

DESIGN MANUAL
for the
**APPROVAL AND ACCEPTANCE OF
INFRASTRUCTURE**



City of El Campo
315 E. Jackson St.
El Campo, TX 77437

Department of Public Works

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CHAPTER 1 - GENERAL AND PROCEDURE REQUIREMENTS

1.1 General Requirements

- 1.1.1 These Standards describe the general requirements for the preparation of construction plans and the supporting documents required for approval by the City of El Campo.
- 1.1.2 Construction plans for public improvements within the City of El Campo or extraterritorial jurisdiction will be reviewed by the Public Works Department, and approved by the City Manager.
- 1.1.3 Construction plans for private improvements that connect to or affect the public infrastructure should conform to Chapter 7 and be approved by the Buildings and Code Enforcement Department.
- 1.1.4 All construction plans and supporting documentation shall conform to the requirements of these Standards and regulations of all Federal, State, County, and Local entities having jurisdiction, including but not limited to:
 - A. Latest revision of the following City of El Campo Code of Ordinances:
 - Chapter 10 – Buildings and Building Regulations
 - Chapter 36 – Streets, Sidewalks and Other Public Places
 - Chapter 38 – Subdivisions and Property Development
 - Chapter 44 – Traffic and Vehicles
 - Chapter 46 – Utilities
 - Chapter 50 – Zoning
 - B. Texas Accessibility Standards (TAS) of the Architectural Barriers Act, Article 9102, Texas Civil Statutes.
 - C. Rules and Regulations published by Texas Commission on Environmental Quality (TCEQ).
 - (1) Water Supply Division, Rules and Regulations for Public Water Systems, latest revision.
 - (2) Design Criteria for Sewer Systems, Texas Administrative Code, latest revision.
 - (3) Storm Water Discharge, Texas Pollution Discharge Elimination System (TPDES), General Permit No. TXR150000
 - D. State of Texas Engineering Practice Act.
 - E. State of Texas Professional Land Surveying Practices Act.
 - F. Wharton County Drainage Criteria Manual
 - G. Texas Department of Transportation Manual on Uniform Traffic Control Devices

1.2 Preliminary Research

- 1.2.1 Public Works Department personnel will be available for preliminary meetings to discuss a

proposed project with the Design Engineer and/or developer. This preliminary meeting should be scheduled prior to submittal of any documents for review.

- 1.2.2 Research of all existing utility and right-of-way or easements for conflicts with the City, Wharton County, Texas Department of Transportation, Railroad companies, Pipeline companies, Power companies and other public and private utility agencies must be documented prior to submittal of any plans to the City.

1.3 Design Review Requirements for Public Improvement Projects

- 1.3.1 Projects involving construction of privately owned facilities require review and approval of any connection to a public water line, sanitary sewer, or storm sewer or to a public street, using the process defined in this manual.
- 1.3.2 Submit one (1) copy of construction plans and supporting documentation to the Department of Public Works for review. When plans are submitted that conform to these Standards, without a variance request, the plans will be returned within ten (10) working days from submittal. Information furnished must be in sufficient detail for the Department of Public Works to assess whether the design meets current City design standards.
- 1.3.3 After all comments have been adequately addressed, submit one (1) copy of the revised and final construction plans with the prints containing preliminary review comments to the Department of Public Works for approval by the City.
- 1.3.4 Submit two (2) copies of the original construction plans, two (2) copies reduced to eleven inches by seventeen inches (11" x 17"), and an electronic file copy (PDF format) to the Department of Public Works after the construction plans have been approved and signed.
- 1.3.5 All separate or special easements that may be required for construction must be recorded in the Wharton County Official Records prior to final approval of the construction plans.

1.4 Quality Assurance

- 1.4.1 All surveying and platting shall be performed under direction of a Professional Land Surveyor.
- 1.4.2 All final surveying and platting documents shall be sealed, signed, and dated by a Professional Land Surveyor.
- 1.4.3 All engineering calculations shall be prepared by or under the direct supervision of a Professional Engineer trained and licensed in disciplines required by the project scope.
- 1.4.4 All final design drawings shall be sealed, signed and dated by the Professional Engineer responsible for development of the drawings.

1.5 Construction Procedure Requirements for Public Improvement Projects

- 1.5.1 Construction cannot begin until construction plans are approved by the City and until plat approval, permits, licenses, etc. have been obtained.
- 1.5.2 Coordinate with the Department of Public Works for the pre-construction meeting for the project. Department staff must attend the pre-construction meeting.
- 1.5.3 Within thirty (30) days after completion of the project the Design Engineer must provide to the city one set of full size reproducible record drawings, an electronic file copy (PDF format) and an Auto CAD file (dwg).

1.5.4 Changes from approved plans must be approved by the City Manager prior to construction.

1.6 Approval and Acceptance of Public Improvement Projects

1.6.1 The construction of improvements must be conducted under the supervision of a licensed engineer who will ensure and certify that work is performed in accordance with the approved drawings.

1.6.2 Final approval by the City will be granted when the following items are complete:

- A. Subdivision plat and required right-of-way or easement instruments have been recorded in the Official Public Records of Wharton County.
- B. Construction is completed in accordance with the approved construction plans and final inspection items have been completed.
- C. All required information including record drawings are submitted to the Department of Public Works with the Design Engineer certifying the correctness of the record drawing and compliance of construction in accordance with these Standards.
- D. Appropriate improvement bonds are in place for the maintenance period. For public improvement projects within the City of El Campo, bonds in the amount of one hundred percent (100%) of the total project cost, including utilities, drainage and paving, must be provided in the name of the City of El Campo for one (1) year. A space on all applicable bonds shall be provided for the City of El Campo to sign off on the maintenance bond before releasing the Contractor.

1.7 Approvals and Variances

1.7.1 Approvals required in these Standards are the responsibility of the Owner. Failure to obtain appropriate approvals may be grounds for suspension of construction until appropriate approvals are granted. Items that do not conform to these Standards must be submitted for a variance request.

1.7.2 Materials and manufactured items used in construction of a Public Works project must be approved by the Department of Public Works prior to installation. Water and sanitary sewer system appurtenances must be included on the approved items as listed in the Approved Water Products List available from the Department of Public Works. Items not appearing on the approved list cannot be used for construction of public works facilities in the City of El Campo or the extraterritorial jurisdiction.

CHAPTER 2 - CONSTRUCTION PLAN AND MISCELLANEOUS REQUIREMENTS**2.1 Required Plan Sheets**

- 2.1.1 Cover sheet.
- 2.1.2 Final plat.
- 2.1.3 Construction notes.
- 2.1.4 Overall plans for proposed improvements; including but not limited to Water, Sanitary, Drainage Area and Calculations, Lot Grading, Pavement Plans (when applicable).
- 2.1.7 Plan and profiles detailing elevations of proposed improvements.
- 2.1.8 Specific construction details.

2.2 Drawing Requirements

- 2.2.1 The seal, date, and original signature of the Design Engineer responsible for preparation of the plans is required on each sheet.
- 2.2.2 A bench mark elevation and description is required on construction plans. Benchmarks shall be tied to the City's system of benchmarks.
- 2.2.3 Label each plan sheet as to street right-of-way widths, pavement widths and thickness, type of roadway materials, curbs, intersection radii, curve data, stationing, existing utilities type and location, etc.
- 2.2.4 Stationing must run from left to right except for short streets or lines originating from a major intersection where the full length can be shown on one sheet.
- 2.2.5 A north arrow is required on all sheets and should be oriented either upward or to the right.
- 2.2.6 Show all lot lines, property lines, rights-of-way lines, and easement lines.
- 2.2.7 A cover sheet is required for all projects involving three or more plan and profile sheets. All plan sheet numbers should be included on the cover sheet. A vicinity map should always be included to show the project location.
- 2.2.8 If a roadway exists where plans are being prepared to improve or construct new pavement or to construct a utility, this roadway should be labeled as to its existing width, type of surfacing, and base thickness.
- 2.2.9 Do not place match lines in intersections.
- 2.2.10 All utility lines four inches (4") in diameter or larger within the right-of-way or construction easement should be shown in the profile view with proposed elevations. All utility lines, regardless of size, should be shown in the plan view.
- 2.2.11 Show flow line elevations and direction of flow of all existing ditches.
- 2.2.12 Show natural ground profiles along the centerline of each right-of-way or easement line.
- 2.2.13 Plans should be prepared on 22" x 34" ANSI standard drawing sheets (preferred), or nominal

24" x 36" drawing sheets.

- 2.2.14 Plans must be drawn to accurate scale, showing proposed pavement typical cross-sections and details, lines and grades, and all existing topography within the street rights-of-way; and at intersections, the cross street shall be shown at sufficient distance in each direction along the cross street for designing adequate street crossings.
- 2.2.15 Grades should be labeled for the top of curb except at railroad crossings.
- 2.2.16 Curb return elevations and grades for turnouts shall be shown in the profile.
- 2.2.17 Station all points of curvature, points of tangency, radius returns and grade change, points of intersection.
- 2.2.18 The standard scales permitted for plans and profiles of paving and utility plans are as follow:
 - A. Major thoroughfares or special intersections/situations:
1" = 2' Vertical; 1" = 20' Horizontal
 - B. Minor streets:
1" = 5' Vertical; 1" = 50' Horizontal or 1" = 4' Vertical; 1" = 40' Horizontal
- 2.2.19 Include standard City details and construction notes, where applicable.
- 2.2.20 Construction plans should include a legend describing standard symbols.
- 2.2.21 All property ownership, easement, and Wharton County recording information should be shown in the construction plans.

2.3 Graphic Standards

The graphic standards for the City of El Campo are taken directly from the City of Houston's Infrastructure Design Manual, latest revision, "General Design Requirements for Sanitary Sewers, Storm Sewers, Water Lines, and Paving". These graphic standards are available online or at the office of the Department of Public Works.

2.4 Easement Requirements

- 2.4.1 Storm sewer, sanitary sewer, and water line easements must be dedicated for the specific intended use.
- 2.4.2 Public utility easement requirements for a 16 feet easement are as outlined in the "Typical Utility Location in 10-Foot Wide and 16-Foot Wide Easement Back-to-Back Lots and Perimeter Lots" drawing prepared by the Utility Coordinating Committee for Metropolitan Area, effective June 1, 1971. The public utility easement width for underground electric power distribution shall be 16 feet. Perimeter easement may be 8 feet by 8 feet, provided that the easement is dedicated by separate instrument or special notes on the plat.
- 2.4.3 Water line easements - the following minimum width easements are required when facilities are not located within public street rights-of-way:
 - A. When possible, easements should be contiguous with public rights-of-way. For water line located not adjacent to public rights-of-way should have a minimum water easement width equal to twice the water line diameter plus the depth of the water line from natural

ground or final ground elevation, whichever is greater; but not less than 15 feet on water line across open country (acreage) or commercial reserve.

- B. For water lines located outside of the public right-of-way:
 - (1) The easement should be contiguous to the street right-of-way.
 - (2) The minimum width of easement for lines 12 inches in diameter and smaller is 10 feet.
- C. For water lines located inside of public right-of-way, less than 5 feet from right-of-way lines, the outside edge of a water line easement is a minimum of 5 feet from the right-of-way line.
- D. Water lines along State rights-of-way must be installed outside of the right-of-way in a separate contiguous easement.
- E. No backlot easements will be allowed for the installation of water lines.
- F. Commercial developments inside the City and in the ETJ requiring on-site fire hydrants must provide a minimum 15 foot water line easement for the water lines and fire hydrants.
- G. The nearest outside diameter of any water line cannot be closer to a building line, building foundation or building slab than 10 feet for water lines 12 inches in diameter and smaller.
- H. When using side lot easements, such easements is a minimum of 15 feet in width, located on one lot or centered between two lots.

2.4.5 Sanitary Sewer Easements - the following minimum easement widths are required for the type of service:

- A. The width of all exclusive sanitary sewer easements is equal to the depth of the sewer from finished grade plus two (2) pipe diameters. Sewer should be located in the center of the easement. The minimum width of a sanitary easement is 15 feet.
- B. Exclusive sanitary sewer easement contiguous to a public right-of-way may be 10 feet wide provided the sewer is 7.5 feet from the edge of the easement and the sewer is no deeper than 15 feet. Sewers at greater depth than 15 feet should be placed within easements described above.
- C. Exclusive easements for force mains of all sizes have a minimum width easement of 15 feet for a single force main where the force main is not located adjacent to a public right-of-way.

2.4.6 Storm Sewer Easements - the following minimum easement widths are required:

- A. The minimum width should be 20 feet where the easement is not located adjacent to a public right-of-way with the storm sewer centered in an exclusive easement.
- B. A minimum distance of five feet must be maintained from the easement line to the outside edge of the storm sewer.
- C. Easements for storm water detention basins should be dedicated by plat or by separate instrument filed in conjunction with plat approval. Such easements must be dedicated to the developer, owner, or City. Such easements should have a minimum 30 foot width for

maintenance access surrounding the perimeter of the detention basin as measured from top of bank unless adjacent to a street right-of-way. If adjacent to a street right-of-way, the minimum width of maintenance access as measured from the top bank to the street right-of-way can be 15 feet.

