

INFRASTRUCTURE DESIGN STANDARDS



CITY OF ENNIS, TEXAS

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REQUIREMENTS FOR INSTALLATION OF PUBLIC IMPROVEMENTS

SECTION 000: ADMINISTRATIVE

Note: These pages contain the requirements for installation of public improvements as of the date adopted as shown on the title page. As amendments or revisions to the document are made and approved by the City Commission, the adoption date will be updated and a brief description of the change(s) will be added to the revision history appendix.

PART 1 - GENERAL REQUIREMENTS:

1.1. – Introduction

The following infrastructure design standards are established as the minimum requirements for all City of Ennis Public Works projects. These specifications are to be used in conjunction with the Public Works Construction Standards, 2017 (Fifth) edition, as published and subsequently amended by the North Central Texas Council of Governments (NCTCOG) as well as with the latest edition of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2014 edition, as published and subsequently amended by the Texas Department of Transportation (TxDOT). The City of Ennis infrastructure design standards supersede any other standard, regulation, or publication when such is in conflict with City of Ennis infrastructure design standards; otherwise, NCTCOG and TxDOT specifications will serve as minimum requirements for all public works projects. Items not covered in writing by the City of Ennis, TxDOT or NCTCOG specifications shall be approved in writing by the Public Works Director of the City of Ennis before construction may commence.

Where stipulated in these design standards there are requirements, alternatives, or waiver of requirements that are stated to be at the discretion of the City of Ennis Public Works Director - any person may petition the City of Ennis City Manager to reconsider the decision of the City of Ennis Public Works Director. Petitions to the City Manager shall be made in writing and explain the basis of the request, and shall also include reference to the specific standard or decision being appealed.

1.2. – Bonding

- A. Performance, Maintenance and Payment bonds must be on file with the City prior to the start of any construction.
- B. Bonds shall be for the entire cost of the project construction within the Public Right-of-way, public easement or all portions of the work that are to eventually be accepted as public infrastructure to be maintained by the City (upon expiration of the Maintenance Bond).
- C. The Payment and Performance Bonds shall be in effect until project completion.
- D. The Maintenance Bond shall be effective for a 24-month period following project completion and acceptance by the City of Ennis and shall cover 100% of the cost of the public improvement portion of the project.
- E. Refer to Appendix A in Section 300 for required bonding language.

1.3. – Insurance

The Contractor will carry Workmen's Compensation Insurance, Public Liability and Property Damage Insurance, and Automobile Insurance sufficient to provide adequate protection against damage claims which may arise from operations under this Contract in compliance with the following:

A. **Contractors Insurance:** Without limiting any of the other obligations or liabilities of the Contractor, during the term of the contract, the Contractor and each subcontractor, at their own expense, shall purchase and maintain the herein stipulated minimum insurance with companies duly approved to do business in the State of Texas and satisfactory to the Owner. Certificates of each policy shall be delivered to the Owner before any work is started, along with a written statement from the issuing company stating that said policy shall not be canceled, non-renewed or materially changed without 30 days advance written notice being given to the Owner, except when the policy is being canceled for nonpayment of premium, in which case 10 days advance written notice is required. Prior to the effective date of cancellation, Contractor must deliver to the Owner a replacement certificate of insurance or proof of reinstatement. Coverage shall be of the following types and not less than the specified amounts:

1. Workers' compensation in at least the minimum statutory amounts on all employees as required by Texas law, with the policy endorsed to provide a waiver of subrogation as to the Owner.
2. Commercial general liability insurance, including independent contractor's liability, completed operations and contractual liability covering, but not limited to, the liability assumed under the indemnification provisions of this contract, fully insuring Contractor's (or subcontractor's) liability for injury to or death of Owner's employees and third parties, extended to include personal injury liability coverage with damage to property of third parties, with minimum limits of \$1,000,000.00 as the combined single limit for each occurrence of bodily injury, personal injury and property damage.
 - a. The policy shall include coverage extended to apply to completed operations, asbestos hazards (if this project involves work with asbestos) and XCU (explosion, collapse and underground) hazards. The completed operations coverage must be maintained for a minimum of one year after final completion and acceptance of the work, with evidence of same filed with Owner.
3. Comprehensive automobile liability insurance, covering owned, hired and non-owned vehicles, with a combined bodily injury and property damage minimum limit of \$1,000,000.00 per occurrence for bodily injury and for property damage. Such insurance shall include coverage for loading and unloading hazards.

B. **Additional Coverage:** Any insurance coverages which are required by statute, which are not expressly stated herein, shall be maintained in accordance with statutory requirements.

C. **Policy Endorsements and Special Conditions:**

1. Each insurance policy to be furnished by Contractor shall include the following conditions by endorsement to the policy:
 - a. Name the Owner as an additional insured as to all applicable coverage;
 - b. Each policy shall require that 30 days prior to the cancellation, non-renewal or any material change in coverage, a notice thereof shall be given to Owner by certified mail. If the policy is canceled for nonpayment of premium, only 10 days written notice to Owner is required;
 - c. The term "Owner" shall include all authorities, boards, bureaus, commissions, divisions, departments and offices of the Owner and individual members, employees and agents thereof in their official capacities, and/or while acting on behalf of the Owner;
 - d. The policy phrase "other insurance" shall not apply to the Owner where the Owner is an additional insured on the policy;

- e. All provisions of the contract concerning liability, duty and standard of care together with the indemnification provision, shall be underwritten by contractual liability coverage sufficient to include such obligations within applicable policies.
2. Insurance furnished by the Contractor shall be in accordance with the following requirements:
- a. Any policy submitted shall not be subject to limitations, conditions or restrictions deemed inconsistent with the intent of the insurance requirements to be fulfilled by Contractor. The Owner's decision thereon shall be final;
 - b. All policies are to be written through companies duly licensed to transact that class of insurance in the State of Texas and shall be represented by an agent or agents having an office located in Tarrant County, Texas or a county with a contiguous border to Tarrant County, Texas; and
 - c. All liability policies required herein shall be written with an "occurrence" basis coverage trigger.
3. Contractor agrees to the following:
- a. Contractor hereby waives subrogation rights for loss or damage to the extent same are covered by insurance. Insurers shall have no right of recovery or subrogation against the Owner, it being the intention that the insurance policies shall protect all parties to the contract and be primary coverage for all losses covered by the policies;
 - b. Companies issuing the insurance policies and Contractor shall have no recourse against the Owner for payment of any premiums or assessments for any deductibles, as all such premiums and deductibles are the sole responsibility and risk of the Contractor;
 - c. Approval, disapproval or failure to act by the Owner regarding any insurance supplied by the Contractor (or any subcontractors) shall not relieve the Contractor of full responsibility or liability for damages and accidents as set forth in the contract documents. Neither shall the bankruptcy, insolvency or denial of liability by the insurance company exonerate the Contractor from liability; and
 - d. No special payments shall be made for any insurance that the Contractor and subcontractors are required to carry; all are included in the contract price and the contract unit prices. Any of such insurance policies required under this section may be written in combination with any of the others, where legally permitted, but none of the specified limits may be lowered thereby.
4. The Contractor shall furnish the Owner with satisfactory proof that he has provided adequate insurance coverage in amounts and by approved carriers as required by these contract documents. Contractor shall not commence work under this contract until Contractor has obtained all the insurance required under this contract, certificates evidencing such coverage are received by the City and such insurance has been approved by the City. Contractor shall be responsible for delivering to the City, Contractor's certificates evidencing such coverage are received by the City and such insurance has been approved by the City. Contractor shall be responsible for delivering to the City, Contractor's certificate of insurance for approval.

1.4. – General

- A. All contractors working in the public right-of-way shall furnish the City with satisfactory proof that they have provided adequate insurance coverage in amounts equal to or greater than those required by the City and by approved carriers. Contractor shall not commence work under any

contract until all required insurance and certificates evidencing such coverage are received by the City, along with a written statement from the issuing company stating that said policy shall not be canceled, non-renewed or materially changed without 30 days advance written notice being given to the Owner. Each insurance policy to be furnished by Contractor shall Name the Owner as an additional insured to all applicable coverage.

- B. No public improvement project construction shall begin until a set of engineered drawings of the proposed construction, stamped by a Texas licensed engineer, is received by the City of Ennis and approved by signature of the Public Works Director or his designee.

- 1. Submittal Requirements:

- a. Interim Submittals: 2 Full Size (24" x 36"), 2 Half Size (11" x 17"), and PDF;
 - b. Final Approved Submittal: 2 Full Size (24" x 36"), 4 Half Size (11" x 17") and PDF;

- 2. Final Project Record Drawings Submittal Requirements:

- a. 1 printed Full Size (24" x 36") copy and a PDF file of "As-Built" plans;
 - b. 1 set of all plan sheets in an AutoCad DWG format. All data shall be in NAD83 Texas State Planes, North Central Zone, US Foot.

- C. Any public improvement which will be located in a State of Texas right-of-way shall be permitted first by the TXDOT Right-of-Way Division (Dallas District) before being considered by the City of Ennis. A copy of the approved TXDOT permit shall be supplied to the City of Ennis prior to beginning any work in TxDOT right-of-way.
- D. If the public improvement construction is to be located in easements on private property, the Inspection Services Department of the City of Ennis shall verify the easement by plat. All plats shall be provided to the City by the developer or contractor when the plans are submitted.
- E. All public improvement construction shall be performed in accordance with specifications listed herein and shall be inspected and documented by the City of Ennis Public Works Department.
- F. If the public improvement construction is required to be done after normal working hours, or on weekends or holidays, all overtime pay for the Public Works Inspector shall be paid for by the contractor. Failure to pay overtime fees shall result in a claim against the project Performance Bond.
- G. The contractor or owner will be responsible for the repair/replacement of any City facilities damaged during construction. Failure to repair/replace damaged City facilities will result in a claim against the contractor/owner's liability insurance policy.
- H. For new construction projects, an emergency contact with 24-hour telephone numbers must be on file in case of an emergency.
- I. All contractors must satisfactorily pass all required testing with written test results in the City's possession before the City will approve any construction.

SECTION 100: STREETS, STORM DRAINAGE & LIGHTING

PART 1 - RESERVED

PART 2 - STREETS:

2.1. – General

- A. All residential streets shall be hot-mix asphalt paving (flexible pavement) unless otherwise approved by the City of Ennis, Public Works Director. All industrial streets, commercial streets, collector streets, and all alleys shall be reinforced concrete paving (rigid pavement design) unless otherwise approved by the City of Ennis, Public Works Director. All residential streets, industrial streets, commercial streets, collector streets, and all alleys, shall meet all requirements shown in this Standard for street lights, street signs, pavement marking, and duct banks.
- B. All testing shall be at the contractor's or developer's expense and completed by a testing laboratory approved by the Public Works Director with current AASHTO accreditation that demonstrates the laboratory's capabilities to perform applicable test procedures. The City shall determine the type, frequency and location of all required testing. Testing laboratories shall notify the City 48-hours in advance of field testing or sampling. A copy of all test results shall be provided to the City of Ennis Public Works Director for approval. All contractors must satisfactorily pass all tests with written test results in the City's possession before the City will approve any construction.
 - 1. No surface paving may be installed unless the sub-grade and base (if applicable) has passed density compaction testing for the appropriate moisture content range per TxDOT Items 132 and 247 as applicable.
 - 2. No surface paving may be placed without passing the sub-base preparation test.
 - 3. The City may periodically require additional test or proof rolling to assist them in evaluating the quality of work.
 - 4. No concrete may be poured without an inspector on site.
 - 5. No concrete may be poured before 6:00 AM without express written authorization from the Director of Public Works.
 - 6. All concrete paving, asphalt paving, and base courses are subject to coring for verification of depth. All core testing shall be at the expense of the developer and shall be performed by a laboratory selected by the City of Ennis Director of Public Works. All coring holes shall be immediately sealed with a City of Ennis approved material to the appropriate level.
- C. Where referred to in this Standard, Proof Rolling shall be defined as:
 - 1. Upon completion of subgrade, subbase or base compaction the exposed subgrade areas shall be properly proof rolled in order to verify suitability to receive the base or pavement course.
 - 2. Proof roll shall consist of passing over the exposed surface with a 25 ton (+/- 1-ton) loaded tandem dump truck during dry weather and observed by the City Inspector. Result of observations shall be documented including horizontal limits of area rolled, approximate extent of vertical deflections, and any observed excessive rutting or pumping (soft spots). Excessive rutting shall be considered prolonged deflection (rutting) in excess of 1-inch for new construction or ½-inch for reconstruction. Excessive pumping shall be considered temporary deflection with rebound (pumping) in excess of 1-inch for new construction or ½-inch for reconstruction. Areas of surface soils that are observed to excessively rut or excessively pump

under the truck load (unsuitable subgrade) shall be removed to such an extent as directed by the Inspector, replaced with sand or other approved suitable material, and compacted.

2.2. – Design

A. Residential Streets:

1. Shall be constructed in accordance with a pavement design performed by a professional engineer, licensed in the state of Texas. The AASHTO pavement design method shall be used, except that other methods may be proposed for consideration by the Public Works Director. A geotechnical investigation and report of the site soils shall be performed by a professional engineer, licensed in the state of Texas in support of the pavement design and submitted to the City of Ennis.
2. Streets shall be a minimum of thirty (30) feet in width (back of curb-to-back of curb) and located within a fifty (50) foot minimum ROW.
3. Residential streets shall consist of hot-mix asphalt (flexible pavement design). See street section detail.
4. Hot-mix asphalt surfacing shall be in accordance with TxDOT standard specification item 340, *Dense-Graded Hot-Mix Asphalt (Small Quantity)*. Hot-mix shall be Type C, PG 64-22, two and one-half (2 1/2) inches typical.
5. All Residential streets shall have a minimum eight (8) inches of Flexible Base Material for base layer with a minimum of four (4) inches of the flexible base material extended beyond the proposed street width a minimum of one-foot on both sides. For example, on a proposed 30-foot wide street the subgrade shall be worked at 32-foot width.
6. Flexible Base Material shall be placed on (6) inch thick lime stabilized subgrade or flexible base material similar to the requirements for Industrial/Commercial and Collector Concrete Paved Streets.
7. Proof rolling of the finished subgrade with a loaded tandem axle dump truck may be required and witnessed by the City inspectors immediately prior to placement of the base layer (flexible base material).
8. All testing shall be at the developer's expense and completed by a testing laboratory approved by the City and with current AASHTO accreditation that demonstrates the laboratory's capabilities to perform applicable test procedures.
9. The City may periodically require additional test or proof rolling to assist them in evaluating the quality of work.
10. All new residential subdivision streets shall typically require a mountable/laydown curb and gutter. On a case by case basis, however, the Public Works Director reserves the right to require six (6) inch integral stand up curbs in lieu of mountable curbs.
11. Valley gutters shall be required at all intersecting streets where drainage flows across the intersection. See pavement detail sheets for valley gutter cross-section detail.
12. At the Public Works Director's discretion, concrete residential streets (rigid pavement design) may be allowed and shall be a minimum of six (6) inch thickness reinforced concrete pavement.
 - a. Concrete streets shall be a minimum of thirty (30) feet in width (back of curb to back of curb) and located within a minimum fifty (50) foot ROW.

- b. Concrete streets shall consist of six sack, minimum 4,000 psi compressive strength concrete for 28-day breaks, NCTCOG Class P1.
- c. Concrete streets shall, at a minimum, be reinforced with No. 4 (1/2 inch) steel deformed reinforcement bars placed on 12-inch centers both directions and tied at every overlap (splice).
- d. All splices shall have a length of not less than 30x the diameter of the reinforcement bar.
- e. Concrete Pavement shall be constructed on lime stabilized subgrade or flexible base material similar to the requirements for Industrial/Commercial and Collector Concrete Paved Streets.
- f. Driveways shall be constructed of 6" thick 4,000 psi concrete reinforced with No. 4 (1/2 inch) steel reinforcement bars placed on 18-inch centers both directions and tied at every overlap (splice).

B. Industrial/Commercial and Collector:

- 1. Shall be constructed in accordance with a pavement design performed by a professional engineer, licensed in the state of Texas. The AASHTO pavement design method shall be used, except that other methods may be proposed for consideration by the Public Works Director. A geotechnical investigation and report of the site soils shall be performed by a professional engineer, licensed in the state of Texas in support of the pavement design submitted to the city.
- 2. Concrete streets (rigid pavement design) shall be a minimum of seven (7) inch thickness reinforced concrete pavement for collector streets, and eight (8) inches or more for commercial/ industrial streets. The Public Works Director reserves the right to require a traffic study to be conducted by the Owner/Contractor in support of proposed pavement design and concrete thickness.
- 3. Streets shall be minimum widths as listed below:
 - a. Industrial/Commercial – forty- eight (48') feet – sixty (60') feet, seventy (70') feet – eighty (80') ROW
 - b. Collector – thirty- seven (37' B-B) feet – forty- four (44' B-B) feet based on anticipated traffic, sixty (60') feet – seventy (70) feet ROW
- 4. Concrete streets shall consist of six sack, minimum 4,500 psi compressive strength concrete for 28-day breaks, NCTCOG Class P2.
- 5. Concrete streets shall, at a minimum, be reinforced with No. 4 (1/2 inch) steel reinforcement bars placed on 12-inch centers both directions and tied at every overlap (splice).
- 6. Pavement shall be constructed on eight (8) inch thick Lime Stabilized Subgrade or on flexible base material. Lime stabilized subgrade and compaction shall meet or exceed the following requirements:
 - a. The subgrade shall be treated with lime at a rate of 6% by weight and mixed wet. Due to the potential presence of sulfates an observation/mellowing period will be required. The treated area shall be kept moist for a period of 4-days. A seal coat may be applied at an appropriate rate for the asphalt emulsion chosen from TxDOT Item 300, Table 18 rather than keeping the surface wet or as approved by the City.

- b. After 4-days the subgrade shall be re-mixed and compacted to a density of not less than ninety-five (95) percent of the maximum density at +3%/-0% of optimum moisture content for a depth of eight (8) inches below the finished subgrade elevation.
 - c. Proof rolling of the finished grade with a loaded tandem axle dump truck may be required and witnesses by City Inspectors.
- 7. If used in lieu of lime stabilized subgrade, flexible base may be placed at a minimum six (6) inches thickness placed on proof rolled subbase.
 - a. Proof rolling of the finished grade subbase with a loaded tandem axle dump truck will be required and witnessed by a City Inspector.
- 8. Stabilized subgrade or flexible base shall extend a minimum 1'-0" outside the proposed back of curb for the width of the street being installed.
- 9. Streets shall have six (6) inch integral stand up curbs.
- 10. Fire lanes and commercial property driveway approaches shall be constructed to the same materials, thickness, reinforcing, subgrade or base, and design requirements as collector street pavement.

C. Alleys:

- 1. Shall be constructed in accordance with a pavement design performed by a professional engineer, licensed in the state of Texas. The AASHTO pavement design method shall be used, except that other methods may be proposed for consideration by the Public Works Director. A geotechnical investigation and report of the site soils shall be performed by a professional engineer, licensed in the state of Texas in support of the pavement design submitted to the city.
- 2. Alleys (rigid pavement design) shall be a minimum of six (6) inch thickness reinforced concrete pavement. The Public Works Director reserves the right to require a traffic study to be conducted by the Owner/Contractor in support of proposed pavement design and concrete thickness.
- 3. Alleys shall be minimum width of twenty (20') feet edge to edge on twenty-five (25') ROW.
- 4. Concrete Alleys shall consist of six sack, minimum 4,000 psi compressive strength concrete for 28-day breaks, NCTCOG Class P1.
- 5. Concrete Alleys shall, at a minimum, be reinforced with No. 4 (1/2 inch) steel reinforcement bars placed on 12-inch centers both directions and tied at every overlap (splice).
- 6. Alley pavement shall be constructed on eight (8) inch thick Lime Stabilized Subgrade or on flexible base material. Lime stabilized subgrade and compaction shall meet or exceed the following requirements:
 - a. The subgrade shall be treated with lime at a rate of 6% by weight and mixed wet. Due to the potential presence of sulfates an observation/mellowing period will be required. The treated area shall be kept moist for a period of 4-days. A seal coat may be applied at an appropriate rate for the asphalt emulsion chosen from TxDOT Item 300, Table 18 rather than keeping the surface wet or as approved by the City.
 - b. After 4-days the subgrade shall be re-mixed and compacted to a density of not less than ninety-five (95) percent of the maximum density at +4%/-0% of optimum moisture content for a depth of eight (8) inches below the finished subgrade elevation.

- c. Proof rolling of the finished grade with a loaded tandem axle dump truck may be required and witnessed by City Inspectors.
 - d. All testing shall be at the developer's expense and completed by a testing laboratory approved by the City and with current AASHTO accreditation that demonstrates the laboratory's capabilities to perform applicable test procedures.
 - e. The City may periodically require additional test or proof rolling to assist them in evaluating the quality of work.
7. If used in lieu of lime stabilized subgrade, flexible base may be placed at a minimum six (6) inches thickness placed on proof rolled subbase.
- a. Proof rolling of the finished grade subbase with a loaded tandem axle dump truck will be required and witnessed by a City Inspector.
8. Stabilized subgrade or flexible base shall extend a minimum 1'-0" outside the proposed edge of pavement for the width of the alley being installed.
9. Alley shall have no curbs but shall be constructed in a "Vee" shape with 2% slope toward the center of the alley.

2.3. – Concrete Pavement Jointing

- A. Jointing for concrete streets shall be saw cut as soon as possible after initial concrete set but such that sawing does not damage the concrete, and no later than 24 hours after it is poured. The Contractor will be required to remove and replace concrete that develops cracks as a result of delay in sawcutting joints.
- B. Joints in concrete pavement shall be sealed within 96 hours after the saw-cutting with a crack sealing material approved by the Public Works Director or his designee. Joints shall be cleaned thoroughly prior to sealing.
- C. Joints in concrete pavement shall be saw-cut a minimum depth equal to 1/4 the thickness of the street concrete.
- D. Concrete streets shall be coated after free moisture has disappeared - at a rate of 180 SF/Gallon with a membrane curing compound in accordance with TxDOT materials specification DMS-4650 and TxDOT Item 420.4.10.3, and Item 360.4.9.1.
- E. All expansion/construction joints shall be doweled.
- F. Dowels for expansion and horizontal construction joints shall be smooth steel. Longitudinal construction joints may be smooth dowels or deformed bars. Required dowel sizes are as shown in table below.

Table 1: Pavement Thickness, Dowel Diameter, and, Dowel Length.

Pavement Thickness	Dowel Diameter	Dowel Length
(inches)	(inches)	(inches)
6	$\frac{3}{4}$	18
7	1	21
8	$1 \frac{1}{4}$	24
>8	Appr'd case by case	Appr'd case by case

- G. Expansion joint dowels shall be greased on the expansion joint end and include an expansion cap.

- H. Details for all pavement jointing shall be included in the construction drawings for review and approval by the City. The details shall indicate how dowels will be kept level and evenly spaced during construction.

2.4. – Testing

- A. Quality control testing required by the plans and specifications, and the associated expenses related to same, shall be the responsibility of the Owner/Contractor. Quality assurance (verification) testing shall be at the expense of the contractor, and shall be provided by a third-party testing lab.
1. The third-party testing laboratory shall be approved by the City of Ennis.
 2. The type, frequency, and location of required testing shall be in accordance with the approved plans and specifications, except at the discretion of the City of Ennis Public Works Director additional testing may be required.
 3. A copy of all test results shall be provided to the City of Ennis Public Works Director for approval.
 4. The construction must satisfactorily pass all tests before the City will approve a project. Failed tests shall require retesting at the sole expense of the Owner/Contractor.
 5. The City of Ennis will acknowledge test result approval or rejection to the contractor.
 6. Lime stabilization for subgrade soils when recommended by the Developer's engineer, and when approved for construction by the City, shall require lime series testing in addition to any plans and specifications required testing.
 7. All concrete pours for paving require that test cylinders be made. A minimum of 4 cylinders shall be prepared for each day's pour or every 50 CY, whichever is less. The City reserves the right to require additional cylinders be made if it deems necessary. The City reserves the right to alter frequency and number of tests as it deems necessary.
 8. All concrete pours are subject to coring for verification of depth. All core testing shall be at the expense of the developer and shall be performed by a laboratory approved by the City of Ennis Director of Public Works. All coring holes shall be immediately sealed with approved epoxy to the appropriate level.
 9. At the discretion of the City of Ennis Public Works Director, there shall be a slump test of concrete required for any truck arrival delivered.
 - a. No traffic will be allowed on new concrete streets for a minimum of seven (7) days.
 - b. Early opening to traffic may be allowed on a case by case basis at the discretion of the City of Ennis Public Works Director, and then only if the concrete has attained a minimum compressive strength of 3,200 psi.

2.5. – Sidewalk and Barrier Free Ramps (BFR)

- A. Sidewalk shall be a minimum of 4'-0" wide for Residential areas and 5'-0" wide for Industrial or Commercial Areas. Sidewalks shall be constructed by either the Developer or the Home Builder.
1. Transverse joints shall tooled (sawcut joints not allowed) at a spacing equal to the width of the sidewalk. Every fifth transverse joint shall be a 1/2" wide expansion joint.
 2. Sidewalk shall be constructed of 4" thick 3,500 psi concrete reinforced with No. 3 (3/8 inch) steel reinforcement bars placed on 14-inch centers both directions.
 3. All Sidewalk shall meet ADA and TAS requirements.

- B. All Barrier Free Ramps (BFR) must meet ADA and TAS requirements.
1. This item shall be governed by Separate Curb and Gutter TXDOT Item 529
 - a. Use Class A concrete or as specified on the plans
 - b. Reinforcement shall be no. 4 bars.
 - c. "CF" is 6" unless otherwise specified.
 - d. Grade shall be measured at *back* of curb.
 2. Materials shall conform to TXDOT:
 - a. Item 360, "Concrete Pavement"
 - b. Item 420, "Concrete Structures"
 - c. Item 421, "Hydraulic Cement Concrete"
 - d. Item 440, "Reinforcing"
 3. Barrier Free Ramps shall be installed by the Developer prior to final acceptance of a subdivision.

PART 3 - STORM DRAINAGE:

3.1. – General

- A. All storm sewer pipe shall be reinforced concrete pipe (RCP) unless otherwise approved by the City of Ennis, Public Works Director. Storm sewer pipe and installation shall conform to required infrastructure design standards (City of Ennis, NCTCOG, TxDOT). Smooth bore, HP Storm pipe by ADS, (PP) pipe or approved equal, if approved by the City, shall require bedding and backfill design details in accordance to manufacture's recommendation. PP pipe, if allowed, shall support same, or better, loads as reinforced concrete pipe of the appropriate loading classification. PP pipe, if allowed, shall require concrete headwalls and safety end treatments. If allowed, change of material from PP pipe to RCP shall only be allowed at a drainage structure.
- B. Manholes or other approved drainage structures shall be required at all change of horizontal or vertical alignment, each change of pipe size, and at the upstream end of each storm sewer systems. No curved storm drain pipe shall be allowed.
- C. Inlets and other drainage structures shall be reinforced concrete. Concrete for drainage structures shall be a minimum five (5) sack mix, meeting 3,500 psi compressive strength at 28 days. Pre-cast structures are allowable if they satisfy the requirements of the approved drawings and specifications.
- D. All grates, frames, and lids for drainage structures shall be traffic rated for minimum HS-20 traffic loading.

3.2. – Design

- A. The capacity of storm sewer conduits, inlets, and other drainage structures proposed shall be supported by calculations signed and sealed by a professional engineer, licensed in the state of Texas and shown in the construction drawings. In addition, a Drainage Watershed Map and hydrological calculations signed and sealed by a professional engineer, licensed in the state of Texas, shall be provided in the construction drawings.
- B. The Rational Method for computing storm water runoff is to be used for hydraulic design of facilities serving a drainage area of less than 600 acres. For drainage areas of more than 600 acres and less than 1200 acres, the runoff shall be calculated by both the Rational Method and the Unit Hydrograph Method with the larger of the two values being used for hydraulic design. For drainage areas larger than 1200 acres the runoff shall be calculated by the Unit Hydrograph Method. Storm

Drain precipitation data for Rational Method shall be based on September 2018 National Oceanic and Atmospheric Administration (NOAA) updated precipitation frequency estimates for Texas. Refer to the [NOAA's Precipitation Frequency Data Server](#) (PFDS) website.

- C. All storm sewer conduit and inlets shall be sized at a minimum to contain the 25-year storm event with emergency overflow. Closed conduit storm drains with no emergency overflow shall be sized at a minimum to contain the 100-year storm event. Computations shall be provided in the construction drawings for the 25-year and 100-year storm events.
- D. For curb and guttered streets, the 25-year closed storm conduit HGL shall not to exceed the street gutter line elevation.
- E. Ponding in streets shall not overtop street right-of-way capacity for the 100-year storm event and the top of curb capacity for the 25-year storm event.
- F. Cross-drainage culverts and bridge spans conveying runoff from one side of the street to the other shall be sized to, at a minimum, convey runoff from a 100-year storm event without overtopping the street.
- G. Storm Inlets should be placed upstream of street intersections to prevent large amounts of runoff from flowing across the intersection. No more than 5.0 c.f.s. may cross an intersection in a 25-year flood. A minimum spacing of 10 feet from the curb return to the leading edge of the storm sewer inlet is preferred.
- H. Storm drain mains, culverts, and inlets shall be sized to convey runoff from storm events based on the design frequencies specified herein and for maintenance purposes the following minimum sizes shall apply. Minimum curb inlet length shall be 10 feet. Minimum drop inlet size shall be 4 feet square. Minimum curb inlet lead size shall be 18-inch diameter. Minimum storm drain main size shall be 24-inch diameter. Minimum open culvert size for cross drainage shall be 24-inch diameter. Minimum open culvert size for driveway culverts shall be 12-inch diameter.
- I. Any habitable structure on property abutting a natural or excavated channel shall have a finished floor elevation at least 2-feet above the 100-year design storm.
- J. Where lots are not abutting a natural stream or excavated channel, the minimum finished floor shall be a minimum of 12 inches above the top of mountable street curb or 10 inches above the top of stand-up street curb, unless otherwise approved by the Public Works Director.
- K. The approved drainage system shall provide for a paved positive overflow at all low points. The term "Paved Positive Overflow" means that when the inlets do not function properly or when the design capacity of the conduit is exceeded the excess flow can be conveyed overland along a paved course.
- L. Storm water runoff shall be conveyed underground in storm sewer conduit unless otherwise approved by the City of Ennis, Public Works Director.
 - 1. At the Public Works Director's discretion, a concrete pilot channel may be allowed and shall be a minimum of six (6) inch thickness reinforced concrete, reinforced with #4 bars at 18" on center each way. The concrete lined portion of the pilot channel shall be 8'-0" wide toe to toe plus 1'-0" lined walls at 4:1 side slope. Above the lined portion of the pilot channel the grass line soil side slopes shall be a maximum of 4:1.
 - 2. Streets adjacent to an open channel shall be designed with an elevation not lower than 1-foot above the drainage and floodway easements or as directed by the City of Ennis, Public Works Director.
- M. Drainage and floodway easements shall be provided for all drainage improvements.

1. Easements for buried storm sewer conduit shall be a minimum of twenty (20) feet.
 2. Easement width for open or lined channels shall be at least twenty (20) feet wider than the top of the channel.
 3. All easements shall be accessible from public right-of-way for maintenance.
- N. Runoff coefficients, as shown in Table 2, shall be used, based on total development under existing land zoning regulations. Where land uses other than those listed in Table 2 are planned, a coefficient shall be developed utilizing values comparable to those shown. Times of concentration shall be computed based on the minimum inlet times shown in Table 2.

Table 2: Coefficients of Runoff and Minimum Inlet Times

Land Use	Runoff Coefficient C	Minimum Inlet Time in Minutes
Residential	0.6	15
Commercial & Industrial	0.9	10
Multiple Unit Dwelling	0.8	10
Parks	0.4	15
Cemeteries & Pasture	0.4	15
Woods	0.3	15
Cultivated	0.6	20
Shopping Centers	0.9	10
Paved Areas	0.9	10
Schools	0.7	15
Patio Homes	0.6	15
Churches	0.8	10

- O. Storm sewers shall discharge into open channels at a maximum velocity of 6 feet per second. Storm drain grades shall be set to produce a velocity of not less than 3 feet per second (fps) when flowing full. Grades producing velocities of less than 3 fps will not be allowed.
- P. Maximum velocities in closed conduits shall be as shown in Table 3 below

Table 3: Minimum Velocities in Closed Conduit.

Type of Conduit	Maximum Velocity	
Culverts	15	f.p.s.
Inlet Laterals	30	f.p.s.
Storm Sewers	12	f.p.s.

3.3. – Detention of Storm Water Flow

- A. Developments shall be required to provide adequate detention so that post-development peak flows do not exceed the pre-developed peak flows calculated for the area. Inflow volumes shall be calculated for the 5, 10, 25, and 100-year storm frequencies. A form of the Rational Method should be used to calculate inflow volumes from areas less than 50 acres. A form of the inflow hydrographs shall be used for areas of 50 acres or more. No reduction in the design storm frequency shall be considered when utilizing detention systems within the overall storm drainage design. The detention shall be designed for the 100-year storm frequency, 24-hour design storm duration and

a time to empty of 48 hours. All design calculations shall be part of the construction plans.

- B. An outlet control structure such as an orifice and weir placed at the inlet end of the outfall conduit is to provide an integrated stage-discharge such that a wide range of storms can be effectively controlled.
- C. Reinforced pilot channels sized for low flow are required for detention facilities between inlet/outlet and at point discharges to pond bottom, minimum paving slope 0.5%. Non paved pond bottom minimum slope shall be 1.0%.
- D. Development shall have zero adverse impact on adjoining property or on receiving roadway, ditch, or stream downstream of the proposed outfalls. A hydraulic study that illustrates no adverse conditions are created downstream as a result of development in lieu of storm detention may be accepted at the discretion of the Public Works Director.
- E. Detention / Retention Pond Operation and Maintenance Manual:

Provide an Operations and Maintenance Manual for any proposed Detention or Retention Pond system. Refer to the example O&M manual contained in Section 300, Appendix B - Detention / Retention Pond Operation and Maintenance, Attachment Number 1, SAMPLE DETENTION BASIN OPERATION AND MAINTENANCE MANUAL. Additional sections / procedures shall be included to address unique or unusual features.

Background / Purpose

A defined maintenance program is essential for detention facilities to maintain their operational integrity and original design intent. Prior to plan approval, the owner will provide an Operation and Maintenance (O&M) Manual to the Public Works Department for review and approval. Attached is an outline of the major topics and specific procedures the O&M manual shall address. O&M manuals are required for retention, detention, and amenity ponds.

The O&M manual will define the pond's key components, their function, and operational characteristics under normal flow conditions. The O&M manual will define the design intent of the system's primary components, its scope, and schedule of maintenance activities required to maintain a safe and effective operating facility.

The O&M manual shall include the name, address and telephone number of the party or parties responsible for long-term maintenance. Documentation of their assumption of this responsibility shall be included in O&M manual with the completion of Section 300, Appendix B - Detention / Retention Pond Operation and Maintenance, Attachment Number 2, MAINTENANCE ACKNOWLEDGEMENT. The transfer of maintenance responsibility to individual property owners in residential subdivisions shall be prohibited except through a homeowner's association agreement.

Maintenance responsibility shall be defined on the subdivision plat and on the design drawings. Permanent access to the facility shall be provided by platting a 15-foot wide continuous access easement from a public right of way to accessible location at the pond.

Note: Any detention pond modifications affecting the storage capacity or outlet structure of a detention pond will require a new manual and calculations reflecting the altered configuration to be approved by the Public Works Department prior to release of the Building Permit. Updated plans and calculation are required for any pond modifications and the modifications must be included in the owner's Operations and Maintenance Manual.

General Maintenance Procedures

The structural and functional integrity of the ponds shall be maintained at all times by removing and preventing drainage interference, obstructions, blockages, or other adverse effects into, through, or out of the system.

The O&M manual shall include provisions for periodic silt removal when standing water conditions occur or the pond's storage volume is reduced by more than 10%. Silt shall be removed and the pond/basin returned to original lines and grades shown on the approved engineering plans. In addition, corrective measures are required any time a basin does not drain completely within 72 hours of cessation of inflow. NO STANDING WATER IS ALLOWED in basins designed for dry detention purposes.

Accumulated litter, sediment, and debris shall be removed every 6 months or as necessary to maintain proper operation of the basin. Disposal shall be in accordance with federal, state and local regulations.

Detention facilities shall be mowed monthly between the months of April and October or anytime vegetation exceeds 12-inches in height.

During subdivision construction or project construction, the detention facility and all associated appurtenances shall be constructed in accordance with the approved design plans. Note the design standards requires among other things, that the basin and appurtenances be constructed at the beginning of the project. The manual will address interim facility maintenance from initial construction through final inspection and acceptance by the City.

Vegetation shall be established on disturbed areas in accordance with the Storm Water Pollution and Prevention Plan and North Central Texas Council of Governments Best Management Practices Manual specification. Irrigation shall be provided during and after subdivision construction. Hardy, disease resistant, perennial grasses shall be specified for the bottom and side slopes of the detention basin.

To prevent debris from entering and clogging the downstream storm sewer system a wire mesh screen or similar screening device shall be installed over the outlet until final acceptance.

Submittal Requirements

Refer to the attached Section 300, Appendix B - Detention / Retention Pond Operation and Maintenance, Attachment Number 5, "OPERATION AND MAINTENANCE MANUAL" REVIEW CHECKLIST for a list of items that should be verified/included in the manual.

3.4. – Installation

- A. Materials for jointing concrete storm sewer conduit, and installation of conduit, shall be in accordance with TxDOT Standard Specification Item 464. Materials for jointing concrete box culverts, and installation of box culverts, shall be in accordance with TxDOT Standard Specification Item 462. Concrete junction boxes, manholes, and inlets shall meet the requirements of TxDOT Standard Specification Item 465. Safety End Treatments for pipes and culverts shall meet the requirements of TxDOT Standard Specification Item 467.
- B. All concrete storm sewer conduit shall be bedded with a minimum 6-inch depth with stone, $\frac{1}{4}$ " – $\frac{3}{4}$ " inch diameter well graded crushed stone, and shall be bedded up to at least $\frac{3}{4}$ the height of the pipe.
- C. Box culverts, inlets, and other concrete drainage structures shall require a minimum of three (3) inches rock bedding, $\frac{1}{4}$ " – $\frac{3}{4}$ " diameter. The rock bedding shall extend a minimum of six (6) inches beyond the edges of the structure in all directions. Larger structures will require additional depth of rock bedding.
- D. Backfill to the top of the pipe or box culvert shall be a fine-graded cohesionless material tamped for compaction, or by use of water ponding. Fine-graded, cohesionless backfill shall extend a minimum of one foot on either side of pipe and box culverts.
- E. Backfill above the pipe or box culvert shall be excavated materials except that density requirements must be attained. Backfill shall be placed in maximum of 8" lifts compacted to 90% Standard Proctor Density in non-paved areas and to 95% Standard Proctor Density underneath or within 5' of asphalt, concrete, driveways, parking lots, structures, or future paved areas.

3.5. – Testing

- A. Quality control testing required by the plans and specifications, and the associated expenses related to same, shall be the responsibility of the Owner/Contractor. Quality assurance (verification) testing shall be at the expense of the contractor, and shall be provided by a third-party testing lab.
- B. The third-party testing laboratory shall be approved by the City of Ennis.
- C. The type, frequency, and location of required testing shall be in accordance with the approved plans and specifications, except at the discretion of the City of Ennis Public Works Director additional testing may be required.
- D. A copy of all test results shall be provided to the City of Ennis Public Works Director for approval.
- E. The construction must satisfactorily pass all tests before the City will approve a project. Failed tests shall require retesting at the sole expense of the Owner/Contractor.
- F. The City of Ennis will acknowledge test result approval or rejection to the contractor.
- G. All concrete pours for manholes, inlets, etc. require that test cylinders be made. A minimum of 4 cylinders shall be prepared for each day's pour or every 50 CY, whichever is less. The City reserves the right to require additional cylinders be made if it deems necessary. The City reserves the right to alter frequency and number of tests as it deems necessary.
- H. At the discretion of the City of Ennis Public Works Director, there shall be a slump test of concrete required for any truck arrival delivered.

PART 4 – Street Lighting:

4.1. – General

- A. Provide a Street Lighting Plan meeting the requirements listed below. Street lights located within street right-of-way may be accepted for perpetual maintenance and power supply:
- B. Street lights shall be required at a maximum distance of 600-feet apart, and at intersections and cul-de-sac ends. Additionally, lights shall be installed where road curvature or other conditions exists that limit illumination between locations.
- C. Lights shall be located in the parkway between the sidewalk and the back of the curb and shall not encroach upon the sidewalks and barrier free ramps.
- D. Final location of street lights shall require approval of the City of Ennis
- E. For Residential developments Street lights shall be 55 W LED Cobrahead on 25' galvanized steel poles with embedded type foundations.

For Commercial and Industrial Developments Street lights shall be 140 W LED Cobrahead on 30' galvanized steel poles with pre-cast type foundations.

PART 5 – Signage

5.1. – Street Signs

- A. The owner/developer will be required to furnish and install sign foundations and purchase permanent and install Street name signs to be provided by the City at procurement cost.
 - 1. Owner/Developer shall submit a layout of street sign locations for City approval.
 - 2. Owner/Developer shall install street sign foundations consisting of the Wedge Anchor Steel System galvanized steel pipe socket installed according to the TxDOT Sign Mounting Details standard drawing SMD(TWT)-08.
 - 3. Owner/Developer shall purchase street sign post and street name signs from the City at invoice cost for procurement of the post and signs.
 - 4. Owner/Developer shall install the post and street name signs.

5.2. – Traffic Control Signs

- A. Temporary and permanent traffic control signage and devices shall comply with the requirements of the Texas Manual on Uniform Traffic Control Devices, latest edition.
- B. The owner/developer will be required to furnish and install temporary and permanent traffic control signage and devices as approved by the City.
 - 1. Owner/Developer shall submit a layout of street sign locations for City approval.
 - 2. Owner/Developer shall install street sign foundations consisting of the Wedge Anchor Steel System galvanized steel pipe socket installed according to the TxDOT Sign Mounting Details standard drawing SMD(TWT)-08.
 - 3. Owner/Developer shall install posts and traffic control signs as shown on the approved layout.

SECTION 200: WATER AND WASTEWATER

DEFINITIONS OF ACRONYMS USED IN THIS DOCUMENT:

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
NCTCOG	North Central Texas Council of Governments
TCEQ	Texas Commission on Environmental Quality
PSI	Pounds per Square Inch
TX-DOT	Texas Department of Transportation
ROW	Right of Way

INTRODUCTION

The following requirements are hereby established as the standard for the City of Ennis and are to be used in conjunction with the most recent versions of the Standard Specifications for Public Works Construction as released by NCTCOG, AWWA specifications, and requirements of the TCEQ Regulations 30 TAC Ch. 217, Ch. 290 and/or others as applicable.

The City of Ennis infrastructure design standards contained herein shall take precedence over the above listed references, when instances of conflicting infrastructure design standards arise.

PART 1 - RESERVED

PART 2 - GENERAL CONSTRUCTION REQUIREMENTS AND STANDARDS

2.1. – Construction Requirements

- A. A notice of at least 48 hours must be provided to the City prior to beginning any construction.
 - 1. If the utility construction is required to be done after normal working hours, or on weekends or holidays, all overtime pay for the City Utility Inspector shall be paid for by the contractor. Failure to pay overtime fees shall result in the forfeiture of the posted Performance and Maintenance Bond.
 - 2. The contractor or owner will be responsible for replacement of any City of Ennis property damaged during construction, including, but not limited to, facilities, appurtenances, lines, valves, fire hydrants, manholes, lift stations, etc.
 - 3. An emergency contact with telephone number must be on file prior to beginning construction.
- B. All testing shall be at the contractor's or developer's expense, and completed by a testing laboratory approved by the Public Works Director. The City shall determine the type, frequency and location of all required testing. Testing laboratories shall notify the City 48-hours in advance of field testing or sampling. A copy of all test results shall be provided to the City of Ennis Public Works Director for approval. All of the contractor's work must satisfactorily pass each test with written test results in the City's possession before the City will approve any construction.
 - 1. All utility backfill and embedment shall be placed and compacted per Utility Details. Backfill shall be placed in maximum of 8" lifts compacted to 90% Standard Proctor Density in non-

paved areas and to 95% Standard Proctor Density underneath or within 5' of asphalt, concrete, driveways, parking lots, structures, or future paved areas.

2. Compaction testing of backfill placement shall be performed for each lift at locations determined or approved the City Inspector. Compaction testing shall be performed every two hundred feet (200') in non-paved areas, or every fifty-feet (50') underneath or within 5' of asphalt, concrete, driveways, parking lots, structures, or future paved areas.
- C. If the utility construction is to be located in easements on private property, the developer or contractor shall provide the easement by platting or dedicating the easement with approval of the City. All plats or easements shall be provided to the City by the developer or contractor when the plans are submitted.
- D. Any utility construction located in a State of Texas right-of-way must be permitted. The engineer shall furnish to the City in electronic format (PDF) the required back up documentation and drawings for the project. The City will complete and submit the proper TX-DOT forms and will bill the engineer or developer for this service on an hourly basis with a 2-hour minimum. Only the City has the ability to secure TX-DOT permits and any questions regarding these permits shall be addressed to the City. These permits generally require a minimum of 3 weeks to process. At least a 72-hour notice is required to the City prior to any construction beginning, and after the permit is issued, in the TX-DOT right-of-way.

2.2. – Standards

- A. All utility construction shall be performed in accordance with infrastructure design standards listed herein and shall be inspected and documented by the City of Ennis Utility Department.
- B. No utility construction shall begin until a set of engineered drawings of the proposed construction, stamped by a Texas licensed engineer, is received by the City of Ennis and approved by signature of the Director of Public Works or his designee.
- C. All water lines up to 12" in diameter must have a minimum cover of 40 inches.
- D. All utility lines and appurtenances must be inspected and approved by the City Public Works Department or City Building Inspections Department prior to back filling or covering.
- E. City streets and/or curbs shall not be cut without the express written approval of the City of Ennis Director of Public Works.
- F. Boring requirements are as follows:
 1. Smooth-wall casing pipe shall be of welded steel construction, shall be of new material and shall meet any additional requirements of the railroad or highway authority that may have jurisdiction.

Table 4: Utility Casing Diameter and Thickness Requirements

Pipe Size in Inches	Casing Size in Inches	Casing Thickness (min.)
6	12	1/4"
8	16	5/16"
10	18	5/16"
12	20	3/8"
16	26	7/16"
20	30	1/2"
24	33	1/2"

2. Pipe within the casing shall be an unbroken run, and this shall be accomplished by using an approved fusible pipe, a pipe with interlocking joints, or joint restraints.

3. Casing spacers shall be used to install carrier pipe inside the encasement pipe. The spacers shall be of a projection type that has a minimum number of projections around the circumference totaling the number of diameter inches. For example, 8" pipe shall have a minimum of 8 projections and 18" pipe shall have a minimum of 18 projections.
4. Casing spacers shall fasten tightly onto the carrier pipe so that the spacers do not move during installation. Casing spacers shall have a span of 10 feet to 6-1/2 feet dependent on the total load anticipated with the pipe full of liquid. On sewer pipe, the maximum span should be 7 feet to prevent sagging of the carrier pipe. The maximum load shall not exceed the load limits per spacer per the manufacturer's recommendation.
5. Casing spacers shall be totally non-metallic and constructed of preformed sections of high-density polyethylene. Spacers shall be certified for strength and quality. Raci type spacers or an approved equivalent shall be used.
6. The ends of the casing shall be sealed using CCI Model ESC Pull on end seals or approved equal. End seals shall be installed as recommended by the manufacturer. In all cases, bands and clamps shall be stainless steel and the seals shall be of the highest quality and meet or exceed industry.

PART 3 - WATER MAIN DESIGN

3.1. – General

- A. Water main construction must in all ways meet AWWA minimum design standards.
- B. All water meter boxes/vaults and valve boxes must be at finished grade, including sod, and visible at the time the job is completed and until the 24-month final inspection is completed. The Maintenance Bond shall not be released if all boxes/vaults are not visible.

3.2. – Minimum Size & Material

- A. The minimum acceptable water pipe size for public utilities shall be eight (8) inches; larger sizes may be required by the City of Ennis Public Works Director as a result of the plan review process. All potable water lines laid in the City must be blue in color.
- B. The minimum acceptable water pipe material for private lines larger than 4" shall be C900, DR 18 PC235.
- C. The minimum acceptable water pipe material for any private line four (4) inches or smaller shall be ASTM D2241, Class 160.

3.3. – Main Line Location

- A. All main water lines shall be located in ten (10) feet from the centerline of the roadway as shown on the typical cross section details. Where possible, the water line shall be placed on the north or westerly side of the centerline unless otherwise approved.
- B. At no time is a water line to be placed closer than nine (9) feet to a wastewater line. Where the nine-foot separation distance cannot be achieved, refer to the guidelines from TAC 30 Chapter 217 as they will apply.
- C. Prior to backfilling, all main water lines and appurtenances shall have GPS locations established in a format sufficient for inclusion on our GIS Mapping System.
- D. Prior to backfilling, all main water lines shall have a Detectable Marking Tape laid on the top of the pipe initial backfill layer to assist in locating the line once it is covered. Said tape shall be placed directly over the center of the top center of the pipe.

3.4. – Joints

- A. All water main fittings must be ductile iron.
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- B. All joints shall be flange or mechanical joint.
- C. All mechanical joints must use Mega Lugs.
- D. After inspection and approval of the joint, all ductile iron fittings and valves shall be wrapped using an 8-millimeter polyethylene. The wrap shall be installed without breaks, tears, or holes in the film.
- E. No slip joints will be allowed on three (3) inch or larger lines.
- F. No glue type joints are allowed on any line.
- G. All fittings subject to surge or pressure must be blocked with 5 sack concrete and in accordance with the WATER MAIN BLOCKING DETAILS as shown in the details sheets.

- H. Line valves must be located so that no more than 500 feet of line will be out of service if a main failure occurred.

3.5. – Bedding

- A. All water lines must be bedded with Grade 4 rounded pea gravel at depths of six (6) inches below the pipe and six (6) inches above the pipe
- B. Service lines shall be bedded with sand at depths of six (6) inches below the pipe and six (6) inches above the pipe.
- C. Place bedding material at trench bottom, level fill materials in a continuous layer not exceeding 8 inches compacted depth, and compact to 90% standard proctor maximum density.
- D. See Pipe Embedment Detail.

3.6. – Fire Hydrants

- A. All fire hydrants that are installed as public utilities shall be improved style of Mueller.
- B. (Super Centurion Model A423) Upper Barrel, Bonnet, and caps painted Flynt Silver from the manufacturer.
- C. 5 ½ inch barrels.
- D. 3-way hydrants with one 4.5" steamer and two 2.5" outlets; outlets shall have national standard thread.
- E. Installed so that the center nut of the steamer cap is located at 18" above the final grade.
- F. Installed so that the breakaway flange is located at final grade.
- G. Installed with a valve between the hydrant and the main line.
- H. Anchored using Grade Lok or another approved swivel type anchor.
- I. Set with the steamer of the hydrant facing the street or fire lane.
- J. Set at 500' intervals in residential areas and 300' intervals in commercial/industrial areas.
- K. Installed in park ways and are not to encroach upon sidewalks or curbs in any fashion.
- L. Rounded rock 1" to 2" in size must be used as backfill up to 12" above the foot of the hydrant.

3.7. – Testing: Before lines can be placed in service, the following must be completed:

- A. Bacteriological Sampling
 - 1. All newly-installed lines and repaired mains must be disinfected and tested for bacteriological presence in accordance with the Rules and Regulations of TCEQ and must be completed prior to a line being placed into service
 - 2. Lines may be placed in service only after sample results are negative for coliform.

3. Introduce 50 ppm (mg/L) chlorine solution, hold in the lines for 24 hours.
4. Flush the highly chlorinated water from the lines.
5. Fill the line with system water.
6. A minimum of one sample must be collected for each 1,000 feet of line that is installed.
7. All sampling shall be at the expense of the contractor who will be billed prior to sampling.
8. Accessible sampling points shall be prepared by the contractor at points designated by the City.
9. No standing water will be at the site where the sample is to be collected. Use whatever means are necessary to ensure the area around the sampling point remains dry.
10. The sample collection site must be at least 3' above ground level, be equipped with a brass hose bib pointed down, and be thoroughly flushed prior to sample collection.
11. All sampling shall be conducted by the City of Ennis however the contractor should have staff on site for the opening and closing of line valves and other duties as required.
12. System valves are never to be operated without City personnel present.
13. If a coliform-found result is reported, the process must be repeated until the sample results are negative for coliform.
14. Water lines that pass all tests shall be put into service at that time.
15. After the acceptance of the main utility lines and public fire hydrants, the Fire Department will flow test and color code the hydrants based on flow characteristics.

B. Pressure Testing:

1. Potable water lines shall pass the appropriate pressure test of 150 PSI for 4 hours.
2. Underground fire sprinkler system lines and/or private fire protection lines shall be tested at 200 PSI for 2-hours.

3.8. – Water Meters sizes 5/8"x3/4", 1", 2", 4", 6", 8"

- A. Type: All 5/8"x3/4" water meters shall be low flow displacement meters or equal. All water meters 1" or greater shall be of Single-Jet design and operation with a single measuring element. For 1" or greater size meters: compound type, turbine type, multi-jet type, and displacement type meters shall not be considered as equals. For compatibility with existing system, all water meter shall be combined with innov8-VN Smart Water Meter Register/Cellular Modems.
1. Any proposed low flow displacement meters must have been in service in U.S. water utilities for a minimum of 5 years.
 2. Any proposed single-jet meters must have been in service in U.S. water utilities for a minimum of 10 years.
- B. Performance: Meters must meet the performance specifications outlined below including technical documentation to support performance claims.

Meter Size	Low Flow (at least 95%)	Accuracy Range (98.5%- 101.5%)	Lay Length (inches)
<u>Altair</u>			
5/8 x 3/4"	0.03 gpm	0.1 - 20 gpm	7 1/2"
<u>Spectrum Meters</u>			
1"	1/8 gpm	1/2 - 70 gpm	10 3/4"
1 1/2"	1/2 gpm	3/4 -105 gpm	8", 13", 17"
2"	1/2 gpm	3/4- 185 gpm	10", 17"
3"	1/2 gpm	3/4 - 350 gpm	12"
4"	1/2 gpm	3/4 - 500 gpm	14"
6"	1 gpm	2 -1000 gpm	18"
<u>Enduro Meters</u>			
6"* (Enduro 2800)	4.4 gpm	7 –3500 gpm	24"
8"* (Enduro 2800)	4.4 gpm	7– 3500 gpm	24"

*FM approved with fire service strainer

- C. Operation: Low flow displacement meters shall utilize a rotary piston driven around a center roller. Single-Jet meters shall utilize only 1 measuring element (impeller) to achieve performance shown in table above. No meters utilizing 2 or more measure measuring elements such as combination meters or compound meters shall be accepted.
- D. Guarantee: These meters shall be guaranteed to be free from defects in material and workmanship for a period of five (5) years from date of shipment.
- E. Main Case: The main case shall be made of non-corrosive metal and shall withstand a working pressure of 230 P.S.I. without seeping or distortion affecting the free operation of the measuring unit. The direction of flow must be permanently indicated on the case. A twenty-year guarantee is required for the main case. Main case must be made of an NSF approved alloy. Epoxy coated meters shall not be considered.

3.9. – Water Meter Box Requirements

A. Purpose: To facilitate water meter reading and/or data acquisition and provide an environment for an unobstructed RF signal from the water meter and protection for the meter.

B. Meter Box:

1. One-inch (1") water meter is the minimum size and shall be installed in 18" x 15" meter box with lid.
2. Two-inch (2") water meters shall be installed in 24" x 15" meter box with lid.
3. All water meters larger than 2" shall be installed in appropriately sized concrete meter vault with sump. (See Vault Installation section and standard details).
4. The meter box body shall be constructed of white seamless PVC, with a ribbed exterior and smooth interior meeting all requirements of ASTM International (ASTM) f794 and UNI-B-9-90.
5. All Meter Boxes shall be slotted (from the bottom – up) on the customer's service line side of the meter to slide over service line to facilitate removal or adjustment of the meter box.
6. Water meter boxes supplied shall be those as manufactured by B2O Environmental featuring the Nicor customized lid or and approved equal.
 - a. The box for one-inch (1") meters shall be round eighteen inches (18") in diameter and fifteen inches (15") depth as specified (PGMB PL-18 x 15) or approved equal.
 - b. The box for two-inch (2") meters shall be round twenty-four inches (24") in diameter and fifteen inches (15") depth as specified (PGMB PL-24 x 15) or approved equal.
 - c. In special cases where approved by the Director of Public Works the Water Meter Ring and Lid may be cast-iron labeled "WATER METER".

C. Meter Box Ring:

1. The ring shall be injection molded and made with 100% virgin no-break polymer for consistency and quality.
2. The ring shall meet H20 load specifications per American Association of State Highway Transportation Officials (AASHTO).
3. A locator disc shall be affixed to the underside of the ring.
4. The ring shall meet the slip resistant requirement of ADA.

D. Meter Box Lid:

1. The lid shall be made of the same materials as the ring and meet the same H20 load specifications.
2. The lid shall be lockable and be ready to accommodate an AMR/AMI device.
3. The lid shall have a locator disc affixed to the underside.
4. The lid shall be embossed with the City name and logo in a 2" x 6" area on the face of the lid.

5. The lid shall meet the slip resistant requirement of ADA.

3.10. – Method of Meter and Meter Box Installation

- A. All water meters must be installed in the public right-of-way without written approval of the Public Works Director.
- B. All water meter boxes shall be installed so that installed meter is centered in meter box.
- C. All meter boxes shall be installed so that the top of the box will be at final grade including sod and with a minimum of 2" of pea gravel covering the entire bottom of the box.
- D. Angle stops shall be set six (6) inches below finished grade.
- E. A meter spud shall be used on all 1" meter installations.
- F. On water meters larger than 1", there must be a brass valve on each side of the meter.
- G. Meters and/or meter boxes shall not be re-located without the consent of the Director of Public Works.

3.11.– Vault Installation

- A. All vaults must be pre-cast concrete with a lid large enough for easy ingress, egress and ventilation of the space
- B. Vault lids must be large enough to allow for removal and reinstallation of all components contained in the vault
- C. All vaults are required to be large enough for a repairman to enter for meter repair and/or replacement and shall have a sump hole at least 1-foot square by 1 foot deep installed and equipped with a pump which will keep the work area dry. Purchasing, providing power for, and maintaining the pump shall be the customer's responsibility.
- D. The meter box/vault shall be large enough to accommodate backflow protection, meter, meter bypass assembly and valves.
- E. The meter vault shall be large enough to allow repair work.
- F. Concrete meter vaults shall have a 2" hole cast or cored in lid to allow for installation of radio read antenna.

3.12.– Tapping Requirements

- A. No direct service taps smaller than 8" diameter shall be allowed on water transmission mains greater than 12" diameter.
- B. No size on size taps are allowed without the written consent of the Director of Public Works.
- C. Tapping saddles or tapping sleeves shall be required for all taps.
- D. All taps 2" and smaller must use a tapping saddle with wide stainless-steel straps and nylon coated bodies such as Romac 101N, Smith Blair 315, or approved equal.
- E. The minimum size service tap allowed shall be 1".

- F. Where taps are adjacent on the same side of the water main, or taps are adjacent but on opposite sides of the water main, place taps no closer than 12" on center.
- G. Corporations must be brass and the style shall be CC by compression.
- H. All taps larger than 2" must use a circumferential seal, all stainless-steel tapping sleeve such as Romac SSTIII, or approved equal.
- I. Tapping sleeves must be air tested to 90 PSI for a minimum of 2-minutes prior to the tap being made and this test must be witnessed by City personnel.
- J. The Director of Public Works shall determine how any and all connections to existing water lines are to be accomplished.
- K. All taps and connections must be inspected by City of Ennis personnel.

3.13. – Valves

- A. All valves shall be installed so that the valve box lid and pad will be at finished grade, including sod.
- B. Valves nuts shall be located in the center of the box.
- C. All valve boxes shall have an 18" x 18" concrete pad around the lid at finished grade. The valve lid and pad shall be at the same elevation.
- D. In line valves must be located so that no more than 500 feet of line will be out of service in the event of a main failure.
- E. All waterlines shall be interconnected to a minimum of two adequately-sized feeder lines. Valving shall be installed as needed to provide continuous service from either direction in the event of water loss from a feeder line.

3.14.– Water Services

- A. All water service line shall be a minimum of 3/4" diameter and shall be ENDOT ENDOPURE HDPE SDR-9 POLY SERVICE LINE (or approved equal).
- B. Water services greater than 100' long from Meter to primary site structure shall require the installation of a testable double check valve immediately downstream of the water meter.
 - 1. A Double Check Valve Assembly is a testable backflow prevention assembly. A residential dual check is not considered a testable device and does not comply with the requirements. The Double Check Valve Assembly shall not be buried in earth but may be installed below ground level in a meter box if the ball-valve test cocks of the assembly are fitted with brass plugs. Some of the brands available that meet the requirements are Watts, Zurn, Febco, and Wilkins.
 - 2. The double check valve assembly shall be tested and reported to SC Tracking, then inspected by City of Ennis prior to initially turning on the water meter and shall be retested and reported annually.

PART 4 - WASTEWATER DESIGN

4.1. – Minimum Size & Material

- A. Wastewater plans and specifications must be prepared by a Professional Engineer registered in Texas, must conform to all sections of 30 TAC Chapter 217, and must be strictly adhered to during construction. Appropriate TCEQ, ASTM, ANSI, ASME, or AWWA standards shall be cited and used where appropriate. All standards must be the latest revision.
- B. Plans and specifications must be reviewed for adherence to 30 TAC Ch. 217 and approved by the City of Ennis and a reviewing engineer prior to any work beginning.
- C. All service line cleanouts and main line manholes must be at grade and visible at the time of job completion and at the final inspection. The 24-month Maintenance Bond shall not be released if these are not visible.
- D. The City of Ennis will not be responsible for any malfunction or failure of any line, connection, assembly or system that results in wastewater backups onto or into the property of a customer.
- E. No sewer other than service laterals and force mains shall be less than eight inches in diameter without written approval of the Public Works Director. Larger sizes may be required by the Director of Public Works as a result of the plan review process.
- F. Proposed gravity collection system pipe shall include the appropriate American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), or American Water Works Association (AWWA) standard numbers for both quality control (dimensions, tolerances, etc.) and installation (bedding, backfill, etc.).
- G. The selection of gravity collection system pipe must be based on:
 - 1. The characteristics of the wastewater conveyed;
 - 2. The character of industrial wastes;
 - 3. The possibility of septic conditions;
 - 4. The exclusion of inflow and infiltration;
 - 5. Any external forces;
 - 6. Any groundwater;
 - 7. The internal pressures;
 - 8. The abrasion and corrosion resistance of the pipe material.
- H. All gravity wastewater mains shall be green in color constructed of ASTM D3034 SDR 26 sanitary sewer pipe.
- I. All wastewater force mains 15" diameter and smaller shall be constructed of ASTM D2241 PR160 SDR26 pipe or its equivalent.
- J. All wastewater force mains over 15" diameter shall be constructed of C900 DR18 PC235 water pipe or its equivalent.
- K. All wastewater force mains shall use white pipe.

- L. A detector tape must be laid in the same trench as a force main pipe. The detector tape must be located above and parallel to the force main. The detector tape must bear the label "PRESSURIZED WASTEWATER" continuously repeated in at least 1.5-inch letters.
- M. A detector tape must be laid in the same trench as a gravity wastewater main. The detector tape must be located 6-12" above and parallel to the gravity wastewater mains. The detector tape must bear the label "SEWER PIPE BELOW" continuously repeated in at least 1.5-inch letters.
- N. All wastewater force mains shall have air release valves installed at any high point along the vertical alignment. Air release valves are to be installed in accordance with 30 TAC Chapter 217. See standard details.
- O. All wastewater force mains shall have isolation valves at no more than 2,000-foot intervals.

4.2. – Main Line Location

- A. All main wastewater lines shall be located in one of the two parkways (between the back of the curb and the leading edge of the sidewalk). The back of curb edge of the pipe shall always be set three (3) feet behind the back of curb.
- B. When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel waterlines must be installed in separate trenches. Where the nine (9) foot separation distance cannot be achieved, the guidelines from TAC 30 Chapter 217 will apply.
- C. All force mains shall have a 12-gauge copper wire laid with the pipe to assist in locating the line once it is covered. Said copper wire shall be attached to the top center of the pipe at a minimum of 15 feet intervals. Test points for connection to the locator wire must be provided at finished grade and in 500' intervals in a cleanout type 18" x 14" sewer box.
- D. Sewers shall be laid in straight alignment with uniform grade between manholes. Any deviation from straight alignment must comply with the requirements of Chapter 217.
- E. Pipe shall be laid to the lines and the grades indicated on the approved drawings.
- F. Prior to backfilling, all main wastewater lines and appurtenances shall have GPS locations established in a format sufficient for inclusion on our GIS Mapping System.

Table 5: Minimum Acceptable Wastewater Pipe Slopes

Size of Pipe (inches)	Minimum Slope (%)	Maximum Slope (%)
6	0.5	12.35
8	0.33	8.4
10	0.25	6.23
12	0.2	4.88
15	0.15	3.62
18	0.11	2.83
21	0.09	2.3
24	0.08	1.93
27	0.06	1.65
30	0.055	1.43
33	0.05	1.26
36	0.045	1.12
39	0.04	1.01
>39	*	*
* For pipes larger than 39 inches in diameter, the slope is determined by Manning's formula to maintain a velocity greater than 2.0 feet per second and less than 10.0 feet per second when flowing full.		

4.3. – Joints

- A. The technical specifications for joints for gravity pipe must include the materials and methods used in making joints.
- B. Materials used for gravity pipe joints must prevent infiltration and root entrance.
- C. A joint must:
 - 1. include rubber gaskets;
 - 2. include polyvinyl chloride (PVC) compression joints;
 - 3. include high density polyethylene compression joints;
 - 4. be welded;
 - 5. be heat fused;
 - 6. include other types of factory-made joints.
- D. The technical specifications must include ASTM, AWWA, ANSI, or other appropriate national reference standards for the joints.

4.4. – Bedding

- A. Wastewater lines must be bedded with six (6) inches of Grade 4 pea gravel, below the pipe and six (6) inches of Grade 4 pea gravel above the pipe. Pea gravel must be rounded and no pea gravel with sharp corners will be allowed.
- B. Place bedding material at trench bottom, level fill materials in on continuous layer not exceeding 8 inches compacted depth, and compact to 90% standard proctor maximum density.
- C. See Pipe Embedment Detail.

4.5. – Manholes

- A. Manholes shall be placed in the collection system at:
 - 1. all points of change in alignment, grade, or size;
 - 2. at the intersection of all pipes;
 - 3. at the end of all pipes;
 - 4. at every 500 ft. interval on straight runs of pipe 15" diameter and smaller – see Table 6 for larger sizes.
- B. Manholes placed at the end of a wastewater collection system pipe that may be extended in the future must include pipe stub outs with plugs. The length of the stub out shall be decided by the Director of Public Works.
- C. A manhole must be made of monolithic, cast-in-place concrete, or pre-cast concrete. The use of bricks to adjust a manhole cover to grade or construct a manhole is prohibited.

- D. Manholes may be spaced no further apart than the distances specified in the following table for a wastewater collection system with straight alignment and uniform grades.

Table 6: Maximum Manhole Spacing and Size

Pipe Diameter (<i>inches</i>) / <i>Depth</i> (<i>feet</i>)	Maximum Manhole Spacing (<i>feet</i>)	Minimum Manhole Size (<i>inches</i>)
8"-15" (0 – 8' depth)	500	48
8"-15" (> 8' – 20' depth)	500	60
8"-15" (> 20' depth)	500	72
18"-30" (0 – 10' depth)	800	60
18"-30" (> 10' depth)	800	72
36-48	1000	72

- E. A manhole must not be located in the flow path of a watercourse, or in an area where ponding of surface water is probable.
- F. The inside diameter of a manhole must be no less than 48 inches. A manhole diameter must be sufficient to allow personnel and equipment to enter, exit, and work in the manhole and to allow proper joining of the collection system pipes in the manhole wall.
- G. Manholes must meet the following requirements for covers, inlets, and bases:
1. Manhole covers and frames must be Pam Rex and must be grouted to the manhole;
 2. All manholes require at least a 30-inch diameter clear opening;
 3. A manhole located within a 100-year flood plain must have a means of preventing inflow and a means of venting when the length of potentially submerged line requires venting;
 4. A manhole cover that is located in a roadway must meet or exceed the American Association of State Highways and Transportation Officials standard M-306 for load bearing.

4.6. – Manhole Inverts

- A. The bottom of a manhole must contain a U-shaped channel that is a smooth continuation of the inlet and outlet pipes.
- B. A manhole connected to a pipe less than 15 inches in diameter must have a channel depth equal to at least half the largest pipe's diameter.
- C. A manhole connected to a pipe at least 15 inches in diameter but not more than 24 inches in diameter must have a channel depth equal to at least three-fourths of the largest pipe's diameter.
- D. A manhole connected to a pipe greater than 24 inches in diameter must have a channel depth equal to at least the largest pipe's diameter.
- E. A manhole with pipes of different sizes must have the tops of the pipes at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe.
- F. A bench provided above a channel must slope at a minimum of 0.5 inch per foot.
- G. The inclusion of steps in a manhole is prohibited.

4.7. – Connections

- A. A manhole-pipe connection must use watertight, size-on-size resilient connectors that allow for differential settlement and must conform to American Society for Testing and Materials C-923.
- B. An external drop pipe should be provided for a sewer entering a manhole more than twenty-four inches (24") above the invert.

4.8. – Vacuum Testing

- A. Vacuum testing of all manholes shall be required and shall be performed by Contractor as specified below:
 - 1. To perform a vacuum test, an owner shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering a manhole with inflatable plugs.
 - 2. No grout must be placed in horizontal joints before testing.
 - 3. Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.
 - 4. An owner shall use a minimum 60 inch/lb. torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.
 - 5. A test head must be placed at the inside of the top of a cone section, and the seal inflated in accordance with the manufacturer's recommendations.
 - 6. A test does not begin until after the vacuum pump is off. A manhole passes the test if after 2.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury.
 - 7. Manholes will be accepted with relation to vacuum test requirements if they meet the criteria above.
- B. Any manhole which fails the initial test must be repaired with non-shrink grout or other suitable material based on the material from which the manhole is constructed. The manhole shall be retested as described above until a successful test is made. After a successful test, the temporary plug shall be removed.

4.9. – Gravity Sewer Testing

- A. After backfilling is completed, and before acceptance of the work, wastewater mains must pass both a deflection and pressure test.
- B. Pressure and deflection testing shall be performed in accordance with the requirements of 30 TAC Ch. 217. No testing shall be performed until 30 days after backfill unless specifically approved by the Director of Public Works.
- C. Television inspection tests shall be required on any gravity sewer main and will be at the Contractor's expense.
- D. Prior to television inspection tests the gravity sewer main to be tested shall be flushed with clean water to remove sludge, dirt, sand, stone, grease, and other materials to ensure a clear view of interior conditions.
- E. Any lines found to be defective will be corrected at the Contractor's expense. All defects will be repaired to the satisfaction of the City of Ennis.

4.10. – Force Main Testing

- A. The final plans and specifications must include the pressure testing procedures.
- B. A pressure test must be conducted at equal to or greater than the pipe's rated pressure (pressure class) of a force main.
- C. A temporary valve for pressure testing may be installed near the discharge point of a force main and removed after a test is successfully completed.
- D. A pump isolation valve may be used as an opposite termination point.
- E. A test must involve filling a force main with water.
- F. A pipe must hold the designated test pressure for a minimum of 4.0 hours.
- G. The leakage rate must not exceed 10.0 gallons per inch diameter per mile of pipe per day.

4.11. – Wastewater Service Lines

- A. All wastewater service lines must be extended to the property line and installed with a cleanout in the City parkway.
- B. All cleanouts located in the parkways shall be enclosed in Bass and Hayes Model 34A round metal boxes that are 18" x 14" in diameter and have lids that are clearly labeled sewer or wastewater. Any proposal which deviates from this requirement shall be justified to the satisfaction of the Director of Public Works.
- C. All cleanout boxes shall be installed so that the lid will be at final grade.

4.12. – Public Lift Stations

- A. The City of Ennis must approve the location of any lift station that will be conveyed to the City for operation and maintenance.
- B. All lift stations that are to be conveyed to the City of Ennis shall be designed and stamped by a Texas registered professional engineer and include a signed and sealed statement by the engineer that the proposed station meets all requirements of 30 TAC Chapter 217.
- C. A minimum of three (3) sets of plans, drawings, and/or spec books must be supplied to the City.
- D. All proposed public lift stations shall submit to the City for prior approval all data and specifications for each proposed station that shall include, but shall not be limited to, the following:

4.13. – Site Design - Access, Security, Flood Control, and Any Potential Odor Concerns

- A. An onsite generator with automatic transfer switch shall be provided for all lift stations in accordance with 30TAC Chapter 217 Subchapter C §217.63. Emergency Provisions for Lift Stations.
- B. An alarm system must self-activate for a power outage, pump failure, or a high wet well water level.
- C. All lift stations shall be within a dedicated easement with a minimum size of 40 ft. x 40 ft or larger as required for easy access of the City's service truck to within boom reach of all pumps or appurtenances.

- D. All public lift stations shall have a concrete access road and shall have a 20' x 20', minimum, concrete pad around the lift station.
- E. All public lift stations shall be fenced for security. Gate and fencing material is to be approved by the City of Ennis.
- F. In some situations, such as lift stations located in residential areas, landscaping around the security fencing will be required.
- G. All Lift Stations shall include an emergency connection within the lift station site where a bypass pump can be discharged into the forcemain. A gate valve shall be on the riser and check valve shall prevent discharge from returning to the lift station valve vault.

4.14. – Operation and Maintenance Data and Manuals

- A. Operation and maintenance manuals shall include but may not be limited to the following information:
 - 1. Equipment function, normal operating characteristics, and limiting conditions, assembly, installation, alignment, adjustment, and checking instructions, operating instructions for start-up, routine and normal operation, regulation and control, shutdown, and emergency conditions, lubrication and maintenance instructions, guide to troubleshooting, parts lists and predicted life of parts subject to wear, outline, cross-section, and assembly drawings; engineering data; and wiring diagrams, test data and performance curves.

4.15. – Pumps

- A. Submittals must include:
 - 1. Name of manufacturer, type and model, rotative speed, size of suction elbow inlet, size of discharge elbow outlet or nozzle, complete performance curves showing capacity versus head, BHP [brake kW], Net Positive Suction Head (NPSH) required, and efficiency, and data on shop painting.
- B. All pumps shall have at a minimum a 2 (two) year full labor and material, non-declining warranty.
- C. General Requirements. A raw wastewater pump, with the exception of a grinder pump, must:
 - 2. be designed to prevent clogging;
 - 3. be capable of passing a sphere of 2.5 inches in diameter or greater;
 - 4. have greater than 3.0-inch diameter suction and discharge openings.
- D. Submersible and Non-submersible Pumps.
 - 1. A non-submersible pump must have inspection and cleanout plates on both the suction and discharge sides of each pumping unit that facilitate locating and removing blockage-causing materials, unless the pump design accommodates easy removal of the rotation elements.
 - 2. A pump support must prevent movement and vibration during operation.
 - 3. A submersible pump must use a rail-type pump support system with manufacturer-approved mechanisms designed to allow personnel to remove and replace any single pump without entering or dewatering the wet well.
 - 4. Submersible pump rails and lifting chains must be constructed of a material that performs to at least the standard of Series 300 stainless steel.

4.16. – Lift Station Pumping Capacity

- A. The firm pumping capacity of a lift station must handle the expected peak flow.

4.17. – Pump Head Calculations

- A. An owner shall select a pump based upon analysis of the system head and pump capacity curves that determine the pumping capacities alone and with other pumps as the total dynamic-head increases due to additional flows pumped through a force main.
 - 1. The pipe head loss calculations, using the Hydraulic Institute Standards, pertaining to head losses through pipes, valves, and fittings, must be included in the report.
 - 2. The selected friction coefficient (Hazen-Williams "C" value) used in friction head loss calculations must be based on the pipe material selected.
 - 3. For a lift station with more than two pumps, a force main in excess of one-half mile or firm pumping capacity of 100 gallons per minute or greater, system curves must be provided for both the normal and peak operating conditions at "C" values for proposed and existing pipe.

4.18. – Flow Control

- A. A lift station or a transfer pumping station located at or discharging directly to a wastewater treatment system must have a peak pump capacity equal to or less than the peak design flow, unless equalization is provided.
- B. A wastewater treatment system with a peak flow that is greater than 300,000 gallon per day must use three or more pumps, unless duplex, automatically controlled, variable capacity pumps are provided.

4.19. – Self-Priming Pumps

- A. A self-priming pump must be capable of priming without reliance upon a separate priming system, an internal flap valve, or any external means for priming.
- B. A self-priming pump must use a suction pipe velocity at least 3.0 feet per second but not more than 7.0 feet per second, and must incorporate its own suction pipe.
- C. A self-priming pump must vent air back into the wet well during priming.

4.20. – Vacuum-Priming Pumps

- A. A vacuum-primed pump must be capable of priming by using a separate positive riming system with a dedicated vacuum pump for each main wastewater pump.
- B. A vacuum-priming pump must use a suction pipe velocity at least 3.0 feet per second but less than 7.0 feet per second and must have its own suction pipe.

4.21. – Vertical Positioning of Pumps

- A. A raw wastewater pump must have positive static suction head during normal on-off cycling, except a submersible pump with "no suction" pipes, a vacuum-primed pump, or a self-priming unit capable of satisfactory operation under any negative suction head anticipated for the lift station.

4.22. – Horizontal Pump Suctions

- A. Each pump must have a separate suction pipe that uses an eccentric reducer.
- B. Pipes in a wet well must have a turndown type flared intake.

4.23. – Valves

- A. The discharge side of each pump followed by a full-closing isolation valve must also have a check valve.
- B. A check valve must be a swing type valve with an external lever.
- C. A valve must include a position indicator to show its open and closed positions, unless a full-closing valve is a rising-stem gate valve.
- D. A grinder pump installation may use a rubber-ball check valve or a swing-type check valve.
- E. A butterfly valve, tilting-disc check valve, or any other valve using a tilting-disc in a flow pipe is prohibited.

4.24. – Pipes

- A. A lift station pipe must have flanged or flexible connections to allow for removal of pumps and valves without interruption of the lift station operations.
- B. Wall penetrations must allow for pipe flexure while excluding exfiltration or infiltration.
- C. Pipe suction velocities must be at least 3.0 feet per second but not more than 7.0 feet per second.

4.25. – Pump Controls

- A. A lift station pump must operate automatically, based on the water level in a wet well.
- B. The location of a wet well level mechanism must ensure that the mechanism is unaffected by currents, rags, grease, or other floating materials.
- C. A level mechanism must be accessible without entering the wet well.

4.26. – Wet Wells

- A. A wet well must be enclosed by watertight and gas tight walls.
- B. A penetration through a wall of a wet well must be gas tight.
- C. A wet well must not contain equipment requiring regular or routine inspection or maintenance, unless inspection and maintenance can be done without staff entering the wet well.
- D. A gravity pipe discharging to a wet well must be located so that the invert elevation is above the liquid level of a pump's "on" setting.
- E. Gate valves and check valves are prohibited in a wet well.
- F. Gate valves and check valves may be located in a valve vault next to a wet well or in a dry well.

4.27. – Wet Well Slopes

- A. A wet well floor must have a smooth finish and minimum slope of 10% to a pump intake.
- B. A wet well design must prevent deposition of solids under normal operating conditions.
- C. A lift station with greater than 5.0 million gallons per day firm pumping capacity must have anti-vortex baffling.

4.28. – Hoisting Equipment

- A. A lift station must be accessible to portable hoisting equipment for removal of pumps, motors, valves, pipes, and other similar equipment. Site access must allow for easy access of the City's service truck to within boom reach of all pumps and appurtenances.

4.29. – Valve Vault Drains

- A. A floor drain from a valve vault to a wet well must prevent gas from entering a valve vault by including flap valves, "P" traps, submerged outlets, or a combination of these devices.

4.30. – Motors

- A. All motors must be 3-phase. Submittals shall include the name of manufacturer, type and model, type of bearings and method of lubrication, rated size of motor, HP [kW], and service factor, insulation class and temperature rise, full load rotative speed, net weight, efficiency at full load and rated pump condition, full load current, locked rotor current. All motors shall have at a minimum a 2 (two) year warrant

4.31. – Instrumentation and Supervisory Control and Data Acquisition (SCADA)

- A. These specifications are for the furnishing and installation of metering, control equipment, and additions to the existing SCADA system.
- B. The entire SCADA system shall be designed, coordinated, and supplied by a qualified SCADA system supplier who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The instrumentation/SCADA supplier shall meet the following qualifications:
 - 1. The system supplier shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the City. In all cases, no programming of the SCADA or PLC may be done by anyone other than the City's approved SCADA technician.
 - 2. The system supplier shall have the physical plant and fabricating personnel to complete the work specified. The supplier's fabrication capabilities and/or arrangements shall be acceptable to the City.
 - 3. The system supplier shall employ competent service personnel to service the equipment furnished and the geographic location and response times of service personnel shall be acceptable to the City.
 - 4. The system supplier shall have successfully provided similar work for at least 5 years and verifiable references that span the 5-year time frame are required.
- C. Full SCADA specifications will be supplied as required.

4.32. – Private Lift Stations

- A. The installation of any private lift station must be approved in writing by the Director of Public Works or his designee.
- B. On lots where wastewater will not gravity flow to the City's wastewater mains and it becomes necessary to install a small lift station and force main, the force main must empty into a manhole.
- C. If no manhole is located in the vicinity, then a manhole must be installed.
- D. All individual lift stations of this type will be installed on private property and will be maintained by the property owner.

SECTION 300: APPENDICES

Appendix A – Bonding

Performance, Payment, and Maintenance Bond Examples

Bond No. _____

TEXAS STATUTORY PERFORMANCE BOND
Public Works

STATE OF TEXAS

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

That _____ (hereinafter called Principal), as Principal, and _____, a corporation organized under the law of the State of _____, a Corporate Surety, authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety, (hereinafter called the Surety), as Surety, are held and firmly bound unto the City of Ennis, Texas (hereinafter called the Obligee), in the penal sum of _____ (\$ _____) for the payment of which sum well and truly to be made, bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents;

Whereas, the Principal has entered into a certain written contract with _____, dated _____ day of _____, 202_, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied the length herein, work constructed to comply with the City of Ennis Ordinances, Codes and Specifications for
(detail work to be done) _____

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if the said Principal shall faithfully perform the work in accordance with the plans and City of Ennis ordinances, codes and specifications and contract document, then, this obligation shall be void; otherwise to remain in full force and effect. The total amount of the Surety's liability under this bond in no event exceed the penal sum thereof;

PROVIDED HOWEVER, that this bond is executed pursuant to the provisions of Article 2253, Texas Government Code and all liabilities on this bond to all such claimants shall be determined in accordance with the provisions thereof to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this

_____ day of _____, 202_.

PRINCIPAL:

X _____
SIGNATURE

Witness

Surety

X _____
Attorney in Fact

Witness

Bond No. _____

(PAYMENT BOND - TEXAS PUBLIC WORKS)

PAYMENT BOND

STATE OF TEXAS

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

That we _____, of the City of _____, County of _____, and State of Texas, as Principal, and _____, a corporate surety authorized under the laws of the State of Texas to act as surety on bonds for Principal, are held and firmly bound unto the City of Ennis, Texas (Owner), in the sum of _____ (\$ _____), we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, the Principal did, on the _____ day of _____, 202__, make and enter into a written contract with _____ for work constructed to comply with the City of Ennis Ordinances, Codes and Specifications for _____ (detail work to be done) _____ which contract is hereby referred to and made a part hereof as fully and to the same extent as if copies the length herein.

NOW, WHEREFORE, a condition of this obligation is such that, if said Principal shall pay all subcontractors and suppliers furnishing labor, material, equipment and/or services to Principal or its subcontractors in the prosecution of the work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and effect. The total amount of the Surety's liability under this bond in no event exceed the penal sum hereof;

PROVIDED, HOWEVER, that this bond is executed pursuant to and in strict performance with the provisions of Chapter 2253, Texas Government Code, as most recently amended, and all liabilities under this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

SURETY, is obligated only to the dollar amount shown on the face of this bond. If any additions or alterations of the original contract upon which this bond was issued occur, increasing or altering the contract price, Surety is obligated only to the proportional amount that the original contract bears to the altered contract price, unless expressly waived by the Surety in writing.

SIGNED, sealed and dated this _____ day of _____, 202__.

PRINCIPAL:

X _____
SIGNATURE

NAME & TITLE

ADDRESS

PHONE NUMBER

SURETY:

X _____
SIGNATURE

NAME & TITLE

The name and address of Resident Agent of
Surety is:

Bond No. _____

MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____
_____ (herein after called the Principal), and _____
_____ a corporation (hereinafter called the Surety), are held and
firmly bound unto the City of Ennis, Texas (hereinafter called the Obligee), in the full and just sum of
_____ (\$ _____) lawful money of
the United States, for the payment of which, well and truly to be made, we bind ourselves, our heirs,
administrators, executors successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has performed work constructed to comply with the City of Ennis
Ordinances, Codes and Specifications for _____ (detail work to be done) _____ which
have been or are about to be completed and accepted.

AND WHEREAS, it is required that _____ should
guarantee the project from defects caused by faulty workmanship and materials, general wear and tear
excepted, for a period of two (2) years from the date of written acceptance by the City of Ennis, Texas.

NOW THEREFORE, if the said project shall be free from defects of workmanship and materials,
general wear and tear excepted, for a period of two (2) years from the date of written acceptance by the
City of Ennis, Texas, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____, 202__.

By: _____

By: _____
Attorney-in-Fact

Appendix B – Detention / Retention Pond Operation and Maintenance

Sample Manual, Maintenance Acknowledgement, Format for Detention Facility Letter of Conformance, Inspection Checklist Chart, “Operation and Maintenance Manual” Review Checklist

ATTACHMENT NUMBER 1

SAMPLE DETENTION BASIN OPERATION AND MAINTENANCE MANUAL

(Project Name & Address) Detention / Retention Pond Operation and Maintenance Manual

SCOPE AND RESPONSIBILITIES

The O&M manual shall include sections defining the scope and the party or parties responsible for maintenance. The Maintenance Acknowledgement shown in Attachment Number 2, must be included, signed, and notarized by the owner.

The O&M manual shall provide guidance for:

- ‡ Funding needed – anticipated future monitoring and maintenance cost,
- ‡ Training required,
- ‡ Reporting,
- ‡ Record retention, and
- ‡ Coordination required with others.

CITY RESPONSIBILITY

O&M manual shall acknowledge that inspection is the only responsibility the City of Ennis has in the operation and maintenance of this facility. The City of Ennis will inspect the basin on a timeline determined by the Director of Public Works and prepare a Notice of Violation (NOV) if required.

Any deficiencies noted on the NOV that are not corrected in the times specified herein may result in fines or application of a lien upon the property adequate to cover the required maintenance and/or repair plus administrative costs.

PROJECT INFORMATION

Project Name:

Project Location:

Contact:

Address:

Phone Number(s):

A. DETENTION BASIN PHYSICAL CHARACTERISTICS

(A separate form should be provided for projects with multiple ponds. Pond name should correspond with the identification shown on the approved plans.)

Pond flowline at inlet:

Pond flowline at outlet:

Pond normal pool elevation:

Pond outlet pipe diameter(s):

B. DESIGN CRITERIA AND OPERATIONS PROCEDURES

Describe design criteria, approach, methods, and assumptions for the Detention or Retention Pond design. Provide documentation showing the design meets the criteria shown for Detention of Storm Water Flow. Include pertinent hydrographs, calculations, pre and post runoff calculations and post detention calculations, grading, and structural drawings where necessary. The engineer of record shall provide a cover letter as shown in the sample contained in Section 300, Appendix B - Detention / Retention Pond Operation and Maintenance, Attachment Number 3, FORMAT FOR DETENTION FACILITY LETTER OF CONFORMANCE.

OPERATIONAL PROCEDURES

NORMAL

- ‡ Describe what is considered normal operating conditions, and

ABNORMAL INDICATORS

- ‡ Outflow reductions,
- ‡ Side slope and erosion near outfalls,
- ‡ Sinkholes along drain line,
- ‡ Standing water,
- ‡ Evidence of piping along embankments,
- ‡ Trees along embankments / emergency spillway ,
- ‡ Spotty / thin plant cover and weed growth,
- ‡ Increases in water loving plants, and
- ‡ Other.

PREVENTIVE MAINTENANCE / INSPECTION

Preventive maintenance guidelines and a routine and annual inspection checklist shall be developed and included in the O&M manual for the detention basin and appurtenances. Visual inspections of all components will be conducted every 6 months. The O&M manual shall stress and require that a log be kept of maintenance actions, and inspections. The log should document the condition of the detention system's primary components, mowing, and silt, litter and debris removal dates. The Manual shall include a customized chart similar to the examples shown in Section 300, Appendix B - Detention / Retention Pond Operation and Maintenance, Attachment Number 4, INSPECTION CHECKLIST CHART.

A good quality assurance and quality control program is essential at the outset. Records are important for evaluation and protection. There is little benefit to monitoring if records are poorly kept. A system should be established with the thought that it may someday have to be defended. **Written maintenance and repair records shall be maintained by the party or parties signing the O&M manual and shall be provided to the City upon request.**

Additional items to consider and suggestions when inspecting and monitoring detention basins and appurtenances include but are not limited to the following:

MANHOLES

- ‡ Monitor monthly during construction and every 6 months thereafter unless problems develop.
- ‡ When monitoring manholes, these items should be noted:
 - ‡ Observe and document general condition of manholes. Check for cracks or other signs of deterioration.
 - ‡ Measure and record depth of water surface from lid.
 - ‡ Note whether water is clear or cloudy.
 - ‡ Note sand or silt in the bottom of the manhole. If bottom is covered, measure the depth.
 - ‡ Note condition of inlet and outlet pipes.

INTAKE / OUTLET STRUCTURES

- ‡ Observe condition of appurtenant structures in relation to the as-built facilities.
- ‡ Monitor every 1 to 2 years or following 2-inch storm event.
- ‡ When monitoring, the following items should be noted:
 - ‡ General condition of intake / outlet structure.
 - ‡ Condition of the riprap, if any.
 - ‡ Check if there is a trash rack in place and if so, if it needs cleaning.
 - ‡ Check for signs of recent erosion in the vicinity of the structure. - Check the vicinity of the structure for sinkholes.

SIDE SLOPE AND BOTTOM

- ‡ Observe condition of side slopes and bottom in relation to the as-built facilities.
- ‡ Note silt & sand accumulations.
- ‡ Note cracks along the side slope, and slope failure areas.
- ‡ Inspect geo-synthetic fabrics used for slope protection

FLUMES

- ‡ Observe /document standing water areas.

MAINTENANCE & REPAIR

Identify basic requirements to maintain the operational characteristics of the facility, expected and typical materials and equipment to be used. Discuss methods and procedures required to repair and replace system components.

BASIC REQUIREMENTS

- ‡ Preserve the drain system in good working condition so it will perform without

interruption.

- ‡ Keep the pipe and structures clear of obstructions.
- ‡ Keep structures in proper repair and earthwork in good condition.

MATERIALS

- ‡ Identify materials needed for maintaining the detention basin.

EQUIPMENT

- ‡ Identify equipment needed, such as
 - ‡ Lawn Mower
 - ‡ Weed Eater
 - ‡ Excavator, front end loader, etc.
 - ‡ Trucks and appropriate small tools
 - ‡ Pumps and ladders
 - ‡ High pressure hydraulic drain cleaner
 - ‡ Trench box
 - ‡ Video inspection equipment
 - ‡ Oxygen sensor
 - ‡ Rain Gauge

METHODS AND PROCEDURES

- ‡ Define anticipated maintenance operations and procedures.

REPAIR, REPLACEMENTS AND ADDITIONS

- ‡ System repairs should always be to the original design standards or better.
- ‡ Replacements and additions should be treated as original construction.

SAFETY

- ‡ Establish general safety guidelines and procedures. Safety measures may include but are not limited to fencing, warning signs, and stadia rod indicating depth at lowest point, outlet structures to limit public access, Trench safety and work in confined spaces could raise additional safety concerns.

ATTACHMENT NUMBER 2

MAINTENANCE ACKNOWLEDGEMENT

I acknowledge and agree by my signature below that I am responsible for the performance of the detention basin maintenance as defined in the attached Operation and Maintenance (O&M) manual. I agree to notify the City of Ennis of any problems with the system and / or prior to any changes to the system or responsible party.

Print Name:

Title:

E-mail Address:

Address:

Phone:

Driver License Number:

Date of Birth:

Signature:

Date:

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, _____, Notary Public for the State of _____

County of _____, do hereby certify that _____

personally appeared before me this _____ day of _____, _____, and acknowledge the due execution of forgoing maintenance requirements identified in the attached O&M manual. Witness my hand and official seal,

My commission expires

ATTACHMENT NUMBER 3

Format for Detention Facility Letter of Conformance
Submitted on Letterhead of Engineering Firm

(Date)

City of Ennis
Public Works Department
500 Lake Bardwell Drive
P.O. Box 200
Ennis, Texas 75119

RE: *(Name of Subdivision or Private Development)* Detention
Facility Conformance

Dear Director of Public Works:

I certify that the design, as approved by the City of Ennis, of each Detention Facility located at

(Name of Subdivision or Private Development and street address if applicable)
conforms to the requirements of the City of Ennis Infrastructure Design Standards. I further certify
that each Detention Facility has been constructed in accordance with the lines and grades on the
approved design drawings and I believe will function in accordance with the intent and purpose
of the approved design. Sincerely,

{Signed Seal of Engineer }

*(Typed Name of Engineer, PE) (Title of
Engineer)*

cc: *(Developer/Owner of Facility)*
(Contractor)

ATTACHMENT NUMBER 4

7. INSPECTION CHECKLIST CHART

FREQUENT INSPECTION	DATE	REPAIRS REQUIRED	REPAIRS MADE	NOTES
Mowing				
Remove trash and debris				
Inspect irrigation system operation				
Remove grass clippings				
Violations noted				

MINOR INSPECTION				
Condition of Pond				
Amount of silt in pond				
Amount of silt in flume				
Amount of ponded water				
Amount of wetland vegetation				
Location of Erosion				
Percent of vegetation				
Condition of trash guard				
Location of erosion				

MAJOR INSPECTIONS				
--------------------------	--	--	--	--

Structure type and Condition				
Condition of rip-rap				
Berm or Embankment Settlement				
Location of erosion				
Evidence of Animals				
Evidence of Aquatic life				
Condition of Aeration Fountain (if applicable)				

ATTACHMENT NUMBER 5

“Operation and Maintenance Manual” Review Checklist

- ‡ Name of project/site
- ‡ Address of site
- ‡ Purpose of manual
- ‡ Normal operation of detention facility
- ‡ General Maintenance procedures
- ‡ Safety considerations
- ‡ City-responsibility declaration
- ‡ Project information:
 - Project Name
 - Location
 - Contact Person
 - Address
 - Phone number
- ‡ Detention facility physical characteristics
 - Flow line at inlet
 - Flow line at outlet – lower and upper
 - Normal pond/pool elevation
 - Pond 100-year WSEL, overflow elevation, pond 1-inch elevation
 - Inlet pipe diameter (s)
 - Outlet diameter (s)
- ‡ Inspection checklist
- ