes – Additional conditions may need to be met prior to plan approval.

\_\_\_\_\_ No

8. Is an itemized breakdown with quantities of all proposed public paving and drainage infrastructure within City ROW and Easements included in this submittal?

\_\_\_\_\_ Yes

\_\_\_\_\_ No – Note: This is required prior to plan approval.

\_\_\_\_\_ N/A

10. Are any retaining/screening walls proposed?

\_\_\_\_\_ Yes – Maximum vertical distance measured from the bottom of the footing to the top of the wall = \_\_\_\_\_ feet.

\_\_\_\_\_ No

11. Is any proposed excavation or filling over 5 feet?

\_\_\_\_\_ Yes – Maximum depth of excavation = \_\_\_\_\_ feet.

\_\_\_\_\_ Yes – Maximum depth of fill = \_\_\_\_\_ feet.

\_\_\_\_\_ No

12. Are sidewalks shown on all street frontages? Per the Joshua City Code, sidewalks are required on all street frontages. Plans submitted for Paving/Drainage review

must include the required sidewalks. The applicant may apply for a Sidewalk Waiver.

☐ Yes

☐ No – Sidewalk waiver has been obtained and a copy is attached.

13. Is on-street parking being proposed?

☐ Yes

☐ No

14. Will an acre or more of soil be disturbed with this development?

☐ Yes – Engineer should inform developer that a SWPPP must be submitted prior to obtaining any permits. See “Construction Plan Review Checklist For projects greater than one acre”.

☐ No

15. Is there a thoroughfare adjacent to the development, or within (passes through) the development? Please refer to the City of Joshua Thoroughfare Plan.

☐ Yes, thoroughfare is adjacent. \*\*Please note that the developer may be responsible for the design and construction of half of the width of the thoroughfare which abuts the proposed development.

☐ Yes, thoroughfare passes within. \*\*Please note that the developer is responsible for the entire width of the thoroughfare within the limits of the proposed development.

☐ No

16. Does this development comply with the International Fire Code?

☐ Yes – I have read the code and verified that it complies.

☐ No – Please explain: \*\* Please note: Where the vertical distance between the grade plane and the highest roof surface exceeds 30 feet, adjacent aerial fire apparatus access roads shall have a minimum unobstructed width of 26 feet. Otherwise, adjacent access roads shall have a minimum unobstructed width of 20 feet.

17. Is there any lot-to-lot drainage? Is the site currently accepting runoff from adjacent properties, or will the site be draining onto/through adjacent properties (regardless of current drainage pattern)?

☐ Yes – Private Drainage Easements may be required.

☐ No

18. Is any work proposed within areas designated as floodplain by FEMA, or in areas near unstudied streams/creeks?

☐ Yes

☐ No

21. Do all storm water outfall locations have the capacity to convey the 100-year storm?

☐ Yes – Provide supporting drainage plans and calculations.

☐ No – Detention may be required. \*\* It is the responsibility of the engineer of record to verify the capacity of existing storm sewer systems, swales/channels, street gutters, or any other public or private conveyances into which the proposed development will discharge storm runoff. If design plans or as-built plans are not on record or otherwise

available, it may be necessary for the engineer of record to perform field verification of the location, size, slope, depth, etc. of these systems to determine their capacity.

22. Is any storm water runoff from the site being diverted from its existing outfall location into a new outfall?

\_\_\_\_\_ Yes – Please explain: \_\_\_\_\_

\_\_\_\_\_ No

23. Is any storm water runoff being discharged onto adjacent cities or other entities?

Yes, onto another City – Please note: Detention may be required and the adjacent City must approve the plans.

\_\_\_\_\_ Yes, onto another Entity (e.g., TxDOT) – Please note: Engineering plans must be reviewed and approved by that entity.

\_\_\_\_\_ No

24. Is there any proposed connection to the storm sewer system that would discharge anything other than rainfall runoff?

\_\_\_\_\_ Yes - Please explain: \_\_\_\_\_

\_\_\_\_\_ No

25. Is detention being proposed?

\_\_\_\_\_ Yes \*\*Please note: Detention must be located onsite, easements must be clear of obstructions and building encroachments, and adequate access must be provided for maintenance purposes via Detention Area Access Easement.

\_\_\_\_\_ No

### **Required Sheet Information**

#### ☐ Cover Sheet

- Project Name, Lot & Block Number/Legal Description
- Sheet Index
- Vicinity Map
  - All information is clearly shown on the Cover Sheet.
  - Some information is missing. Here is what's missing and why:

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#### ☐ Preliminary or Final Plat

- When the Planning & Zoning Commission approves the Preliminary Plat, a conditional approval letter is issued and mailed to the owner and Surveyor.
- The Engineer should request a copy from the owner and:
  - Ensure that the surveyor has addressed all conditions on the Preliminary Plat that is being submitted with the engineering plans.
  - Ensure that all conditions are addressed on the engineering plans.

- Right-of-Way dedications are clearly shown and dimensioned
- Easement dedications are clearly shown and dimensioned
- All existing easements are clearly shown and dimensioned
  - Vicinity Map
  - All information is clearly shown on the Plat
  - Some information is missing. Here is what's missing and why:

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☐ Existing Conditions Plan

- Show and label existing contour lines (with elevation labels) at one or two foot contour intervals referenced to sea-level datum.
- Show and label existing drive approaches, street frontage sidewalks & barrier-free ramps, street and onsite pavement material (e.g., concrete, asphalt, pavers, gravel, etc.), street pavement & right-of-way widths, on-street parking, street curb lines, bar-ditches, onsite buildings, vehicle circulation lanes, private drives, fire lanes, parking areas, landscape areas, fencing, retaining walls, and all public and private storm/water/wastewater/other utility infrastructure.
- Show, label, and dimension all existing easements.
- Show and label all existing signs, utilities, signal poles, parking meters, bike racks, newsracks, advertising kiosks, etc. located within the right-of-way.
- Show and label all streams, creeks, drainage ways, and 100-year floodplain. In addition to FEMA overlays, show and label actual 100-year water surface elevations.
- All information is clearly shown on the Existing Conditions Plan.
- Some information is missing. Here is what's missing and why:

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☐ Demolition Plan

- All items listed above under "Existing Conditions Plan" is either labeled: "Existing to Remain", "To be Removed", or "To be Relocated".
- All information is clearly shown on the Demolition Plan.
- Some information is missing. Here is what's missing and why:

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☐ Site Layout or Dimension Control Plan

- Show and label proposed drive approaches, street frontage sidewalks & barrier-free ramps, onsite & offsite pavement material (e.g., concrete, asphalt, permeable pavers, etc.), street pavement & right-of-way widths, on-street parking, street curb lines, bar-ditches, onsite buildings, vehicle circulation lanes, private drives, fire lanes, parking areas, fencing, retaining walls, and landscape areas.
- Show and label all existing and proposed signs, utilities, signal poles, parking meters, bike racks, newsracks, advertising kiosks, DART bench/shelter, etc. located within the right-of-way.
- Show, label, and dimension visibility triangles at street intersections and drive approaches.
- All information is clearly shown on the Site Layout or Dimension Control Plan.
- Some information is missing. Here is what's missing and why:

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☐ Paving Plan (& Profile, where applicable)

- All proposed work is clearly shown and labeled with a paving legend to distinguish between the different pavement specifications within the right-of-way and private property.
- Limits of new paving and adjustments to intersecting streets and drives are clearly defined by stations and dimensions, as necessary.
- Typical cross sections are shown and dimensioned for each proposed street/alley classification with station limits and centerline corrections.
- Station/top of curb (offset from centerline if not typical) for all PC's, PT's and midpoints of curb returns.
- A curve schedule should be provided for concentric and non-concentric curves.
- Check all drives, intersections and other locations involving cross traffic for possible hazardous situations. Watch for obstructed sight distance, hindrances to safe operation at design speed, danger to pedestrians, etc.
- Intermediate tangents have been designed between reverse curves based on the design speed along the centerline of the proposed streets.
- Complete vertical curve information is provided and meets minimum sight distance requirements for design speed.
- Existing and proposed water/wastewater lines are clearly shown and labeled when located under proposed pavement.
- Street lighting on divided thoroughfares is clearly shown and labeled.
- Type, thickness, strength, rebar size, and subgrade preparation of proposed pavement is shown and is in conformance with standards.
- Show cross-slope of street and driveway slopes into property. Slopes must comply with the EDSS.

- Sidewalks are clearly shown and labeled on all street frontages. Concrete thickness, strength, and rebar size is shown and is in conformance with standards.
- Show, label, and dimension visibility triangles at street intersections and drive approaches.
- Please note: Where the vertical distance between the grade plane and the highest roof surface exceeds 30 feet, adjacent aerial fire apparatus access roads shall have a minimum unobstructed width of 26 feet. Otherwise, adjacent access roads shall have a minimum unobstructed width of 20 feet.
- All information is clearly shown on the Paving Plan.
- Some information is missing. Here is what's missing and why:

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☐ Grading Plan

- Existing onsite and offsite contour lines (with elevation labels) and proposed grades are clearly shown and labeled.
- Surface drainage easements are provided for lot-to-lot drainage paths.
- Typical cross sections for all retaining walls are provided. Show footings, utility crossings, wall heights, and distances to property lines.
- All utilities are clearly shown and labeled.
- Show and label all streams, creeks, drainage ways, and 100-year floodplain. In addition to FEMA overlays, show and label actual 100-year water surface elevations.
- All information is clearly shown on the Grading Plan.
- Some information is missing. Here is what's missing and why:

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☐ Existing Drainage Area Map

- Existing onsite and offsite contour lines (with elevation labels), onsite and offsite subdivided drainage areas, and drainage area calculation tables are clearly shown.
- Indicate zoning for each drainage area.
- Existing inlets and storm drain lines are clearly shown and labeled.
- Existing onsite and offsite flow direction is clearly shown with directional flow arrows.
- Show the design storm that the downstream storm drain system was designed for (e.g, 25-year storm, 100-year storm, etc.) and the drainage criteria that was used for that design.
- Show and label outfall locations.



- Show and label all streams, creeks, drainage ways, and 100-year floodplain. In addition to FEMA overlays, show and label actual 100-year water surface elevations.
- All information is clearly shown on the Existing Drainage Area Map.
- Some information is missing. Here is what's missing and why:

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☐ Proposed Drainage Area Map

- Proposed onsite and offsite grades, onsite and offsite subdivided drainage areas, and drainage area calculation tables are clearly shown.
- Indicate zoning for each drainage area.
- Existing and proposed inlets and storm drain lines are clearly shown and labeled.
- Proposed onsite and existing offsite flow direction is clearly shown with directional flow arrows.
- Show runoff calculations and use design criteria as shown in the Drainage Design Manual.
- Show and label outfall locations.
- Demonstrate, with supporting calculations, that there is adequate capacity downstream to convey the 100-year storm.
- Show and label all streams, creeks, drainage ways, and 100-year floodplain. In addition to FEMA overlays, show and label actual 100-year water surface elevations.
- All information is clearly shown on the Proposed Drainage Area Map.
- Some information is missing. Here is what's missing and why:

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☐ Storm Drain Plan (& Profile, where applicable)

- Show a plan and profile for all proposed public storm drain lines. Pipe lengths are to be shown by stationing at each structure. Show pipe size, material, slope and class for each run. Show pipe inverts, discharge, velocity and friction slope. Show and label the hydraulic gradient.
- Show all hydraulics, velocity head changes, gradients, computations and profile outfalls with typical sections and computations.
- Specify at least Class III RCP. Provide inlets where street capacity is exceeded. For thoroughfares, one lane must remain dry.
- Existing and proposed inlets and storm drain lines are clearly shown and labeled.
- Discharge storm drains at the flowline of creeks and channels with the last 10 feet at a grade not to exceed one percent, unless otherwise directed.
- Show the 100-year water surface elevation at the outfall of the storm drains.

- Where connections are made to an existing storm drain, provide the design data of existing system (Q100, HGL, inverts, diameter, etc.).
- Intersect laterals at 60 degrees with the trunk line, if possible. Where laterals tie into a trunk line, channel or creek, place them at 60-degree angle with center lines. Connect them so that longitudinal centers intersect.
- Indicate flow line elevations of the storm drains on the profile. Label the line grade (in percent). Match top inside of pipe where adjacent to other size pipe.
- Do not use high velocities in storm drain design. Refer to the Drainage Design Manual for maximum allowed velocities.
- The minimum pipe slope is 0.30% unless otherwise directed.
- The downstream system must be sized to adequately convey the fully developed runoff from the site.
- Provide a written statement certifying that you have analyzed the proposed storm drainage outfall effects on the adjoining property owner(s) and that your discharge will not adversely affect or jeopardize any downstream properties.
- Proposed driveway turnouts must be a minimum of 10 feet from any existing or proposed inlet.
- Do not use bends on public storm drain lines for pipe sizes less than 30-inch diameter.
- Do not use 90-degree bends on storm drains or outfall. Provide a junction structure or manhole.
- Show and label all streams, creeks, drainage ways, and 100-year floodplain. In addition to FEMA overlays, show and label actual 100-year water surface elevations.
- Drainage swales/channels should have cross sections with 100-year water surface elevation, slopes, side slopes, and velocity clearly shown and labeled.
- All information is clearly shown on the Storm Drain Plan.
- Some information is missing. Here is what's missing and why:

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☐ Erosion Control Plan

- Existing contour lines (with elevation labels) and proposed grades are clearly shown and labeled.
- Design plans comply with all current rules and regulations of EPA, TCEQ, and other applicable federal and state agencies.
- All information is clearly shown on the Erosion Control Plan.
- Some information is missing. Here is what's missing and why:

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☐ Construction Details

- All details are clearly labeled private or public.
- All applicable details from the City of Joshua Standard EDSS or NCTCOG Construction Standards should be clearly shown, labeled, and cross referenced on the plans.
- All details not covered by the City of Joshua EDSS or NCTCOG Construction Standards are clearly shown, labeled, and dimensioned.
- All applicable details for work within the right-of-way of another entity (e.g., TxDOT, etc.) are clearly shown, labeled, and cross referenced on the plans.
- All information is clearly shown on the Construction Details.
- Some information is missing. Here is what's missing and why:

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I have reviewed this check list and certify that the design plans submitted have been reviewed by me and are in compliance with all City of Joshua design standards. I understand that the City reserves the right to provide review comments at any time throughout the plan review process until all standards have been addressed.

\_\_\_\_\_, PE  
Print Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

### 5.3 APPENDIX C – CONSTRUCTION PLAN SWPPP REVIEW PROCEDURE

Background: This checklist is used by the City of Joshua staff for Stormwater Pollution Prevention Plan (SWPPP) reviews. It is provided as an additional resource intended for designers for construction projects to assure all required elements of a SWPPP are included. Use of this checklist will determine if your SWPPP is complete, though not all checklist items are applicable to all projects.

#### Review Information

Applicant: \_\_\_\_\_ Project name: \_\_\_\_\_

Application Date: \_\_\_\_\_ Reviewer name: \_\_\_\_\_

#### Reason for Review:

Mandatory

Random Audit

Enforcement Case

#### SWPPP contains one or more of these:

Narrative

Plan Sheets

Standard Detail Sheets

#### Project Type:

Residential

Commercial/Industrial

Road Construction

Other (describe) \_\_\_\_\_

#### SWPPP Information (Does the project narrative contain the following)

- ☐ What is the nature of the construction activity?
- ☐ Address the potential for a discharge of sediment and/or other potential pollutants from the site?
- ☐ List the chain of responsibility for SWPPP implementation for all operators on site?
- ☐ Describe installation timing for all Erosion Sediment Control (BMP's)
- ☐ Describe procedures to amend the SWPPP and establish additional temporary BMP's as necessary for site conditions?
- ☐ Methods used to minimize soil compaction and preserve topsoil must be described.
- 7. ☐ Describe hazardous material, construction debris, and concrete slurry management.

**Plan Sheets:** (Do they contain the following?)

- ☐ Existing and final grades.
- 2. ☐ Locations and types of all temporary and permanent BMP's.
- 3. ☐ Locations of areas not to be disturbed (buffer areas)
- 4. ☐ Location of areas where construction will be phased to minimize duration of exposed soil areas.
- 5. ☐ Areas of steep (3:1 greater slope)
- 6. ☐ Locations of adjacent wetlands, surface waters, and storm ponds.
- 7. ☐ Description and location of final stabilized method.
- 8. ☐ Are standard details or specifications included?

## 5.4 APPENDIX D – PUBLIC WORKS MATERIALS TESTING

### Section I: Storm Sewer

#### Backfill and Density Testing

All trenches shall be backfilled in maximum 12" (inch) loose lifts and mechanically compacted with approved vibratory methods (NCTCOG item 504.5.3.2.1)

Densities shall conform to minimum 95% ASTM D-698 and be at or above optimum moisture unless specified otherwise (NCTCOG item 504.5.3.2.1). Proctor samples shall be taken for all classifications of soil on site. Atterberg Limits shall be determined on all Proctor samples.

Densities shall be taken on every other lift as lifts ascend. No "potholing" or "ramping" will be allowed unless approved by the inspector.

Densities shall be taken at intervals not exceeding 300' (feet) along the length of storm sewer mains.

Densities shall be taken on every lateral under pavement.

Backfill adjacent to inlets, headwalls, junction boxes, and other structures shall be compacted manually, and density tested on every lift.

#### Connections

Collars, junctions, wyes, and damage repairs will be inspected prior to concrete placement and again prior to final embedment and backfill.

All collars must have No. 3 rebar for reinforcement supported by blocks.

Structure construction:

A concrete mix design must be submitted and approved by City prior to any placement of concrete.

Inspector shall be notified of concrete placement 24 hours in advance for steel and form inspection.

One set of four cylinders (2 - 7 days, 2 - 28 days) shall be made for every day concrete is placed (ASTM C-31).

Air, slump, and temperature tests shall be taken for every set of cylinders made. Concrete with a temperature above 95° F will be rejected. Additional cylinders and or tests may be requested at the inspector or Engineer's discretion.

Exterior forms shall not be removed for a minimum of 24 hours unless approved by Inspector or Engineer.

## **Section II: Stabilization**

### Soil Classification and Sampling

Lime Stabilized sub-grade shall have an initial cure time of not less than 72 hours prior to remixing according to NCTCOG spec (Item 301.2.3.5.1).

### Sub-grade Testing

Gradations for lime treated sub-grade shall be taken at intervals not exceeding 300' (feet) along road and must pass 100% through a 1 ¾" (inch) sieve and 60% through a #4 sieve according to NCTCOG spec (Item 301.2.3.5.1).

Gradations for Portland Cement treated sub-grade shall be taken prior to placement of cement and at intervals not exceeding 300' (feet) along road and must pass 100% through a 1" (inch) sieve and 80% through a #4 sieve according to NCTCOG spec (Item 301.3.3.2).

Lime sub-grade shall be tested for depth at intervals not exceeding 300' (feet) along road. Tests will be performed by excavating deeper than lime treatment and administering a phenolphthalein indicator.

Densities shall be taken on sub-grade at intervals not exceeding 300' (feet) along road and conform to minimum 95% ASTM D-698 (NCTCOG Item 301.2.3.6). Moisture content shall be at or above optimum moisture.

All sub-grade shall be visually "proof rolled" after it is trimmed and prior to placement of steel or asphalt.

Densities shall be taken within 72 hours of concrete placement (NCTCOG Item 303.5.1). If more than 72 hours elapses, densities must be retaken unless an approved emulsion sealant is used (NCTCOG Item 302.3.5).

Location for densities, gradations, and depth checks shall be at the discretion of the Inspector and shall be representative of the entire cross section of sub-grade.

Sub-grade failures shall be defined by inspector or Engineer. Repair methods will be discussed with the inspector or Engineer and approved prior to beginning repair work.

At all testing location intervals, multiple tests may be required across width of right-of-way.

#### TX Dot Cement Treated Subgrade Spec Item 275

Curing of cement stabilized subgrade, cure for at least three days by sprinkling in accordance with item 204, "Sprinkling" or by applying asphalt material at the rate of 0.05 to 0.20 gal per square yard, as shown on the plans or directed.

#### Microcracking

When shown on plans, maintain moisture content of the finished cement treated base for a period of 24 to 48 hr. during this time, but not sooner than 24 hr., roll the finished course with a vibratory roller to induce microcracking. The vibratory roller must be in accordance with Item 210, "Rolling", with a static weight equal to or more than 12 tons and the vibratory drum must be not less than 20" (inch) wide. The roller must travel at a speed of 2 mph (miles per hour), vibrating at a maximum amplitude, and make 2 to 4 passes with 100% coverage exclusive of the outside 1' (foot) of the surface crown, unless otherwise directed by the Engineer. Additional passes may be required to achieve the desired crack pattern as directed. Notify the Engineer 24 hours before the microcracking begins.

### **Section III: Concrete Pavement**

#### Concrete Testing

A concrete mix design must be submitted and approved by the city prior to any placement of concrete.

The Inspector shall be notified of concrete placement 24 hours in advance for steel and form inspection.

Any rebar stand-offs to be used to support the rebar street mat driven in the ground should be epoxy coated in slip form paving situations.

One set of 4 cylinders (2-7 days & 2-28 days) shall be made for every 150 cubic yards of concrete that is placed for pavement, sidewalks, ramps, and or retaining walls (ASTM C-31).

Air, slump, and temperature above 95° F will be rejected.

Additional cylinders and or tests may be requested at the Inspector or Engineer's discretion.



(ASTM C-94) no more than 90 minutes before concrete placement for ready-mix batch trucking.

All saw-cuts shall be left smooth and free of any fractures.

#### Cure Time, Cores & Form Removal

Forms shall not be removed from pavement, sidewalks, ramps, or retaining walls for 24 hours minimum, and shall not be backfilled less than 72 hours after concrete placement.

Pavement shall have a minimum cure time of 7 days but may be opened to traffic earlier at the discretion of the Inspector or Engineer only after review of compressive strength data. Temporary perpendicular crossings may be made after 72 hours provided field cured specimens indicate concrete has met at least 75% of design strength, by ramping soil over the new pavement at a depth of not less than 18" (inches) and a width of not less than 10' (feet).

Prior to grout wiping any concrete, the contractor shall demonstrate a method of surface preparation to ensure adhesion of grout.

The paving contractor at their cost shall core all streets to verify proper pavement thickness prior to acceptance. Cores shall be 2" (inches) diameter and taken at intervals not exceeding 300' (feet). Locations will be approved by the city. Multiple cores may be required at each interval to represent the entire cross section. Evaluation of cores will be in accordance with NCTCOG spec (Item 303.8.2). All concrete replacements shall be in full panel increments or NCTCOG Item 402 and illustrations 3070 C and D for asphalt paving.

*This information is an explanation of basic testing procedures and is mean to be used in conjunction with the North Central Texas Council of Governments Standard Specifications for Public Works Construction, November 2017Edition and TX Dot Item 275.*

## 5.5 **APPENDIX E – GENERAL NOTES**

1. The term Municipality refers to the City of Joshua. J.C.S.U.D. refers to Johnson County Special Utility District.
2. All work shall conform to the requirements of the Municipality/J.C.S.U.D. and shall be in accordance with the Municipal/J.C.S.U.D. standard details and specifications for construction. All work not covered in the contract documents and Municipal/J.C.S.U.D. standard details and specifications for construction shall be Governed by the North Central Texas Council of Government Standard Specifications for Public Works Construction.
3. The contractor shall protect existing property monumentation and primary control. Any such points which the contractor believes will be destroyed shall have offset points established by the contractor prior to construction. Any monumentation destroyed by the contractor shall be reestablished at contractors' expense by a registered professional land surveyor.
4. It shall be the responsibility of the contractor to: A.) Prevent any damage to private property and property owner's poles, fences, shrubs, etc. B.) Protect all underground utilities. C.) Notify all utility companies at least 48 hours prior to excavation in accordance with Texas Law. D.) Field verify horizontal and vertical location of all utilities in the vicinity of construction activities prior to start of construction. The contractor shall notify the Engineer of any unidentified potential conflicts that may exist between the existing utilities and construction plans.
5. Any damage that may occur to real property or existing improvements, including existing private and public landscape irrigation systems, shall be restored by the contractor to at least the same condition that the real property or existing improvement were in prior to the damages. The contractor will also be responsible for the adjustment of sprinkler heads to final grade and relocation if necessary.
6. The contractor shall always maintain drainage during construction. The ponding of water in streets, drives, trenches, etc. will not be allowed. The contractor shall always maintain existing driveways access.
7. The contractor shall always maintain existing sanitary sewer and water services during construction.

8. Areas of the site that will underlie fill shall be scarified to a depth of 8 inches. Fill shall be placed in loose lifts not exceeding 8 inches in uncompacted thickness. All fill material shall be compacted to 95% standard proctor density with a moisture content from -3% to +1% of optimum or per Geotech recommendation. Field density tests per municipal requirements.
9. The contractor shall abide by all applicable Federal, State, and local laws governing excavation. The contractor shall provide detailed plans and specifications for trench safety systems that comply with applicable laws governing excavation. These plans shall be sealed by an Engineer experienced in the design of trench safety systems, licensed in the State of Texas. The contractor shall submit completed trench safety plans to the municipality prior to commencing work. The contractor shall be solely responsible for all aspects of work related to excavation. All excavations, trenching and shoring operations shall comply with the requirements of the U.S. Department of Labor, OSHA, "Construction Safety and Health Regulations."
10. Work may not be backfilled or covered until it has been inspected by the Municipality/J.C.S.U.D.
11. All excavation on the project is unclassified.
12. All curb and gutter shall be integral with the concrete pavement.
13. Contractor shall coordinate the protection of existing franchise utilities and appurtenances, including existing utility poles, in the vicinity of construction operations whether utilities are shown on plans or not. Any damage incurred to existing franchise utilities, appurtenances, utility poles, light standards, etc., by construction related activities shall be the sole responsibility of the contractor.
14. The contractor shall locate and record existing irrigation systems prior to construction. The contractor shall temporarily remove and cap the irrigation system as necessary for construction and shall replace the portion removed with equivalent systems. The contractor shall coordinate any irrigation work with the municipality and property owner's representatives.
15. The contractor must cease all construction operations immediately if a suspected archeological object/artifact is uncovered during construction. The contractor must immediately contact the Texas Historical Commission and the Municipality/J.C.S.U.D. Project work will not commence until proper permits are in place and provided to the Municipality/J.C.S.U.D.

16. All paving dimensions are to the back of curb unless otherwise noted.
17. It is the contractor's responsibility to ensure compliance with all handicapped accessibility requirements including signage, textures, coloring, markings, and slopes of ADA/TAS 2012 accessible routes & ramps, and parking spaces.
18. All pipe lengths measured from station to station based on the center of structure unless otherwise noted.
19. The contractor shall notify the Engineer if any discrepancies arise.
20. All excavations, trenching and shoring operations shall comply with the requirements of the U.S. Department of Labor, OSHA, "Const. Safety and Health Regulations." Vol 29, Subpart P. PG. 128-137, and any amendments thereto. The contractor shall prepare and implement a trench safety plan for this project.
21. The contractor shall restore all areas, onsite and offsite, disturbed by construction to their original condition or better. Restored areas include, but are not limited to: trench backfill, side slopes, fences, culvert pipes, drainage swales, staging areas, driveways, private yards, and roadways. Unless otherwise directed by the landscape drawings, restoration shall include hydro mulching all disturbed areas with a slope of less than 20% (1:5) and sodding areas with a slope of 20% (1:5) or greater. Establishment of grass through proper watering is left up to the contractor's means and methods, unless otherwise directed by the landscape/irrigation drawings.
22. The contractor shall keep records for as-builts drawings and shall submit mark-ups to the municipality inspector prior to scheduling a final walk-through inspection.
23. Prior to construction, a pre-construction meeting shall be held with representatives from all contractors, the Engineer, and the municipality.
24. All construction must adhere to the tree preservation requirements of the municipality.
25. The contractor, his agents, and sub-contractor are completely responsible for the verification of the accuracy of the dimension control furnished herein. The owner, Engineer, and their agents are not responsible for the accuracy of the coordinated furnished. The contractor is required to verify all coordinates for accuracy and confirm the locations of all utilities to be constructed both

horizontally and vertically. Discrepancies found by the contractor shall be reported in writing to the owner immediately for reconciliation.

26. The contractor shall be responsible for the implementation of stormwater pollution prevention plan (SWPPP) required for this project in accordance with the contract documents. The contractor shall prepare, implement, and maintain the SWPPP in accordance with the requirements of the current TCEQ and NPDES General Permit in accordance with the register pages 36489-36519.

#### 5.5.1 General Notes for Paving Improvements

1. The sub grade shall be proof rolled and observed by the construction inspector prior to and after sub-grade stabilization.
2. Individual water and sewer services and water valves shall be marked in accordance with Municipal/J.C.S.U.D. requirements.
3. The contractor shall proceed with paving no more than seventy-two (72) hours after density/moisture tests have been taken and passed by a registered testing firm. Copies of the test results shall be furnished to the municipality. In the event paving operations have not commenced within the seventy-two (72) hour limit, a retest shall be required at the contractor's expense.
4. Manhole rim elevations, clean-outs, valve boxes, fire hydrants, etc. shall be adjusted to finished grade by the paving contractor at the time of paving.
5. The paving contractor shall install a blue reflector in the street or fire lane centerline at the location of each fire hydrant.
6. The contractor shall prepare all traffic control plans and submit them to the municipality prior to the issuance of any construction permits for work within the municipality. The plan shall be prepared in accordance with the current edition of the Texas M.U.T.C.D and as modified by the TXDOT supplement to the M.U.T.C.D. The plan shall address the requirements for all signs, barricades, flagmen, lights, hours of construction, and other devices as necessary for safe traffic control.
7. The concrete sealant to be per the municipality's standards.
8. Any rebar stand-offs to be used to support the rebar street mat driven in the ground must be epoxy coated in slip form paving situations.

#### 5.5.2 Work in TxDOT ROW

1. The Texas Department of Transportation (TxDOT) must approve any work to be done on the State Highway right-of-way. An application and appropriate plans must be submitted to the municipality and the municipality will submit the application to TxDOT for review and approved by the municipality where the work will be performed.

#### 5.5.3 Utility Coordination

1. Existing utility locations shown are generally schematic in nature and may not accurately reflect the size and location of each utility. Existing utilities shown have been based on available record drawings and surface appurtenance field ties only. Some utility lines and surface locations may not be shown. The contractor shall assume responsibility for actual field locations and protection of existing utilities whether shown or not. The contractor shall also assume responsibility for repairs to existing utilities whether shown or not damaged by the contractor's activities. Differences in horizontal or vertical locations of existing utilities shall not be a basis for additional compensation to the contractor.
2. The location of underground facilities indicated on the plans is taken from public records. It is the contractor's sole responsibility to make arrangements with the owners of such underground facilities prior to working in the area to confirm their exact location and to determine whether any additional facilities other than those shown on the plans may be present. The contractor shall preserve and protect all underground facilities. If the existing underground utilities are damaged, the contractor will be responsible for the cost of repairing the utility.
3. Where existing utilities, service lines or irrigation lines are cut, broken or damaged, the contractor shall replace or repair the utilities, service lines or irrigation lines with the same type of original material and construction, or better, unless otherwise shown or noted on the plans, at his own cost and expense. The contractor shall immediately notify the Engineer at once of any conflicts in grades and alignments.
4. At a minimum, the contractor shall contact the following at least 48 hours prior to excavation:
  - TEXAS 811
  - Atmos Gas 972-881-4161
  - TXU Electric Delivery 1-800-711-9112
  - JCSUD (Water – Sanitary Sewer) 817-760-5200

#### 5.5.4 General Notes for Water Improvements

1. All water lines shall be PVC pipe conforming to AWWA standard C-900 SDR-18 minimum with NSF seal, pressure tested, and disinfected in accordance with municipal and/or NCTCOG STD. SPECS unless otherwise noted within the construction plans.
2. All water mains, unless otherwise noted, shall have a minimum cover of 42" below finished grade.
3. All water mains, unless otherwise noted, shall have a minimum of 2 FT separations at all utility crossings.

#### 5.5.5 General Notes for Sanitary Sewer Improvements

1. Sanitary Sewer PVC pipe shall be furnished and installed in accordance with J.C.S.U.D. requirements.
2. After completion of all sanitary sewer testing (I.E., Mandrel and Air) contractor shall perform a television inspection and provide a videotape to J.C.S.U.D. All manholes shall be vacuum tested.
3. One joint of 150-PSI pressure rated pipe shall be installed and centered under all proposed water pipe crossings.
4. Contractor to place a  $\frac{3}{4}$ " plywood false bottom in all sanitary sewer manholes before paving contractor begins work.
5. Any connection tie-in to an existing manhole must be cored.
6. All clean-outs are to be provided per municipal requirements.

#### 5.5.6 General Notes for Storm Drain Improvements

1. All storm sewer and culvert pipe and fittings shall be ASTM C76, Class III reinforced concrete pipe (RCP), installed with compressive type joints in accordance with NCTCOG Item 501.6.1.3.1 unless noted otherwise.
2. After completion of all storm sewer installation, the contractor shall ensure that all debris and siltation has been removed.
3. Concrete riprap is required for safety end treatments in public ROW.

4. Use Class H embedment/backfill for storm sewer pipe in accordance with NCTCOG Std. Drawing 3060, except that filter fabric is to be wrapped completely around the crushed stone embedment/backfill material.