- 2.4.7 Drainage/Floodway Easements - Drainage easements must be provided along all natural and man-made drainage channels and floodways, which drain two (2) or more lots or tracts of land, with sufficient width for the water course to handle the flow from the 100 year equivalent frequency storm plus a minimum 30-foot width for maintenance access on each side beyond top of bank, for clearance from fences, and for adequate slope maintenance necessary along the bank.

2.5 Utility Locations

- 2.5.1 The utility locations for back lot easements are outlined in the "Typical Utility Location in 10-Foot Wide and 16-Foot Wide Easement Back-to-Back Lots and Perimeter Lots" drawing prepared by the Utility Coordination Committee for Metropolitan Area effective June 1, 1971. A portion of the Utility Coordination Committee drawings are provided in Appendix B.
- 2.5.2 Water Main Location - Must be located within a public right-of-way or within dedicated water main easements.
- 2.5.3 Sanitary Sewer Location - Should be located within the right-of-way between the property line and the back of curb on the opposite side of the right-of-way from the water main.
- 2.5.4 Storm Sewers - All storm sewer lines should be located within public rights-of-way or approved easements. Placement of a storm sewer in side lot and back lot easements is discouraged. Specific approval of the City for the use of side lot or back lot easements for storm sewers should be obtained prior to plan preparation.

2.6 Private Facility Locations (Not Including Landscaping)

- 2.6.1 Installation of private facilities, including utilities, in public road rights-of-way and their adjoining easements must be approved by the City and cannot conflict with other public utilities or traffic visibility.

2.7 Crossings

- 2.7.1 Highway Crossings - All State and County Roads - A utility main must be encased in a steel pipe casing extending at least ten feet (10') from outside edge of each service road or outside edge of pavement, across the right-of-way to a similar location on the other side of the highway.
- 2.7.2 Street Crossings
- A. All water main and sprinkler line crossings under major thoroughfares should be constructed using a minimum Class 150, AWWA C900 Polyvinyl Chloride.
 - B. Conduits and sewers that do not carry liquid under pressure may be bored and jacked into place without a steel encasement pipe.
 - C. Crossings under existing concrete streets, other than major thoroughfares, should be constructed by boring and jacking.
 - D. All open cut installations under existing or proposed streets must be backfilled with

cement stabilized sand backfill conforming to requirements of Section 4.2.3.

- 2.7.3 Railroad and Pipeline Crossings - A utility main shall be encased in a steel pipe casing extending at least ten feet (10') from outside edge of railroad or pipeline right-of-way and must be coordinated and approved by owning entity.
- 2.7.4 Ditch and Stream Crossings
 - A. Crossing under a stream or ditch is preferred by the City. The top of the carrier pipe should be designed to provide a minimum clearance of at least 3 feet below the ultimate flow line and sides of the ditch and with sufficient bottom length to exceed the ultimate future ditch sections.
 - B. Separate, aerial, free-standing crossings across drainage ways are not allowed.
 - C. All stream or ditch crossings must be approved by the City.

2.8 Trench Safety

All construction within the City of El Campo and its extraterritorial jurisdiction must conform to the requirements of state and federal guidelines for trench safety. Adequate details for construction in accordance with applicable OSHA regulations will be required in all construction plans that are approved by the City of El Campo.

2.9 Street Lighting

- 2.9.1 The installation of street lighting is mandatory along all public streets in the City of El Campo. In addition, the installation of street lighting is strongly encouraged along existing or repaved streets.
- 2.9.2 The location of street lights will be designed by AEP Energy or Wharton County Electric Cooperative (WCEC) and approved by the City of El Campo.

2.10 Bench Mark

- 2.10.1 The bench mark elevation and location must be certified by a Texas Registered Professional Land Surveyor in accordance with the Texas Society of Professional Surveyors "Standards and Specifications" for Category 8, Condition II, TSPS Second Order Vertical Control Survey. All elevations will be based on the North American Vertical Datum of 1988 (NAVD 88).
- 2.10.2 The bench mark horizontal positions must be certified by a Texas Registered Professional Land Surveyors "Standards and Specifications" for Category 7, Condition II, Second Order Horizontal Control. All horizontal control will be based on the North American Datum of 1983 (NAD 83).
- 2.10.3 All bench mark locations must be provided with ties to existing monuments including coordinates using Texas State Plane Coordinate System, South Central Zone 4204 (NAD83), in grid format and provide scale factor to revert back to surface coordinates.
- 2.10.4 Proposed bench marks are constructed of a brass disc set in concrete as approved by the City. The concrete footing for the bench mark are eight inches (8") in diameter and three feet (3') deep. Concrete to be reinforced with two number four (2 - #4) rebar.
- 2.10.5 The construction plans must clearly identify the location of the bench mark and include a complete description, coordinates and elevation, with adjustment date, of the bench mark

and must be referenced on every layout and profile sheet.

- 2.10.6 If the site is located within a regulatory flood area, the bench mark information should include nearest base flood elevation and description of floodplain boundary, with reference to latest FEMA DFIRM Panel.

2.11 Residential Lots and Improvements

- 2.11.1 All residential lots must drain to a public right-of-way directly adjoining the lot. Drainage from a residential lot to a public right-of-way at the rear or side of a lot may be permitted provided the drainage system has been properly designed to accept the flow.
- 2.11.2 A lot grading plan showing proposed minimum slab elevations will be included in the construction plans. If slab elevations do not change, a notice of minimum elevation will suffice. The minimum slab elevations should be noted on the subdivision plat.

2.12 Flood Plain Management

- 2.12.1 All development must conform to the requirements of the National Flood Insurance Program, as required by the regulations of the local governing authority having jurisdiction.
- 2.12.2 Amendments to the published flood maps, map revisions and all requests for changes to the base flood elevation within the El Campo city limits must be submitted to the City of El Campo for approval. Technical data required by the Federal Emergency Management Agency (FEMA) and justification for the proposed change must be included with all requests. All fees associated with FEMA approval of said amendments will be paid by the party requesting the amendments.

2.13 Storm Water Pollution Prevention

- 2.13.1 All construction projects must conform to the requirements of the Texas Pollutant Discharge Elimination System (TPDES), General Permit No. TXR150000 or latest requirements set by the TCEQ.
- 2.13.2 Construction plans should include a storm water pollution prevention plan for review and approval detailing Best Management Practices (BMPs) to prevent or reduce the discharge of pollutants.

CHAPTER 3 - WATER SYSTEM DESIGN REQUIREMENTS

3.1 General

Water system design requirements are established based on standards in this section.

- 3.1.1 Construction and sizing of all water mains and appurtenances must meet or exceed the requirements of the Texas Commission on Environmental Quality (TCEQ). The TCEQ's Water Supply Division must review and approve engineering plans and specifications before construction begins for any project defined by TAC §290.39(j)(1)(D) as a significant change to the existing distribution system that would add more than 10% of the existing capacity or 250 connections, whichever is smaller.
- 3.1.2 The Public Water System does not extend beyond the water meter. All private construction beyond the meter should conform to the requirements of the codes and ordinances of the City.
- 3.1.3 Obtain approval from the Department of Public Works for exceptions or deviations from these requirements.

3.2 Water Main Sizing and Materials

- 3.2.1 Minimum size water mains as follows:
 - A. Pipe with 2-inch diameter is allowed only in rehabilitation projects where tie-ins to existing 2-inch lines are necessary.
 - B. Pipe with 4-inch diameter may be used within cul-de-sacs (permanent dead end) less than or equal to 200 feet in length and should be terminated with an automatic flushing device. Fire hydrants are not allowed on a four inch (4") main.
 - C. Six-inch (6") mains should be a maximum of one thousand five hundred feet (1,500') long when supported on both ends by eight-inch (8") mains or larger and have no more than three (3) intermediate fire hydrants. If unavoidable, dead end six-inch (6") mains should not be more than six hundred feet (600') in length and terminate at a fire hydrant. Six-inch (6") fire hydrant leads cannot exceed two hundred feet (200') in length.
 - D. Eight-inch (8") mains are required for mains over one thousand five hundred feet (1,500') long, or when more than three (3) intermediate fire hydrants are required. The maximum length of an eight-inch (8") main should be three thousand five hundred feet (3,500') and be terminated with a fire hydrant, or if approved by the Department of Public Works, an automatic flushing device.
 - E. Twelve-inch (12") and larger mains will be required at locations established by the Department of Public Works.
- 3.2.2 Water mains in commercial, industrial, and multi-family developments have a minimum sizing as follows:
 - A. Minimum size of main is eight-inch (8"). Maximum length of a dead-end eight-inch (8") main is be three hundred fifty feet (350'). A dead-end main should be terminated with fire hydrant, or is approved by the Department of Public Works, an automatic flushing device.
 - B. Twelve-inch (12") and larger mains will be required at locations established by the

Department of Public Works.

3.2.3 Dead-end lines within public right-of-way:

- A. In temporary dead end situations the water line should be 6-inch diameter or larger, should not exceed more than 200 feet in length from the closest interconnection water line, and terminated with an automatic flushing device.
- B. In permanent dead ends situations approved by the Department of Public Works, the water line should be 6-inch diameter or larger, should not exceed more than 500 feet in length from the closest interconnection water line and be terminated with an automatic flushing device.

3.2.4 Water lines within cul-de-sac:

- A. Reduce pipe sizes successively. Carry 8-inch and/or 6-inch and/or 4-inch diameter pipe in accordance with requirements found in paragraph 3.2.1. Place last service meter as near as possible to the end of water line.

3.2.5 Water mains must be constructed using the following materials:

- A. Poly Vinyl Chloride (PVC) Pressure Pipe, four-inch (4") through sixteen-inch (16"), shall conform to the requirements of ANSI/AWWA C900, current revision, Class 150 (or higher) DR 18. Pipe shall be designed and constructed in conformance with the minimum requirements of the "Manual of Water Supply Practices", AWWA Manual No. M23.
- B. Ductile-Iron Pipe (D.I.P.), four-inch (4") through fifty-four-inch (54"), conforming to the requirements of "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds for Sand-Lined Molds, for Water and Other Liquids", AWWA C151, (ANSI A21.51), current revision. Pipe thickness being the minimum specified in C151. Under special conditions, the Department of Public Works may require thickness design in conformance with the minimum requirements of "Thickness Design for Ductile- Iron Pipe", AWWA C150 (ANSI A21.51), current revision. Pipe shall be installed in conformance with the minimum requirements of AWWA C600, "Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances". Ductile-Iron Pipe shall be furnished with bituminous or cement mortar lining, AWWA C104 (ANSI A21.4). Polyethylene tube encasement shall be provided as required in Section 3.8.6 of these Standards.
- C. Steel Water Pipe, four-inch (4") and larger shall conform to the requirements of "Standard for Steel Water Pipe Six Inches and Larger", AWWA C200. Steel pipe, minimum wall thickness shall conform to the thickness shown on the City of El Campo Construction Details. All steel pipe shall have coal tar exterior coating in accordance with "Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape-Hot Applied", AWWA C203, liquid epoxy interior coating in accordance with "Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipelines", AWWA C210 and/or "Painting for Steel Water Storage Tanks" AWWA D102. All material used for internal coating of steel carrier pipe must be NSF61 listed as suitable for contact with potable water as required in Chapter 290, Rules and Regulations for Public Systems, TEXAS COMMISSION ON ENVIRONMENTAL QUALITY, latest revised.

3.2.5 Water mains and appurtenances are not allowed in the following sizes: three-inch (3"), ten-inch (10"), and fourteen-inch (14").

3.3 Location of Water Mains

- 3.3.1 Water mains should be placed along a uniform alignment with the right-of-way. When necessary, the water main may be deflected at a fire hydrant location to accommodate proper installation of the fire hydrant. At all locations where a water main changes alignment, the location of the water main should be clearly shown on the construction plans. A minimum distance of two feet (2') should be maintained from the right-of-way line to the outside edge of the water line.
- 3.3.2 When necessary, water mains may be located within the esplanade section of boulevard type streets. Mains should be located as near the centerline as possible to avoid conflicts with future pavement widening.
- 3.3.3 Along streets with open ditch drainage, all twelve-inch (12") and smaller water mains may be located five feet (5') from the right-of-way line.

3.4 Clearance of Water Lines from Other Utilities

Water mains are to be designed and located to conform to the regulations of the Texas Commission on Environmental Quality.

- 3.4.1 Proposed Water Lines Parallel to Gravity Sanitary Sewers and Force Mains: Locate water lines a minimum of 9 feet horizontally apart, measured from outside wall to outside wall, when parallel to gravity sanitary sewers and force mains. Use the following procedure when stated separation cannot be achieved:
 - A. The existing sanitary sewer shall be replaced with lined ductile iron pipe or PVC pipe meeting ASTM specifications, having a minimum working pressure rating of 150 psi or greater and equipped with pressure-type joints.
 - B. The water lines, gravity sanitary sewers, or force mains, shall be separated by a minimum vertical distance of 2 feet, and a minimum horizontal distance of 4 feet, measured between the nearest outside walls of the pipes. Locate 20-inch diameter and smaller water lines above gravity sewer lines.
 - C. Water line shall be constructed with approved restrained joints in an approved casing with at least two nominal sizes larger than the carrier pipe. The carrier pipe shall be supported at five-foot intervals with spacers or be filled to the spring line with washed sand.
- 3.4.2 Proposed Water Lines crossing gravity Sanitary Sewers and Force Mains. Conform to requirements of TAC §290.44 Paragraph (e).
 - A. No protection is required if the sanitary sewer is 9 feet below the water line.
 - B. For all other cases, use the following Table.

**PROTECTION REQUIREMENTS AT
WATER LINE (WL) - SANITARY SEWER (SS) CROSSINGS**

	PROPOSED WATER LINE				PROPOSED SANITARY SEWER			
	OVER		UNDER		OVER		UNDER	
	EXISTING SS	PROP SS	EXISTING SS	PROP SS	EXISTING WL	PROP WL	EXISTING WL	PROP WL
Minimum 2 feet vertical clearance	√ ¹	√ ¹	√	√	Not Allowed	√	√ ¹	√ ¹
Place 1 full section (min 18 ft) of WL centered at SS Crossing. Provide restrained joints on WL, spaced at least 9 ft horizontally from centerline of SS	√	√	√	√		√		√
Place 1 full section (min 18 ft) of SS centered at WL Crossing. Provide restrained joints on SS, spaced at least 9 ft horizontally from centerline of WL		√					√	√
Replace 1 full section of existing SS with pressure-rated DIP or pressure-rated PVC pipe with adapters and restrained joints centered at WL crossing	√ ^{2,3}		√ ³					
Provide DIP for small diameter WL (less than 24 inches), PVC pipe is only allowed if encased as per TAC § 290.44, and use restrained joints for both DIP and PVC pipe			√	√		√		
Embed SS with CSS for the total length of 1 pipe segment plus 1 foot beyond the joints on each end.	√ ^{2,3}	√ ⁴	√ ³	√ ⁴		√ ⁴	√ ⁴	√ ⁴
Place 1 full section (min 18 ft) of min 150 psi SS centered at WL crossing. Provide restrained joints on SS, spaced at least 9 ft horizontally from centerline of WL or encase in a joint of 150 psi pressure pipe (min 18 ft) two nominal sizes larger with spacers at 5 ft interval.				√		√		

1. Minimum clearance is 2 feet for non-pressure rated SS and 1 foot for pressure rated SS.
2. Required if existing SS is disturbed and /or there is evidence of leakage.
3. Not required for augered WL unless there is evidence of leakage; completely fill augered hole with bentonite/clay mixture.
4. Not required for augered SS; completely fill augered hole with bentonite/clay mixture.

Note:

- a. Both water lines and wastewater main or lateral must pass a pressure and leakage test as specified in AWWA C600 standards.
- b. Sanitary sewers (SS) is applicable to both gravity sanitary sewers and force mains.

- 3.4.3 Sanitary Sewer Manholes: Provide a minimum 9-foot clearance from outside wall of existing or proposed manholes unless manholes and connecting sewers can be made watertight and tested for no leakage.

3.5 Depth of Cover

Minimum depth of cover for water mains shall be as follows:

- 3.5.1 Twelve-inch (12") and smaller mains should have a minimum cover of four feet (4') from the top of curb. For open ditch roadway sections, twelve-inch (12") and smaller mains should be installed at least three feet (3') below the ultimate flow line of ditch or six feet (6') below natural ground at the right-of-way line, whichever is deeper.

3.6 Valves

3.6.1 All water system valves must conform to AWWA standards and be designed as follows:

- A. Two-inch (2") through sixteen-inch (16") valves shall be resilient seated gate valves, AWWA C509, counter-clockwise opening with mechanical joints. Valves must have a complete coating on all iron parts in the valve interior to eliminate corrosion.
- B. Cast iron valve boxes are required on all gate valves except as noted below. Valve vaults are required on all valves larger than sixteen-inch (16").
- C. All valves to be sized equal to the size of the main on which it is located.

3.6.2 Spacing - valves should be set at maximum distances along the main as follows:

- A. Four-inch (4") through and including twelve-inch (12") mains - one thousand feet (1,000').
- B. All main intersections must have a minimum of one (1) less valve than the number of mains at the intersection.

3.6.3 Location - valves shall be located as follows:

- A. All mains shall be valved within the street right-of-way. Valves shall not be placed under or within two feet (2') of ultimate pavement, except as specifically approved by the City.
- B. Valves are normally located on the projection of intersecting street right-of-way lines or at the curb return adjoining a paved street across the main. Tapping sleeves and valves are excluded from this requirement.
- C. All fire hydrants shall be isolated from the service main with a valve located in the fire hydrant lead.
- D. Intermediate valves not located on the projection of intersecting street right-of-way lines may be located at lot line projections or five feet (5') from fire hydrants.
- E. Valves shall be placed at the end of all mains that are to be extended in the future, and extend main a minimum of forty feet (40') past valve.

3.7 Fire Hydrants

- 3.7.1 Fire hydrants shall have three-way nozzle arrangement, five and one-quarter-inch (5-1/4") compression type main valve, mechanical joint boot, and conform to the requirements of AWWA C502. The pumper nozzle shall be four and one-half inch (4-1/2") NST and the hose nozzles shall be two and one-half-inch (2-1/2") NST threads. Fire hydrants shall be listed on the Approved Water Products List found online or at the office of the Director of Public Works.
- 3.7.2 Spacing - fire hydrants shall be spaced along all mains six inches (6") and larger as follows:
- A. A maximum of five hundred foot (500') spacing.
 - B. A maximum of three hundred foot (300') spacing in commercial and industrial developments.
- 3.7.3 Location - In or along street right-of-way; fire hydrants shall be located as follows:
- A. Fire hydrants should be set primarily at street intersections or near residential sidelots if needed.
 - B. Fire hydrants shall be located three feet (3') behind the back of curb or projected future curb and be set at the point of curvature (PC) of the intersection curb radius. A parallel tee may be used for a fire hydrant lead at the water main when specifically approved by the City.
 - C. On all State Highways and open-ditch roadways, set the fire hydrants within three feet (3') of the right-of-way.
 - D. All fire hydrants shall be located in protected, but easily accessible, areas behind the pavement.
- Outside and adjacent to street rights-of-way; fire hydrants shall be located as follows:
- A. The City Fire Marshall will establish and approve the location of fire hydrants in apartment complexes, platted private street developments, and other multi-family developments within the City.
 - B. For fire hydrants which are located adjacent to water lines for fire protection constructed in 10-foot wide water line easements, the fire hydrant shall be centered in a minimum 10-foot by 10-foot separate easement.
 - C. For commercial developments inside the City and ETJ, provide isolation valves at each end of fire loops requiring on-site fire hydrants.
- 3.7.4 Depth of Bury - the depth of bury for all fire hydrants shall be established such that the bury line on the fire hydrant is installed at the ground line at each location or at the finished ground after pavement construction is completed. The depth of bury for fire hydrants shall be shown on the construction plans. Minimum cover for fire hydrant leads shall be four feet (4').
- 3.7.5 Fire hydrants shall not be installed within nine feet (9') of a sanitary sewer system under any conditions.

- 3.7.6 Fire hydrants shall be color coded on the fire hydrant bonnet and caps. The color coded paint shall be as follows:

COLOR	Water Main Diameter (In.)
White	16"
Green	12"
Blue	10"
Orange	8"
Red	6"

The body of the fire hydrant will be painted red in accordance with specifications from the City of El Campo Fire Department.

3.8 Fittings and Appurtenances

- 3.8.1 Fittings shall be Ductile-Iron Compact Fittings Three-Inch (3") - Twelve-Inch (12"), AWWA C153/A21.53.84, conforming to the minimum requirements of "Gray-Iron and Ductile-Iron Fittings, Twelve-Inch (12") through Forty-Eight-Inch (48")", for Water and Other Liquids", AWWA C110 (ANSI 21.10), current revision. Fittings shall be furnished with bituminous or cement mortar lined, AWWA C104 (ANSI A21.4).
- 3.8.2 All fittings shall be identified and described on the construction plans.
- 3.8.3 Fittings are not permitted in fire hydrant leads, except as approved by the City.
- 3.8.4 All water main fittings shall have mechanical joints. Push on joints may be used at special locations if specifically approved by the City.
- 3.8.5 All plugs shall be provided with retention clamps.
- 3.8.6 Polyethylene tube encasement shall conform to the minimum requirements of "Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids", ANSI/AWWA C105, current revision. Soils within the project shall be tested in accordance with Appendix A of ANSI/AWWA C105 to adequately determine the requirements for encasement.
- 3.8.7 Concrete thrust blocks shall be required on all bends, tees, plugs and combinations thereof. Refer to the City of El Campo Construction Details for specifications.

3.9 Crossings

Installation of a water main across a proposed or existing highway, county road, public street, railroad, pipeline, or drainage way shall conform to the requirements of Section 2.7.

3.10 Water Meter Service

- 3.10.1. Water meter service for lines in or along street rights-of-way. Locate in areas with easy access and with protection from traffic and adjacent to rights-of-way whenever possible. Do not locate meters in areas enclosed by fences. Meters shall be located in public rights-of-way or water line easements.
- A. Where possible, locate domestic water meters at common lot lines and place two domestic meters on one service tap and 1-inch service lead. Meter, line size, and appurtenances shall conform to the latest edition of the Uniform Plumbing Code.
- B. Meters 2 inches and smaller and shut-off valves (stop boxes): Locate in rights-of-way,

water line easements, or in a minimum 5-foot by 5-foot separate water meter easement contiguous with public right-of-way. Provide concrete meter boxes for meters located under sidewalks.

- C. Meters 3 inches to 6 inches: Locate in minimum 10-foot by 20-foot separate water meter easement contiguous with public right-of-way.
 - D. Meters 8 inches and larger: Locate in minimum 15-foot by 25-foot separate water meter easement contiguous with public right-of-way.
 - E. All water meters must have the same size as of the service lines except 4-inch and 12-inch diameter service lines shall be installed for 3-inch and 10-inch water meters.
 - F. Meters larger than 6 inches for applications in potential hazardous chemical environs must be installed in an above ground meter installation assembly.
- 3.10.2. Water service lines shall be placed at a minimum depth of thirty-six inches (36") below final paving elevation. Service lines shall be installed as a part of all new single family development.
- 3.10.3. All water service fittings and appurtenances for all projects shall be approved by the City and shall be listed on the Approved Water Products List found online or at the office of the Department of Public Works.
- 3.10.4. City maintenance shall end at the water meter. The water meter box or vault shall be constructed to meet the City's requirements and will be maintained by the City.

3.11 Overall System Layout

- 3.11.1 Layout and size of all water mains shall be consistent with the overall layout of the existing water system. Layout of the overall system and of all water mains within the City's extraterritorial jurisdiction shall be approved by the City. The overall water system shall be designed to maintain adequate pressure throughout the system. In special cases, specific water pressure and flow analysis and study may be required.
- 3.11.2 The layout of the water mains should provide maximum circulation of water to prevent future problems of odor, taste, or color due to stagnant water. Some factors to be considered are as follows:
- A. Provide a source of fresh water at each end or at multiple points in a subdivision.
 - B. Provide adequate circulation and place valves and fire hydrants, so that flushing of all mains will be simplified.
 - C. Dead-ends should be avoided. All dead-ends should be isolated with a line valve, be as short as possible, and be terminated with an automatic flushing device.

3.12 Additional Standards

- 3.12.1 Construction Features - In conjunction with the design, the Design Engineer shall determine the extent of, and fully exemplify on the plans, all special construction features required to complete the project in a manner of safety, convenience, and economics.
- 3.12.2 Bore and Jack - Bore and jack sections shall be clearly shown on plans by location and footage. The following criteria are generally used as a basis for setting bore and jack sections.

- A. Public Streets - All public streets are to be bored and jacked regardless of surface. Bore and jack length shall be computed as roadway width at proposed bore plus five feet (5') to either side.
 - B. Driveways - Whenever it is cost effective, concrete driveways in good condition shall be bored and jacked. Bore and jack length shall be computed as driveway width at bore plus one foot (1') to either side. Where driveways cross culvert pipe sections along open ditch streets and the proposed water main is in close proximity and parallel to the culvert pipe, the length of bore shall be the same as the length of culvert pipe.
 - C. Sidewalks - When the water line crosses under a sidewalk four feet (4') or more in width and in good condition, the sidewalk shall either be bored and jacked or the sidewalk shall be removed and replaced to the City of El Campo criteria, whenever it is cost effective. Bore and jack length shall be at least the width of the sidewalk. The proposed type of construction shall be noted on the plans.
 - D. Trees - When saving trees and shrubs are a consideration, all trees six inches (6") and larger in diameter within ten feet (10') of the centerline of the water main must be noted on the plans. The water main should be bored and jacked within the drip line of any tree larger than six inches (6") in diameter.
 - E. Bore Pits - Bore pits shall be at least three feet (3') from back of curb and five feet (5') from back of curb on a major thoroughfare. Bore pits in highway, county road, or railroad right-of-way shall conform to these requirements and to the requirements of the crossing permit and/or use agreement. All bore pits shall be shored in accordance with OSHA requirements. Bore pits and/or receiving pits to be located in street or driveway paving, shall be shown on plans.
- 3.12.3 Open Cuts - Where open cuts are required in street paving, plans should call for steel plate covers to be installed and maintained over the cut during periods when contractor is not actively engaged in work at the site. Streets that are open cut shall be "saw cut".
- 3.12.4 All existing developed areas shall be restored to original condition after construction.
- 3.12.5 Proper barricading and signage, conforming to the Texas Manual of Uniform Traffic Control Devices, must be required on all projects. Adequate signage for vehicular and pedestrian traffic will be installed.

CHAPTER 4 - SANITARY SEWER DESIGN REQUIREMENTS

4.1 General

- 4.1.1 Sanitary sewers within the City of El Campo's jurisdiction shall allow for orderly expansion of the system.
- 4.1.2 Sewers shall be sized to the minimum requirements set out in this standard and the standard wastewater flow rates as established by the City of El Campo.
- 4.1.3 All sewers shall conform to the minimum requirements of the Texas Commission on Environmental Quality, "Design Criteria for Sewerage Systems".
- 4.1.4 Sewers shall be separated from water lines by a minimum of nine feet (9'). Where the minimum separation is not maintained, refer to Section 3.4 for allowable clearances.
- 4.1.5 The public sanitary sewer, as maintained by the City of El Campo, shall be defined as all sewers, including stacks and service leads, which serve more than one sewer connection, that are located in public easements or street rights-of-way, and that are installed in accordance with these Standards.
- 4.1.6 This Chapter addresses the design of the wastewater collection systems within the public Right-of-Way or a dedicated public easement. Sanitary sewers located on private property that are not in such a dedicated easement, are under the jurisdiction of the Plumbing Code, and will be reviewed by the Inspections Department.
- 4.1.7 Public sewers and force mains shall be located in either the public Right-of-Way or easements. Side lot easements may be used only with special approval. Back lot easements shall not be utilized except in the case of preexisting conditions or as approved by the Department of Public Works.
- 4.1.8 There shall be no closed-end easements for public sanitary sewers and force mains.
- 4.1.9 Manholes located within the 100-year floodplain shall be sealed and vented per TCEQ requirements Engineering judgment and aesthetics should be considered.
- 4.1.10 Manholes located within driveways shall be sealed and vented per TCEQ requirements.
- 4.1.11 New manholes shall not be located within ditches, swales, unless approved by the City.
- 4.1.12 Wastewater lines along State Right-of-Way shall be installed outside of the right-of-way in a separate contiguous easement; width of easement shall be as provided in Chapter 2.

4.2 Sewer Size and Materials

- 4.2.1 Minimum design criteria for determining the size of a sewer shall be as follows:
 - A. Wastewater flows shall be based on the current projected requirements for the area. The average day flow for the design of sanitary sewers shall be based on a minimum of three hundred fifty (350) gallons per day per single family connection for residential areas. Commercial, industrial, and office areas shall be designed for an average day flow that can be anticipated from the contributing area.
 - B. The peak design flow for sewers shall be four (4) times the average day flow of the fully developed service area. Sewers larger than eighteen-inch (18") may be sized using a

peaking factor of less than four (4) with approval of the City. The minimum allowable values for the design peak factor are presented in Appendix C of these Standards.

- C. Minimum size public sewer shall be eight-inch (8").
 - D. Service leads 6-inches in diameter shall not serve more than the equivalent of 2 single-family lots or other types of small land tracts.
 - E. Service leads of 6-inch and 8-inch diameter for single-family residential lots shall have a minimum grade of 0.70 percent and 0.44 percent respectfully.
 - F. Commercial sewer service lead shall be six-inch (6") pipe or larger and shall not serve more than one (1) commercial connection.
 - G. Sewer lines shall be laid at a size and depth to conform to designs permitting an orderly expansion of the sewer system of the City and so as to avoid a duplication of lines in the future.
 - H. The City shall be the final judge as to size and depth required and any exception to service leads as previously defined.
- 4.2.2 Sewers will be constructed of materials specified in the City of El Campo Approved Product List.
- 4.2.3 Cement Stabilized Sand for Bedding and Backfill:
- A. Portland Cement, Type I, ASTM C150.
 - B. Clean, durable sand, with less than 0.5 percent clay lumps, ASTM C142; with less than 0.5 percent lightweight pieces, ASTM C123; with organic impurities, ASTM C40, not showing a color darker than standard color and a plasticity index of less than six (6) when tested in accordance with ASTM D423 and ASTM D424.
 - C. Compact to ninety-five percent (95%) Standard Proctor Density (ASTM D698) in lifts of eight inches (8") thick. Actual testing may be required as deemed necessary by the City.
 - D. The cement-sand mixture shall consist of at least one and one-half (1-1/2) sacks of cement per cubic yard of sand. The cement-sand mixture shall have a minimum unconfined compressive strength of one hundred pounds per square inch (100 psi) in forty-eight (48) hours, when compacted to ninety-five percent (95%) of Standard Proctor Density (ASTM D698), without additional moisture control, cured and tested in accordance with ASTM C31, and placed to the spring line on sewer lines shallower than 8-feet and 6-inches over pipe for sewer lines 8-feet deep or greater, prior to backfilling the trench. In water bearing sands, crushed shell or other approved granular material will be required with geotextile fabric wrap. When water bearing sands are encountered, the City shall be notified immediately.

4.3 Sewer Depth

- 4.3.1 The depth and location of a sanitary sewer line shall be as follows:
- A. Sanitary sewers with a maximum depth of ten feet (10'), measured from finished grade, shall be placed within the right-of-way at least five feet (5') from the right-of-way line, except as provided herein. All sewers that are deeper than ten feet (10') shall be located in an easement parallel and adjoining the right-of-way. Where required in accordance

with Section 2.4.5, additional easement shall be provided adjoining the right-of-way to provide required clearances.

- B. Sewer line shall be laid with the top of the pipe a minimum of 4-feet below the surface of the natural ground.
- C. Where the minimum cover as specified above is not possible, the sewer shall be laid with Class 150 (150 psi) pressure pipe with cement-stabilized sand backfill as shown in Standard Details.
- D. Maximum depth for 8-inch, through 12-inch diameter collection lines shall be 20-feet from average ground surface of the trench width to pipe invert. Depths greater than 20-feet are subject to approval by the Department of Public Works if justified for site-specific reasons during the preliminary engineering phase of the project design.

4.3.2 Easements: Sanitary sewers placed in easements shall conform to the requirements of Section 2.4.5.

4.4 Sewer Grades

- A. The following table lists the minimum grades for 6-inch to 27-inch diameter public sewers. (6-in. diameter is for service leads only). The minimum grade is based on a minimum full pipe velocity of 2.3 feet per second (fps). The maximum grade is based on a maximum full pipe velocity of 4.5 fps. In both cases, the Manning Formula has been used with an n coefficient of 0.013. The use of different pipe materials will not alter the use of 0.013 for the purposes of the Design Manual. Where sewers are anticipated to flow less than one-half full, consideration should be given to increasing the slope of sewer to provide two feet (2') per second velocity in the pipe for the anticipated flow rate.

NOMINAL INTERNAL PIPE DIAMETER (INCHES)	MINIMUM GRADE TO DEVELOP V= 2.3 FPS (PERCENT)	MAXIMUM GRADE TO DEVELOP V=4.5 FPS (PERCENT)
6	0.70	2.46
8	0.44	1.73
10	0.33	1.21
12	0.26	0.97
15	0.19	0.72
18	0.15	0.57
21	0.13	0.46
24	0.11	0.38
27	0.09	0.33

- B. Slopes below minimum grade may be allowed with specific approval of the City.
- C. Sewers are to be designed so that the crowns of the pipes are matched at manholes. The upstream sewer may be designed so that the flow line of the upstream sewer is higher than the flow line of the downstream sewer. When the flow line of the upstream sewer is raised more than three feet (3') above the flow line of the downstream sewer, a drop manhole connection is required, except as specifically approved by the City.

4.5 Alignment

Gravity sewers shall be laid in straight alignment with uniform grade between manholes. Deviations from straight alignment shall be justified by complying with the TCEQ requirements and approved by the City. Deviations from uniform grade without manholes shall not be allowed.

4.6 Appurtenances

4.6.1 Manholes

- A. Manholes should be placed at points of changes in, grade, or size of sewers, at the intersection of sewers and at the end of all sewers (clean-outs will not be permitted).
- B. Manholes should be spaced at a maximum distance of four hundred feet (400') apart.
- C. The elevation of the crown of the discharging sewer shall either match the elevation of the crown of the receiving sewer or be approved as a special case by the City.
- D. Sewers laid in easements shall have a manhole in each street crossing.
- E. Manholes should be located to eliminate the inflow of storm water into the sanitary sewer.
- F. Manholes shall be constructed in accordance with the City of El Campo Standard Details.
- G. A drop manhole should be constructed for any sewer twelve-inches (12") in diameter or less that enters a manhole of greater than thirty-six inches (36") above the invert of the manhole. Sewers larger than twelve inches (12") shall be designed to accommodate a drop at the manhole using standard pipe fittings.
- H. Steps in manholes will not be permitted.
- I. Fiberglass manholes with precast, gasketed, concrete bottoms shall be required for manholes that are less than eight feet (8') deep and are located within an easement, upon specific approval by the city. Unless approved by the Department of Public Works, all other manholes shall be pre-cast or poured in place.
- J. Manhole covers shall be cast iron, traffic bearing type ring and cover with the words "Sanitary Sewer" and if within the City, the words "City of El Campo" cast into the cover.
- K. All manhole covers shall be minimum 32-inch diameter.

4.6.2 Stacks: Stacks shall be constructed for connections to sewers that are more than eight feet (8') below finished grade. Stacks shall be provided during the initial construction of the sewer.

4.6.3 Lift Stations

Lift stations shall be designed in conformance with the "Texas Commission on Environmental Quality Design Criteria for Sewerage Systems". Lift stations should be considered only when a gravity system cannot be achieved. All lift stations shall be specifically approved by the City. The Design Engineer shall provide design requirements and pertinent data with construction plans for review. A preliminary design meeting with the Department of Public Works is recommended. Lift stations shall be designed as follows:

- A. Pumps shall be sized to operate at optimum efficiency. Minimum acceptable efficiency

at the operating point will be sixty percent (60%), unless specifically approved by the City.

- B. Operation and maintenance should be considered in the design of the station and the location of the station.
- C. Wet well working volume should size to allow for the recommended pump cycle time of fifteen (15) minutes for each pump.
- D. Controls and equipment shall be approved by the City.
- E. Emergency operations should be considered. Provide fittings and a blind flange that will be readily accessible for emergency bypass pumping.

4.7 Service Connections

- 4.7.1 Sewer service leads shall not exceed 100 feet in length.
- 4.7.2 Single-Family Residential Lots, Multi-Family Residential, Commercial, and Office Development
 - A. All service connections shall be installed at the time of construction of the sewer.
 - B. Service connections shall be constructed of materials as described in Section 4.2.2.
 - C. Service connections should be installed at a manhole, when possible.
- 4.7.3 Service Connections at Manholes
 - A. Service connections at manhole should be made when possible. When a service connection stub-out is not provided, an opening shall be neatly cut out of the manhole at the required elevation. The service connection shall be extended into the manhole
 - B. Service connection at a concrete manhole shall be grouted in place using non- shrink grout. When a hole for a service connection in a brick manhole exceeds 18 inches, the manhole shall be rebuilt above the disturbed area.
 - C. Service connections at fiberglass manholes shall be drilled, uniformly, through the manhole wall. A neoprene gasket shall be installed around the pipe to provide a water-tight seal through the wall. Where required, fiberglass matte and resin shall be used, in accordance with the manufacturer's recommendations, to repair wall openings.
 - D. Service connections entering a manhole 3 feet or more above the flow line of the manhole shall include a drop pipe with fittings outside the manhole. The drop shall be installed adjoining and anchored to the wall of the manhole, unless specifically approved otherwise.
- 4.7.4 Provide adequate markings on site and accurate as built locations, so that the service connection stub-out can be recovered at the time that the connection to the service is made.
- 4.7.5 All connections to the public sewer system shall be approved by the Department of Public Works prior to construction. Actual connections to the public sewer system within the City Limits shall be inspected by a representative of the City.
- 4.7.6 Service connections that are installed after initial construction of a sewer shall be constructed using a P.V.C. saddle with gasket and stainless steel straps as approved by the City.

4.8 Unsewered Building Site

- 4.8.1 Sanitary sewer shall be extended to all building sites prior to development. Septic systems are not allowed, except as specifically approved by the City.

4.9 Testing Installed Pipe

- A. An infiltration, exfiltration or low pressure air test shall be performed. All tests shall be in accordance with the TEXAS COMMISSION ON ENVIRONMENTAL QUALITY Design Criteria for Sewage Systems and ASTM C828, C924, F141, or other appropriate procedures. Testing times are outlined in the TEXAS COMMISSION ON ENVIRONMENTAL QUALITY design criteria.
- B. Deflection testing shall be performed on all flexible pipes. The test shall be conducted after the final backfill has been in place at least thirty (30) days. Testing shall be done in accordance with the TEXAS COMMISSION ON ENVIRONMENTAL QUALITY Design Criteria for Sewerage Systems. The mandrel must move freely inside the pipe and will be pulled by hand from the upstream end of the pipe to the downstream end. Test equipment shall conform to the requirements set out in Appendix D. A second mandrel test, after settlement has occurred, may be required by the City to determine long term deflections. Deflections in flexible pipe shall not exceed five percent (5%).

CHAPTER 5 – STORMWATER DESIGN REQUIREMENTS

5.1 General

5.1.1 Drainage Principles and Policy

- A. Drainage criteria administered by the City of El Campo and complemented by Wharton County for newly designed areas provide protection from Structural Flooding from a 100-year storm event. This is accomplished through application of various drainage enhancements, such as storm sewers, roadside ditches, open channels, detention and overland (sheet) run-off.
- B. Recognizing that each site has unique differences that can enhance the opportunity to provide proper drainage, the intent of these criteria is to specify minimum requirements that can be modified provided that the objective for drainage standards is maintained. For projects which require a site specific approach and where unique engineering solutions will achieve drainage objective, a request for consideration of alternative standards (pipe flow, overland sheet flow, and detention storage) shall be submitted to the Department of Public Works for review and approval.
- C. Street Drainage: Street ponding of short duration is anticipated and designed to contribute to the overall drainage capability of the system. Storm sewers and roadside ditch conduits are designed as a balance of capacity and economics. These conduits are designed to convey less intense, more frequent rainfalls with the intent of allowing for traffic movement during these events. When rainfall events exceed the capacity of the storm sewer system, the additional run-off is intended to be stored or conveyed overland in a manner that reduces the threat of flooding to structures.
- D. Overland Run-off: Proposed New Development, Redevelopment, or In-fill Development shall not adversely impact existing overland flow patterns and shall not increase or redirect existing sheet flow to adjacent private or public property. Sheet flow from the developed property shall discharge only to the abutting public right-of-way or drainage easement. Where the existing sheet flow pattern is blocked by construction (i.e. raising the site elevation) of the Development, the sheet flow shall be re-routed within the developed property to return flow to original configuration or to the public right-of-way. Except under special circumstances dictated by natural drainage patterns, no sheet flow from the developed property will be allowed to drain onto adjacent private property.
- E. Flood Control: The City of El Campo recognizes and is seeking participation with the National Flood Insurance Program (NFIP). The flood insurance program makes insurance available at low cost where the municipal entity implements measures that reduce the likelihood of Structural Flooding. The design criteria in this chapter are provided to support the NFIP. All development shall comply with Chapter 10, BUILDINGS AND BUILDING REGULATIONS, of the Code of Ordinances if located within the City limits or Extraterritorial Jurisdiction (ETJ).
- F. Relationship to the Platting Process: Approval of storm drainage is a part of the review process for planning and platting of a New Development. Review and approval of plats is conducted by the Building Code Enforcement Department. Review of storm drainage is conducted by the Department of Public Works.
- G. The criteria in this Chapter apply to all projects located in the City limits and the City's Extraterritorial Jurisdiction (ETJ). If the criteria conflicts with Wharton County, or other jurisdictions the most restrictive criteria shall govern.

- 5.1.2 All storm sewers shall meet or exceed the requirements of the City of El Campo and the requirements of the "Drainage Criteria Manual for Wharton County, Texas".
- 5.1.3 All drainage systems that are to become a maintenance responsibility of the City of El Campo shall be enclosed storm sewers, except as specifically approved by the Director of Public Works.
- 5.1.4 All drainage systems shall take into account any storm drainage from multi-phased subdivision or project areas planned to contribute to the system. No existing system shall have flows added (or directed to it) that will exceed its theoretical design capacity.
- 5.1.5 Public storm sewers are defined as sewers and appurtenances that provide drainage for a public right-of-way or easement. Private storm sewers provide internal drainage for a reserve or other tract. Private storm sewer connections to public storm sewers shall occur at a manhole or at the back of an inlet as approved by the City.
- 5.1.6 All new construction shall convey public or private drainage to an inlet prior to entering the public drainage system.
- 5.1.7 All construction shall conform to the City of El Campo Standard Details.

5.2 Storm Sewer Materials for Public Drainage System

- 5.2.1 Storm sewer and culvert pipe shall be precast reinforced concrete pipe, unless specifically approved by the City. Concrete pipe shall be manufactured in conformance with the requirements of ASTM C 76, "Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe", current revision. Reinforced concrete pipe shall be Class III or stronger. The Design Engineer shall provide for increased pipe strength when conditions of the proposed installation exceed the allowable load for Class III pipe. All concrete pipe constructed in water bearing soil or forty-two inches (42") in diameter or larger, shall have rubber gasket joints meeting the requirements of ANSI/ASTM C 443, "Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets", current revision. Concrete pipe with a diameter of less than forty-two inches (42") may be installed using pipe with tongue and groove type joint and Ram-neck, or approved equal, as joint filler. When specifically approved by the City, reinforced concrete arch and elliptical pipe conforming to ASTM C506 and C507, respectively, current revision may be installed in lieu of circular pipe. Reinforced concrete box culverts shall meet the minimum requirements of ASTM C789, "Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers", current revision.
- 5.2.2 Storm sewer outfalls into open channels shall be constructed using polymer coated corrugated steel pipe. Polymer coated corrugated steel pipe shall be manufactured in conformance with the requirements of AASHTO M245 and M246, current revision. Polymer coating shall be both inside and outside of pipe, with a minimum thickness of 10 mil. Pipe joints and fittings shall meet the minimum requirements of these specifications and shall have an O-ring gasket seal meeting the requirements of AASHTO C-361, current revision.
- 5.2.3 Storm sewer outfalls shall have slope protection to prevent erosion. Slope protection may be constructed of slope paving or rip rap. Slope paving shall be four-inch (4") five (5) sack concrete with six-inch by six-inch (6" X 6") welded wire mesh (W3 X W3) or three-eighths-inch (3/8") steel rebar on twenty-four-inch (24") centers, each way. Rip rap shall be a minimum of six-inch (6") broken concrete rubble with no exposed steel or well-rounded stone and shall be a minimum of eighteen inches (18") thick. Slope protection texturing shall be required where public access is likely.

5.3 Construction Plan Requirements

- 5.3.1 A drainage area map and proposed drainage characteristics shall be included in the construction plans. The drainage area map shall include:
 - A. Existing Contours.
 - B. Drainage areas, including areas draining from off-site onto or adjoining the project.
 - C. Flow quantities draining to each inlet and pipe segment from manhole to manhole.
 - D. Delineate extreme event (100-year) sheet flow direction to the primary drainage outlet.
 - E. Elevation and location of maximum 100-year ponding elevation.
- 5.3.2 Detailed drainage calculations for the 2-year and 100-year Hydraulic Grade Line of each line or ditch, and for detention facilities, if any, shall be submitted with the construction plans.
- 5.3.3 The drawing(s) shall include a profile of the roadway from the upper reach of the drainage area to the primary drainage outlet. The drawing(s) shall be exaggerated vertical scale and shall include roadway profile at the gutter, ground profile at the right-of-way, and the hydraulic gradient for the 2-year and 100-year design storm.
- 5.3.4 Elevations for the 10-year, 25-year and 100-year storms in the outfall channel at the proposed outfall location shall be shown on the profile drawing.
- 5.3.5 If project lies below the base flood level, the flood plain must be delineated graphically on all plan sheets.
- 5.3.6 Benchmark description shall include nearest base flood elevation with reference to latest FEMA DFIRM Panel if the site is within a regulatory flood hazard area.

5.4 Design Requirements for Closed Conduits

- 5.4.1 Design Storm Runoff: shall be calculated in accordance with the "Drainage Criteria Manual for Wharton County, Texas".
- 5.4.2 Storm sewers shall be designed using the Manning Equation in combination with Continuity Equation.
- 5.4.3 Design Considerations of Overland Flow: The parameters stated below are independent measures that shall be evaluated for each project. The limiting parameter will depend on project-specific conditions, and the most restrictive condition shall govern.
 - A. The design frequency for consideration of overland sheet flow will consider extreme storm events, 100-year design frequency. The events which exceed the capacity of the underground storm sewer and result in ponding and overland sheet flow, shall be routed to drain along street right-of-way or open areas and through the development to a primary outlet.
 - B. Streets shall be designed so that consecutive high points in the street will provide for a gravity flow of drainage to the ultimate outlet.
 - C. The maximum depth of ponding at low points shall be 18 inches above the gutter line. This condition shall not be higher than the natural ground elevation at the right-of-way

line.

- D. Provide a minimum 20-foot easement to accommodate sheet flow that is routed between lots or across reserve tracts in accordance with Chapter 2.4.6 of the City of Infrastructure Design Manual. Fence lines and other improvements are prohibited from extending across dedicated drainage easements.
- E. In areas where ponding occurs and no Sheet Flow path exists, then a calculation shall be provided showing that run-off from the 100-year event can be conveyed within an underground conduit and remain in compliance with the other requirements of this paragraph.
- F. Maximum Ponding Elevation
 - (1) The maximum ponding elevation for the 100-year event at any point along the street shall not be higher than the natural ground elevation at the right-of-way line. Where existing topographic conditions, project location within a special flood hazard area, and/or other site conditions preclude achieving this objective, the City will waive this requirement upon submittal of documentation and analysis prepared, signed, and sealed by a professional engineer, registered in the State of Texas. Analysis shall demonstrate that structural flooding will not occur.
 - (2) For new subdivisions along local or collector street, the maximum allowable ponding elevation for the 100-year event shall be the lowest of the following: 12 inches below the lowest proposed finished slab elevation or 18 inches above the gutter line. The maximum ponding elevation for the 100-year event at any point along the street shall not be higher than the natural ground elevation at the right-of-way line. The maximum allowable ponding elevation along a major thoroughfare is the lowest of the following: 12 inches below the lowest proposed finished slab elevation or 6 inches above the gutter line (low side).
- G. All structures shall be higher than the highest level of ponding anticipated resulting from the extreme event analysis.

5.4.4 Design Frequency:

- A. New Development: The 2-year rainfall and 100-year rainfall design storm event shall be evaluated for sizing storm sewers in newly developed areas.
- B. Redevelopment or In-fill Development with Increased Rate of Runoff: The existing storm drain (sewer, ditch) will be evaluated using the 2-year and 100-yr design storm, assuming no development takes place. The storm drain will then be evaluated for the 2-year and 100-yr design event with the Development in place.
 - (1) If the proposed Development results in the hydraulic gradient of the existing storm drain below the gutter line and no structures are threatened by the project, then no improvements to the existing storm drain are required.
 - (2) If the 100-year rainfall indicates that structures are threatened by flooding, the applicant has the option of either making improvements to the existing storm sewer drain, providing detention or improving the receiving stream and not impacting downstream conditions. Detention and flow discharged to the storm drain shall be in compliance with Paragraph 5.7.

5.4.5 Velocity Considerations

- A. Storm sewers should be constructed to flow in subcritical hydraulic conditions if possible.
- B. Minimum velocities should not be less than 3 feet per second with the pipe flowing full, under the design conditions. Manning's formula should be used to compute the size of the storm sewer. Manning's coefficient, n , is 0.013 for concrete pipe and 0.024 for corrugated metal pipe.
- C. Maximum velocities should not exceed 8 feet per second without use of energy dissipation downstream.
- D. Maximum velocities should not exceed 12 feet per second.

5.4.6 Hydraulic Requirements.

- A. The 2-year storm event hydraulic gradient shall be calculated throughout the conduit system assuming the top of the outfall pipe as the starting water surface. The hydraulic gradient shall at all times be below the gutter line.
- B. At drops in pipe invert, should the upstream pipe be higher than the hydraulic grade line, then the hydraulic grade line shall be recalculated assuming the starting water surface to be at the top of pipe at that point.
- C. The 100-year storm event hydraulic gradient shall be calculated from the 25-year water surface elevation of the receiving outfall channel or top of the outfall pipe as the starting water surface, the most restrictive starting water surface shall govern.
- D. The 100-year storm event hydraulic gradient should be calculated throughout the conduit system. Maximum allowable hydraulic gradient elevation at any inlet location shall conform to requirements of 5.4.3.F.
- E. Drainage calculations, along with 2-year and 100-year water surface or hydraulic grade line profiles shall be included on the plans and submitted to the Department of Public Works for approval.

5.4.7 Pipe Sizes and Placement

- A. Public storm sewers shall be located within a public street right-of-way or a storm sewer easement, dedicated to the public and adjoining a public street right-of-way. Back lot easements are discouraged and will require a variance from the City design standards.
- B. Use storm sewer and inlet leads with at least 24-inch inside diameter or equivalent cross section. Box culverts shall be at least 2 feet by 2 feet.
- C. Larger pipes upstream should not flow into smaller pipes downstream unless construction constraints prohibit the use of a larger pipe downstream, or the improvements are outfalling into an existing system, or the upstream system is intended for use in detention.
- D. Match crowns of pipe at any size change at manholes unless severe depth constraints prohibit.
- E. Minimum depth of a storm sewer (measured to the top of pipe) shall be twenty-four inches (24") below top of curb or finished grade, whichever is lower. Minimum size storm sewer for main and inlet lead shall be twenty-four inch (24").

- G. Storm sewers shall be bedded using cement stabilized sand or approved granular materials (See specification in Section 4.2.3.).
- H. Storm sewers shall have a minimum clearance of six inches (6") from all other utilities. The clearance shall be measured from the outside wall of the pipe.
- I. Minimum acceptable slopes in reinforced concrete pipe storm sewers shall be:

PIPE DIAMETER (INCHES)	MINIMUM SLOPE (%)
24	0.180
30	0.130
36	0.100
42	0.080
48	0.070
54	0.060
60	0.050
66	0.045
72	0.040

5.4.8 Manholes

- A. Manholes shall be placed at all:
 - (1) Size or cross section changes.
 - (2) Inlet lead and conduit intersections.
 - (3) Change on pipe grade.
 - (4) Street intersections.
 - (5) A maximum spacing of 600-feet measured along the conduit run.
- B. Do not place manholes in driveways or in the street in front of or immediately adjacent to a driveway
- C. Manhole covers shall be cast iron, traffic bearing, type ring and cover with the words "Storm Sewer", and if within the City, "City of El Campo" cast into the cover.
- D. All manhole covers shall be minimum 32-inch diameter.

5.4.9 Inlets

- A. Locate inlets at low points in the gutter. In no case shall inlets be placed in the curved portion of curbs connection intersecting streets.
- B. Where storm sewer is collected on one side of the street and must be conveyed to the other side, it shall be accomplished via inlet and underground conduit.
- C. Valley gutters across intersections are not permitted.
- D. Curb inlets shall be spaced and sized to intercept the calculated runoff. Minimum inlet

capacity for residential subdivisions shall be 5 cubic-feet per second.

- E. Inlet spacing is a function of gutter slope. The minimum gutter slope shall comply with Chapter 6, Street Paving Design Requirements. For minimum gutter slopes, the maximum spacing of inlets shall result from a gutter run of 350 feet from high point in pavement or the adjacent inlet on a continuously graded street section, with a maximum of 700 feet of pavement draining towards any one inlet location.
- F. Place curb inlets on side streets intersecting major thoroughfare streets.
- G. Grated inlets will not be permitted in an open ditch.
- H. Back slope swale interceptors shall be placed in accordance with the requirements of Wharton County.
- I. Backfill around inlets with cement stabilized sand (section 4.2.3) to the top of first stage of the inlet, or to within 6 inches of bottom of pavement, whichever is higher.

5.5 Design Requirements for Open Channels and Outfalls

- 5.5.1 Open channels shall be designed according to methods described in the Wharton County Drainage Criteria Manual.
- 5.5.2 Design standards for outfalls into channels shall conform to those in the Wharton County Drainage Criteria Manual.
- 5.5.3 Water surface elevations shall be calculated using Manning's Equation and the Continuity Equation. The water surface must be calculated to remain within the banks and include 1-foot of freeboard.

5.6 Design Requirements for Roadside Ditches

- 5.6.1 Design Frequency.
 - A. Roadside ditch design is permissible only for single family residential lots or commercial areas equal to or larger than 0.5 acres.
 - B. The 2-year rainfall and 100-year rainfall design storm event shall be evaluated for sizing roadside ditches.
 - C. Design capacity for a roadside ditch shall be to a minimum of 0.5 feet below the edge of pavement or 0.5 feet below the natural ground at right- of-way line, whichever is lower.
 - D. The design must include an extreme event analysis to indicate that structures will not be flooded, and maximum ponding elevation for the extreme event complies with Paragraph 5.4.3-F.
- 5.6.2 Velocity Considerations.
 - A. For grass-lined sections, the maximum design velocity shall be 3.0 feet per second during the design event.
 - B. A grass-lined or unimproved roadside ditch shall have side slopes no steeper than three horizontal to one vertical (3:1), or as soil conditions will permit.

- C. Minimum grades for roadside ditches shall be 0.1-foot per 100 feet.
- D. Calculation of velocity will use a Manning's roughness coefficient (n) of 0.045 for earthen sections and 0.025 for ditches with paved inverts.
- E. Use erosion control methods acceptable to the City when design velocities are expected to be greater than 3 feet per second.

5.6.3 Culverts.

- A. Culverts will be designed assuming inlet control and shall be designed according to methods described in the Wharton County Drainage Criteria Manual.
- B. The size of roadside culverts is to be based upon drainage area. Notwithstanding this requirement, the minimum culvert size shall be eighteen inches (18") for residential and commercial driveways. Culvert shall be placed to be a minimum of 2 inches and no more than 6 inches below the ditch flow line. Existing roadside ditch on both sides of the proposed culvert shall be regraded for positive drainage to the nearest intersection or up to 500 linear feet whichever is smaller.
- C. Culvert length shall be determined by measuring the width of the crossing and adding a one-foot (1") shoulder to each edge of radius of the crossing and the intersection length from the edge of the shoulder to the flow line of the ditch. The slope will not be steeper than a three (3) horizontal to one (1) vertical (3:1) at each end.

5.6.4. Depth and Size Limitations.

- A. Maximum depth shall not exceed 4-feet from adjacent edge of pavement.
- B. Roadside ditch bottoms shall be at least 2 feet wide, unless design analysis will support a narrower width.
- C. Ditches in adjoining and parallel easements shall have top of bank not less than 2 feet from the outside easement line.

5.7 Design Requirements for Stormwater Detention

5.7.1 The intention of stormwater detention is to mitigate the effect of the New Development, Redevelopment, or In-fill Development on an existing drainage system. Stormwater detention volume is based on increased impervious cover and is calculated at the minimum rates set forth in Paragraph 5.7.3.

5.7.2 Application of Detention.

- A. The use of on-site detention is required for all Developments within the City and within the City's ETJ. Detention will not be required if the City has developed detention capacity or developed capacity of the receiving outfall facilities for a drainage watershed, and/or infrastructure improvements, to serve the drainage watershed in compliance with the requirements of this Chapter.
- B. If Redevelopment occurs without increasing the overall impervious character of the site, then no detention will be required by the City.

- C. A waiver of detention requirements may be requested if the following conditions are satisfied:
 - (1) Development is located in an area determined by the City to not need detention due to the geographic location in the watershed, the Development's proximity to the capacity of the receiving outfall facilities. Such conclusion by the City shall be supported by submittal of a Hydraulic Report as described below.
 - (2) Hydraulic Report: Submit a hydraulic analysis prepared, signed, and sealed by a professional engineer, registered in the state of Texas, to demonstrate compliance with the conditions stated in this Chapter. The hydraulic analysis shall consider (1) the current developed condition of the watershed of the stormwater conveyance system, and (2) the fully developed condition of the watershed. The probable land use for the fully developed condition will be determined by the Design Engineer for review and approval by the City. The hydraulic analysis shall demonstrate no negative impact to upstream or downstream conditions and shall demonstrate that a positive impact will be achieved.

5.7.3 Calculation of Detention Volume.

- A. Detention volume for Development areas is calculated on the basis of the amount of area of increased impervious cover. Impervious cover includes all structures, driveways, patios, sidewalks, etc.
- B. Existing single family residential (SFR) lots are exempt from detention (not applicable to master planned residential subdivisions).
- C. Areas less than 1 acre: Detention will be required at a minimum rate of 0.20 acre feet per acre of increased impervious cover, unless a hydrologic and hydraulic analysis, as defined by the Wharton County Drainage Criteria Manual, shows a lower rate and volume is acceptable. The discharge rate shall be limited to the existing storm sewer capacity allocated to the tract.
- D. Areas between 1 acre and 50 acres: Detention will be required at a minimum rate of 0.50 acre feet per acre of increased impervious cover, unless a hydrologic and hydraulic analysis, as defined by the Wharton County Drainage Criteria Manual, shows a lower rate and volume is acceptable. The discharge rate shall be limited to the existing storm sewer capacity allocated to the tract.
- E. Areas greater than 50 acres: Reference Wharton County Drainage Criteria Manual.
- F. Private parking areas, private streets, and private storm sewers may be used for detention provided the maximum depth of ponding does not exceed 9 inches directly over the inlet, and paved parking areas.

5.7.4 Calculation of Outlet Size shall be designed according to methods described in the Wharton County Drainage Criteria Manual.

5.7.5 Ownership and Maintenance Responsibilities.

- A. Private Facilities:
 - (1) Pump discharges into a roadside ditch requires the submittal of pump rate specifications on the design drawings.

- (2) All private properties being served by a detention pond shall have drainage access to the pond. Dedicated easements may be required. The City requires a maintenance work area of 30-foot width surrounding the extent of the detention area. If approved by the City, public rights-of-way or permanent access easements may be included as a portion of this 30- foot width.
- (3) Owner provides 'Notice of Detention Requirements' indicating operation and maintenance responsibilities of the detention facility, recorded in the Wharton County Official Records prior to final approval of construction plans, except with specific approval of the City.

B. Public Facilities:

- (1) Facilities will only be accepted for maintenance by the City within the City limits in cases where public drainage is being provided.
- (2) The City requires a maintenance work area of 30-foot width surrounding the extent of the detention area. Public rights-of-way or permanent access easements may be included as a portion of this 30- foot width.
- (3) A dedication of easement shall be provided by plat or by separate instrument.
- (4) Proper dedication of public access to the detention pond must be shown on the plat or by separate instrument. This includes permanent access easements with overlapping public utility easements.
- (5) Backslope drainage systems are required where the natural ground slopes towards the drainage basin and must comply with criteria provided in the Wharton County Drainage Criteria Manual.

CHAPTER 6 - PAVING AND STREET DESIGN REQUIREMENTS

6.1 General

- 6.1.1 Streets and Right-of-Ways shall be aligned and designated to conform to the City of El Campo Major Thoroughfare Plan.
- 6.1.2 All paving plans and construction shall be approved by the City of El Campo for all public streets within the City and its extraterritorial jurisdiction. All streets designated to be private are subject to the same requirements stipulated within.
- 6.1.3 All streets shall be reinforced concrete on compacted subgrade with concrete curb and gutter, or with the approval of City Council, a flexible base with an asphaltic concrete surface course on a compacted subgrade. Flexible base pavement shall be provided with a monolithic curb and gutter section. Gravel, or comparable material, will not be permitted.
- 6.1.4 Fire lane easements shall be specified on all multi-family and non-residential plats. All fire lane easements must have access to public roadways. Location, alignment width, and construction specifications shall be reviewed and approved by the City.

6.2 Pavement Width – The minimum width shall be in accordance with the following table:

Land Use on Both Sides of Right-of-Way (R.O.W.)	Roadway Classification	Single Paving Section			Divided Paving Section		
		Right-of-Way Width	Pavement Width	Curb	Right-of-Way Width	Pavement Width	Curb
Single family Residential	Local	60'	31' (B-B)	6" or 4" x 12	--	--	--
Single Family Residential	Collector	60'	41' (B-B)	6"	80'	2 - 25' (B-B)	6"
Multi-family Residential	Collector	60'	31' (B-B)	6"	80'	2 - 25' (B-B)	6"
Commercial or Industrial	Collector	60'	41' (B-B)	6"	80'	2 - 25' (B-B)	6"
Residential, Commercial or Industrial	Major Thoroughfare	100'	51' (B-B)	6"	100'	2 - 25' (B-B)	6"
Alleys	Access	20'	12' (E-E)	--	--	--	--

6.3 Concrete Pavement

6.3.1 Concrete Pavement Structure Requirements

- A. Expansion joint shall be placed at the end of each curb return and at maximum 80' spacing. Expansion joints shall be continuous across pavement and curb.
- B. Local residential streets shall have a minimum thickness of six (6") inches with number four (#4) rebar spaced at twenty-four inches (24") measured center to center of the rebar,

each way.

- C. Residential collector streets and all streets in multi-family residential, commercial, or industrial areas shall have a minimum thickness of seven inches (7") with number four (#4) rebar spaced at eighteen inches (18") measured center to center of the rebar, each way.
- D. Major thoroughfares shall have a minimum thickness of seven inches (7") with number four (#4) rebar spaced at eighteen inches (18") measured center to center of the rebar, each way.
- E. The pavement structure for each roadway shall be designed based on soil data from the site and based on the anticipated traffic volume, loading and service life of the proposed pavement structure. The Design Engineer is responsible to insure that the pavement structure is designed to withstand the anticipated loads that are expected on the roadway.
- F. Alleys for commercial and industrial districts shall have a minimum thickness of seven inches (7") with number four (#4) rebar spaced at eighteen inches (18") measured center to center of the rebar, each way. Residential alleys shall have a minimum thickness of six inches (6") with number four (#4) rebar spaced at twenty-four inches (24") measured center to center of the rebar, each way.

6.3.3 Materials

- A. Concrete - five and one-half (5-1/2) sacks cement per cubic yard concrete, with a minimum twenty-eight (28) day compressive strength of 3,500 psi. A mix design containing more than 25% Fly Ash of cement material is not allowed.
- B. Reinforcing steel - Grade 60, ASTM A615, current.

6.3.4 Subgrade

- A. The preparation of the sub-grade shall follow good engineering practices as directed by the Design Engineer. When the PI is greater than 20, then a sufficient amount of lime shall be added as described in TxDOT Item 260 "Construction Methods for Lime Treated Sub-grade" until the PI is less than 20. If Item 260 is not feasible, an alternate stabilizing design will be required. The sub-grade will be prepared and allowed to reach a Proctor Density of 95% (standard). The sub-grade shall be watered, rolled and bladed to a depth of 6 inches.
- B. The sub-grade must be inspected and approved by an Independent Testing Laboratory and a certified copy given to the Department of Public Works, who must approve the report prior to application of the concrete.
- C. The sub-grade shall extend 12-inches outside the paving width, each way.

6.4 Hot-Mix Asphaltic Concrete Pavement (HMACP)

- 6.4.1 This section of the Specifications covers the HMACP street design for minor residential streets at the locations and to the dimensions shown on the drawings when specifically approved by City Council. Collector street, thoroughfares, and arterial streets shall require additional construction materials as approved by the Director of Public Works. Earthwork, preparation and stabilization of sub-base material shall conform to the 2004 Texas Department of Transportation Standard Specifications for construction of highways, streets and bridges.

6.4.2 Material

- A. Prime coat shall conform to the requirements of Item 300 "Asphalts, Oils and Emulsions" of the Texas Department of Transportation Standard Specifications for Road and Bridge Construction.
- B. Surface course shall consist of a minimum compacted thickness of two inch (2") Type D HMACP and shall conform to the requirements of Item 340 "Dense-Graded Hot-Mix Asphalt" of the Texas Department of Transportation Standard Specifications for Road and Bridge Construction.
- C. Flexible Base Material. Flexible base material shall consist of appropriate base course and shall be surfaced with a minimum of surface course indicated above:
 - (1) Base material shall conform to TxDOT Item 247 "Flexible Base." The base material shall be Type A Grade 2.
 - (2) The base will be prepared and allowed to reach a Proctor Density of (standard) +/- 2% optimum moisture. The base must be inspected and approved by an Independent Testing Laboratory and a certified copy given to the Public Works Director for approval. All streets and roads must have a flexible base. The flexible base shall have a minimum thickness of 8-inches after compaction of the authorized base material.

6.4.3 Subgrade

- A. The preparation of the sub-grade shall follow good engineering practices as directed by the Design Engineer. When the PI is greater than 20, then a sufficient amount of lime shall be added as described in TxDOT Item 260 "Construction Methods for Lime Treated Sub-grade" until the PI is less than 20. If Item 260 is not feasible, an alternate stabilizing design will be required. The sub- grade will be prepared and allowed to reach a Proctor Density of 95% (standard). The sub-grade shall be watered, rolled and bladed to a depth of 6 inches before any flexible base material is placed on it.
- B. The sub-grade must be inspected and approved by an Independent Testing Laboratory and a certified copy given to the Department of Public Works, who must approve the report prior to application of the base.
- C. The sub-grade shall extend 12-inches outside the flexible base width, each way.

6.5 Curb and Gutters

- 6.5.1 Standard curb height for residential streets is either standard 6-inch curb or a 4-inch by 12-inch roll-over curb configuration. Islands, esplanades shall be constructed only with 6-inch standard curb height.
- 6.5.2 Curbs to decrease to different size shall transition over 10-feet to tie into existing curb height or existing roadway without curbs.
- 6.5.3 Curbs shall not extend through the sidewalk within a driveway.
- 6.5.4 Materials and Construction

All materials and construction methods shall conform to Item 529 "Concrete Curb, Gutter,

and Combined Concrete Curb and Gutter" of the Texas Department of Transportation Standard Specifications for the construction of highways, streets and bridges with the following modifications:

- A. General. All curbs and gutters shall be constructed of 4,500 psi concrete conforming to Item 420 "Concrete Structures" and shall be of the thickness, width, and at the locations and elevations shown on the drawings.
 - B. Finish. Curbs and gutters shall be finished true to line, grade, and cross section with the aid of a straight edge, steel trowel and steel "gooseneck" to give the work the appearance of a trowel finish, then edged and jointed.
 - C. Joints. Joints shall be provided where shown on the drawings, and as hereinafter specified. Edges of joints shall be rounded to a one-eighth (1/8) inch radius with an edging tool.
 - D. Dummy Groove. Dummy groove joints shall be formed at 8 foot intervals in curbs and gutters. Dummy groove joints shall not be less than one inch in depth.
 - E. Expansion. Provide 3/4 inch pre-molded expansion joint filler in curbs and gutters at intervals not exceeding 80 feet and at edges abutting other concrete. The filler shall extend the full depth of the concrete but shall be held down 1/4 inch below the finish surface of the slab. All expansion joints shall be properly sealed with hot poured elastic bituminous sealer.
 - F. When the grade of existing dirt, gravel or iron ore driveways must be altered to conform to proposed construction, in the opinion of the Design Engineer, the work shall be performed by the contractor so as to produce a driveway equal to that removed.
- 6.5.5 Curb and gutter replacement will be designed and constructed per the above requirements. The curb will have a smooth trowel finish. If concrete exists in the street, dowel rods must be installed in the street and a slip form placed on the end of the steel in the gutter. No deviation from this design will be allowed without permission of the Director of Public Works.

6.6 Grading and Layout Requirements

- 6.6.1 Minimum gradient on gutter shall be 0.33 percent.
- 6.6.2 Inlet spacing as defined in Section 5.4.9.
- 6.6.3 Maximum cut measured from finished grade at the right-of-way line to top of curb shall be 1.75 feet. The recommended maximum slope for driveways shall be ten (10) to one (1) slope.
- 6.6.4 Minimum one percent (1%) fall around intersection turnout for a minimum radius of twenty-five feet (25').
- 6.6.5 Cul-de-sac pavement:
 - A. Single family, residential - pavement radius measured to the back of curb shall be forty two and half feet (42.5').
 - B. Multi-family, residential, commercial, and industrial - radius measured to the back of curb shall be fifty and half feet (50.5').
 - C. Curb radii at the transition to the cul-de-sac shall have a minimum radius of twenty-five

feet (25') in single family residential areas and thirty-five feet (35') in other areas.

- D. Maximum lengths of cul-de-sac streets for residential subdivision shall be five-hundred feet (500'). Maximum length of cul-de-sac streets for commercial or industrial developments shall be six hundred feet (600'). A traffic analysis may be required in commercial or industrial areas to determine high traffic volumes that may be generated from the development, reducing the maximum length of cul-de-sac allowed.
- 6.6.6 Minimum slope for the gutter of a cul-de-sac or of the long radius of an L-type Street shall be 0.60 percent.
- 6.6.7 Major thoroughfares with a centerline radius of the right-of-way less than two thousand feet (2,000') shall be designed considering recommendations for super elevation in accordance with the American Association of State Highway and Transportation Officials, "A Policy on Geometric Design of Highways and Streets", 1984, or latest addition. Signage and design speed shall be considered for all curved thoroughfares. A maximum rate of super elevation should be 0.04 for urban conditions.
- 6.6.9 The amount of cross slope over the pavement section should be shown on the plans (the usual cross slope is three-eighths-inch (3/8") per foot from the curb line to quarter point, and one-fourth-inch (1/4") per foot from quarter point to centerline, and one-eighth-inch (1/8") per foot for left turn lanes).
- 6.6.10 Proposed top of curb elevations should be designed to match the top of the curb at an existing inlet.
- 6.6.11 Top of curb elevations shall be shown on the construction plans.
- 6.6.12 Gutter elevations are required for vertical curves where a railroad track is being crossed.
- 6.6.13 Vertical curves shall be designed when algebraic difference in grades exceeds one percent (1%). Elevations shall be shown on the construction plans at ten-foot (10') intervals through vertical curves. The gradient for tangents to vertical curves at railroad crossings shall be a maximum of 3.5 percent. All crest vertical curves shall be determined by sight distance requirements for the design speed. The minimum design speed on any vertical curve shall be based on the street classification.
- 6.6.14 Intersections:
- A. Curb radii shall be twenty-five feet (25') minimum in residential areas and thirty-five feet (35') minimum in commercial or industrial areas or on major thoroughfares.
- B. Streets and traffic lanes shall be properly aligned across an intersection. Proposed streets centerlines shall be aligned with existing streets centerlines. Off-set street intersections are prohibited.
- C. Intersection Distances: All intersection distances shall be measured along the right-of-way line from blockface to blockface.
- (1) A local street shall intersect with another public street at least every 1,400' but not less than 75'.
- (2) A major thoroughfare shall intersect with a public local, collector, or another major thoroughfare at least every 2,600' but not less than 600'.

- 6.6.15 Left turn lanes shall conform to Appendix F of the Design Standards. Minimum bay storage lengths may need to be calculated as per traffic analysis. The referenced standards are minimum requirements. Middle block left turns may be permitted when approved by the City.
- 6.6.16 Median openings for major thoroughfares shall conform to Appendix F of the Design Standards. When areas adjoining the right-of-way are not planned for immediate development, esplanade opening may be spaced one thousand feet (1,000') apart when specifically approved by the City.
- 6.6.17 Horizontal dowels are required when making a connection of a proposed street to an existing concrete street that has no exposed steel. Dowels should be number four (#4) bars, sixteen inches (16") long, eighteen inches (18") center-to-center, embedded eight inches (8") and epoxied.
- 6.6.18 Dead-end streets designed to be extended in the future shall have fifteen inches (15") of reinforcing steel exposed beyond the pavement, coated with asphalt and wrapped with burlap for future pavement tie. A temporary turnaround shall be constructed within the standard right-of-way at the end of any dead-end street.
- 6.6.19 Paving headers shall be placed at the end of all concrete slabs.
- 6.6.20 All concrete to be removed shall be removed either to an existing joint or a sawed joint.

6.7 Sidewalks

- 6.7.1 Sidewalks are required and shall be four feet (4') in width on each side of all public residential streets. Sidewalks of five feet (5') in width are required on each side of a collector street and a major thoroughfare. Construction of a sidewalk along a single-family residential local street may be deferred until a lot is improved, provided there is a note regarding sidewalk construction on the recorded subdivision plat.
- 6.7.2 Sidewalk wheelchair ramps shall be required at all intersections.
- 6.7.3 Sidewalk construction in an esplanade: Concrete sidewalk, six inches (6") thick may be constructed in all esplanades. All concrete sidewalks in esplanades shall be a minimum of six feet (6') wide as measured from the esplanade nose.

6.8 Traffic Control Devices and Street Signs

- 6.8.1 Traffic and street signage, striping, channelization devices, etc. shall be shown on the paving site plan in the construction plans and shall conform to the requirements of the Texas Manual of Uniform Traffic. Prior to final approval of a construction project, all devices shall be installed in accordance with the approved construction plans.
- 6.8.2 Type III barricades shall be permanently installed at the end of all dead-end streets not terminating in a cul-de-sac and at all turnouts. Barricades must meet the requirements of the Texas Manual of Uniform Traffic Control Devices for Type III barricades. Type III barricades must be Scotchlite brand, or approved equal, high intensity sheeting on a nominal two-by-eight inch (2" x 8") non-pressured treated #2 pine wood, painted white with latex enamel paint.
- 6.8.3 Traffic Signs
- A. Standard sign blanks shall be aluminum conforming to ASTM B209; alloy 5052-H38. Preparation of aluminum sign blanks must conform to specification MIL-C-5541C. The coating material must be included on the OPL-871706-10 list or subsequent additions

thereto. Sheeting for signs must be Scotchlite, or approved equal. Visual Impact Performance (VIP) Diamond Grade Sheeting shall be used on all signs on all roadways classified as Collector or greater. Scotchlite brand, or approved equal, High Intensity Sheeting shall be used on all other road signs. Signs shall be mounted on a 2-3/8 inch diameter by twelve foot (12') long galvanized tubular post with vandal proof mounting brackets.

- B. The nine inch (9") street name sign blanks shall be aluminum conforming to ASTM B209; alloy 5052-H38 or 2154-H38. Preparation of aluminum sign blanks must conform to specification MIL-C-5541C. The coating material must be included on the QPL-81706-10 list or subsequent additions thereto. The sign blanks shall be extruded aluminum and shall be installed on tubular sign supports with a minimum sign length of twenty-four inches (24") and a maximum length of forty-eight inches (48"). When a "No Outlet" is included, the maximum sign length is fifty-four inches (54"). Letters shall be white six inch (6") upper case with Helvetica Medium, font #H0907 letter style. The six inch (6") letters shall have a stroke width of 1-1/4 inch. To accommodate longer street names, alternative stroke widths may be approved.
- C. All posts shall be Poz-Loc Sign Post Anchor System with galvanized 2-3/8" diameter (O.D.) post. All sign posts and signs shall remain in their natural condition with no painting or coating allowed.

6.8.4 Pavement markings shall be shown on the approved construction plans. All pavement markings shall be retro-reflective material applied to the road surface in a molten state by screed/extrusion, suspend extrusion or spray means, with a surface application of glass beads. For lane delineation, reflectors shall be used on all roadways classified as Collectors or greater. The Public Works Director may approve variations of types of materials due to phasing, temporary construction, etc. All pavement markings shall comply with the Texas Manual of Uniform Traffic Control Devices and Texas Department of Transportation standards, latest revision.

6.8.5 Developer shall install traffic control devices as warranted by a traffic study approved by the City.

6.9 Roadway Geometric Design

6.10.1 Right-of-Way Width

A. Right-of-way width is generally determined by the pavement section (roadway type/classification) required to perform the function and carry the traffic. Other considerations of right-of-way may include the provisions of vehicle safety areas, sidewalks, bus turnouts, bicycle paths, and utility locations. Right-of-way widths shall be determined from the major thoroughfare plan or applicable planning tool for classifications and other width considerations.

B. Street right-of-way shall be dedicated by a subdivision plat or street dedication plat.

6.10.2 Street Access

A street system shall be provided within the development with at least one (1) point of access to a public street adjacent to the development; provided, however, that development containing one hundred and fifty (150) dwelling units or more shall provide at least two (2) points of access to adjacent public streets.

6.10.3 Horizontal Curvature and Vertical Curves

Horizontal curvature and vertical curve criteria for roadways are referenced to and shall conform to the major thoroughfare study for additional design criteria when special traffic hazards exist.

6.10.4 Storage Length

Storage lengths provided in turning lanes should be sufficiently long to store the maximum number of vehicles likely to accumulate during a critical period. A storage length which is too short could cause vehicles to undesirably back up into through traffic lanes.

Storage lengths should be calculated if turning volumes are known or may be accurately estimated. The formula for calculating storage length is:

$$L = 25N$$

Where:

L = Length of storage lane in feet and,

N = Number of vehicles expected in the queue during the peak thirty (30) minute traffic period, using a Poisson Distribution, ninety percent (90%) confidence level, and a ninety (90) second arrival period.

Where analysis indicates that dual left-turn lanes are needed, a lane distribution of fifty-five percent (55%) in the leftmost lane and forty-five percent (45%) in the rightmost lane should be used for calculations.

Unless a longer storage length is indicated by the calculation, the minimum length of a left-turn storage lane for collector level or lower streets is one-hundred feet (100') from the nose to the point of transition. On major streets (collectors and thoroughfares), the minimum length is one-hundred fifty feet (150').

6.10.5 Intersection Sight Distance:

Each intersection design should consider the required sight distances before establishing corner right-of-way clips. Unless larger clips are indicated at a particular intersection, a twenty foot by twenty foot (20' X 20') triangular public open space corner clip, measured at the property line, is required on corner lots at the intersection of two public streets. A fifteen foot by fifteen foot (15' X 15') triangular corner clip or easement is required at the intersection of a public street and a dedicated alley. Traffic and street signage, striping, channelization devices, etc. shall be shown on the paving site plan in the construction plans and shall conform to the requirements of the Texas Manual of Uniform Traffic. Prior to final approval of a construction project, all devices shall be installed in accordance with the approved construction plans. Intersection sight distance requirements shall conform to the major thoroughfare study for criteria.

CHAPTER 7 - SITE DEVELOPMENT REQUIREMENTS

7.1 General

- 7.1.1 Site development plans for all site developments within the City of El Campo and its extraterritorial jurisdiction shall conform to the requirements of these standards and be approved by the City prior to construction.
- 7.1.2 Site developments, not including single family residential, shall include any project that affects public water, wastewater, storm drainage, or paving facilities.

7.2 Design Review Requirements for Site Development Plans

- 7.2.1 All site development plans for proposed developments shall be submitted to the City for approval prior to construction. Site development plans shall show all proposed water, wastewater, paving, parking, drainage, and flood protection facilities.
- 7.2.2 One (1) copy of the site development plans shall be submitted for review. The City will respond within fourteen (14) days with an approval letter and/or with plans showing the required changes.
- 7.2.3 When plan changes are requested, two (2) copies of the revised site development plans shall be resubmitted to the City for final review and issuance of an approval letter.
- 7.2.4 Site development plans for projects located within the City shall be submitted to the Building Code Enforcement Department, with the approval letter attached, and construction plans, for issuance of a permit prior to construction.

7.3 Building Slab Elevations

Minimum building slab elevations within the City Limits shall be set at or above the elevation shown on the recorded plat, twelve inches (12") above the 100-year flood plain elevation and maximum ponding elevation, or eighteen inches (18") above natural ground or twelve inches (12") above the top of curb at the front of the lot, whichever is higher. Minimum building slab elevations within the extraterritorial jurisdiction of the City of El Campo shall conform to the requirements of Wharton County.

7.4 Water Service

Water service lines and meters shall be sized in accordance with requirements set out in Chapter 3 of these Standards (3.11).

7.5 Sanitary Sewer Service

Sanitary sewer service leads are normally installed during construction of the public sanitary sewer. When a sanitary sewer service lead is to be installed for a site development, refer to requirements set out in Division 4 of these Standards. All lots, tracts, or reserves shall be connected directly to a public sanitary sewer by a single lead, except as specifically approved by the City.

7.6 Site Drainage Requirements

All commercial, industrial, office, recreational, and multi-family tracts deeper than one hundred feet (100') measured from the right-of-way line shall have an internal drainage system. The internal drainage system shall collect all site runoff beyond one hundred feet (100') from the right- of-way line

into a storm sewer system that shall connect to the public drainage facilities in the area, except with specific approval. The one hundred foot (100') area adjacent to the right-of-way may sheet flow to the roadway drainage system if the roadway system is designed to accommodate the additional sheet flow from development.

- 7.6.1 The internal site storm sewer shall be connected to a public storm sewer at a manhole or at an inlet adjoining the site. The site drainage outfall shall be connected to the nearest existing drainage system with adequate capacity to serve the drainage area. Where extension of the existing drainage system is required, all costs for extension shall be the responsibility of the development.
- 7.6.2 All storm sewers extended into a public right-of-way or easement shall be reinforced concrete pipe at least twenty-four inches (24") in diameter. Storm sewers shall be reinforced concrete pipe, ASTM C-76, Class III.
- 7.6.3 All internal facilities shall be designed by a registered professional engineer and shall be sized to drain the site in accordance with these Standards.
- 7.6.4 Drainage calculations shall be submitted with all site development plans.
- 7.6.5 When the site drains directly into a Wharton County drainage facility and/or into a highway right-of-way, the appropriate governmental entity (entities) shall approve the site development connection to public facilities.

7.7 Traffic Impact Analysis for Driveway and Roadway Access

- 7.7.1 The location and width of all driveways that will connect to a public street must be reviewed and approved by the City prior to construction and may be required to be identified at the time of platting, prior to the submission of a building permit, or at the time a land plan or site plan is submitted. This includes replats where relocating or shared access may be required or denial of an additional driveway on the newly formed lot.
- 7.7.2 All driveways are required to first obtain a permit through the City. In addition, if the driveway is located on a state roadway, the City requires the applicant to obtain a driveway access permit from the Texas Department of Transportation (TxDOT). No permit from the City shall be released until a permit has been approved by TxDOT and delivered to the City. The City will adhere to the guidelines, rules adopted and approved by TxDOT on all TxDOT controlled roadways.
- 7.7.4 Residential – specific. No residential driveway shall be allowed on a major thoroughfare. If it is an existing lot, access will be allowed if there is no adjacent side street or rear street in which safer access is available. When located on a major thoroughfare, if possible, a circle driveway will be designed in which the driveway width will be a minimum twenty feet wide, the driveway entrances are to be thirty feet (30') apart from outside turning radii at curb line, and turning radii at curb line shall be a minimum of twenty feet (20'). If not possible, every effort should be made to create space on the lot to provide a turnaround maneuver and turning radius at the curb line of twenty feet (20'). All other streets, residential driveways shall be a minimum of ten feet (10') and maximum of thirty feet (30') wide at the right-of-way line with a turning radius of five (5) feet on local streets and ten (10) feet on collectors. No lot shall have more than one driveway (circle drive is considered two drives) on a local street unless it has at least one hundred (100) feet of frontage or the additional drive is on another street. No turn radius with the curb return shall extend beyond the property line of the property when extended in a straight line from the right-of-way to the curb line.

- 7.7.5 A traffic impact study may be required as a part of the approval process for driveways and other roadway access. A traffic impact analysis (TIA), when required, shall be prepared by an individual, group, firm or corporation having demonstrated professional emphasis and experience in transportation planning, engineering and in the preparation of similar analyses. The TIA document shall bear the seal and signature of a Texas Registered Professional Engineer.
- A. A TIA shall include the following information:
- (1) Study purpose and objectives.
 - (2) Description of the site and study area – to include entire property or master plan, not just portion submitted for building permit or plat approval.
 - (3) Existing conditions in the area of the development.
 - (4) Recorded or approved nearby development.
 - (5) Trip generation and trip distribution.
 - (6) Projected future traffic volumes.
 - (7) An assessment of the change in roadway operating conditions resulting from the development traffic.
 - (8) Recommendations for site access and transportation improvements needed to maintain traffic flow to, from, within, and past the site at an acceptable and safe level of service.
- B. Prior to preparation of a TIA, the Design Engineer is required to meet with the Public Works Director to identify the study area, define the area of influence, non-site impacts, and determine or define essential elements such as but not limited to study area, design year, trip generation rates, trip assignments, non-site traffic estimates, etc.
- C. The TIA shall be presented in the following manner:
- (1) Straightforward and in a logical sequence; step by step toward conclusions and identifying recommendations and alternatives.
 - (2) It shall allow the reviewer to duplicate the calculations.
 - (3) Recommendations shall specify the time period within which the improvements should be made, particularly if the improvements are associated with various phases of the development.
 - (4) Recommendations shall also specify the time period for any monitoring of operating conditions.
 - (5) Data shall be presented in tables, graphs, maps, and diagrams wherever possible for clarity and ease of review.
 - (6) A brief executive summary of one or two pages be provided, concisely summarizing the purpose, conclusions, recommendations, and alternatives.

- 7.7.6 Large speed differentials shall be minimized to prevent unsafe conditions. Every attempt should be made to have driveway designs that create no more than 20 mph maximum speed differential on roadways. Driveway approaches accessing major thoroughfares should be situated in a manner that minimizes the number of potential conflict points. Use of deceleration lanes, acceleration lanes, turning lanes, turning bays, shared driveways, access easements for adjoining properties, cross driveway easements (an easement allowing two or more properties to share a common drive(s).), traffic signals and traffic control devices, special lanes for pedestrians, crosswalks, medians and median markings, special signage, and other internal and external designs, signage, devices, markings, etc. shall be considered on all driveway requests.
- 7.7.7 Anyone planning on developing a site, parcel of land, or preparing a parcel of land or site for such shall be prepared to submit a driveway plan for the entire property. If the parcel to be platted is a portion of a larger tract, the city may require all driveways be identified or at a minimum the number, general location and access easements identified to allow joint use of driveway(s) located on separate tracts or parcels on the larger tract before the platting of the smaller tract or sub-parcel. A TIA may be required to take into consideration a larger section of roadway or other roadways other than the roadway immediately adjoining the tract(s) of land under consideration.
- 7.7.8 An individual may be required to negotiate driveway access on an adjacent property prior to or instead of being granted a driveway access on a tract or parcel of land.
- 7.7.9 Driveways serving non-residential and multi-family tracts that connect to a street classified as a thoroughfare or collector street or has a speed limit exceeding 35 mph must be a thirty- five (35) feet to forty-five (45') wide at the right-of-way line. Non-residential and multi-family tracts fronting on all other streets shall be twenty-five (25) to thirty-five (35) feet wide at the right-of-way line.
- 7.7.10 It is the City's policy to minimize whenever practical the number of non-single family residential driveways on all arterial and collector streets in order to reduce the number of conflict points and facilitate traffic flow. To facilitate that policy, driveways shall be placed no closer than the following distances from adjacent streets and driveways (measured from the turn radius at the curb line to the nearest turn radius at the curb line). More than one driveway may be allowed as long as it meets the following criteria:

<u>Roadway Classification</u>	<u>Minimum Separation</u>
Major Highway	200 ft. or greater as determined by a TIA
State Highway	200 ft. or greater as determined by a TIA
Thoroughfare	165 feet
Collectors	165 feet
Local streets	75 feet

- 7.7.11 If the separation requirements for non-single family residential driveways cannot be met because of the location of existing driveways on adjoining tracts, joint access driveways, access easements, or cross driveway easements, across adjoining tracts should be used. When minimum separation requirements cannot be met with the existing private driveway on the adjacent property and joint access cannot be obtained, the controlling factor shall be to maximize the distance between the subject property's private driveway and the public cross street.
- 7.7.12 On streets classified as collectors, thoroughfares (arterials), and highways that do not contain medians, non-residential driveways must align with driveways on the opposite side of the street the minimum separation requirements.

- 7.7.13 At signalized intersection in which one public street terminates at the intersection of a connecting cross street, a driveway should be avoided in the area of the signal at a spacing outlined above and not be placed on the cross street as to be in alignment with the terminating street. If the requirements for driveways otherwise allow the placement of a driveway within the area due to size or a TIA, then the driveway width must match the cross-section of the intersection public street and be properly aligned. Non-residential driveway connections to the public street shall be approved and inspected by the City of El Campo.
- 7.7.14 Driveways shall be located and designed so as to have adequate sight distances along the intersecting street.

7.8 Fire Lanes

- 7.8.1 Fire lane easements shall be created on all multi-family and non-residential tracts. Fire lane easements shall be an all-weather driving surface capable of supporting the imposed loads of fire apparatus and subject to the approval of the Fire. All fire lane easements must have access to public-access streets.
- 7.8.2 Fire lanes shall be of an unobstructed width of not less than twenty feet (20'), with adequate turning radius capable of supporting the imposed loads of fire apparatus and shall extend for the minimum length necessary to provide access for emergency vehicles as determined by the Fire Official in accordance with accepted fire safety standards. A ninety (90) degree intersection is acceptable with prior approval of the Fire Official. All fire lanes have a minimum vertical clearance of thirteen feet six inches (13' 6").
- 7.8.3 Fire lanes shall be designed to drain in compliance with the site development requirements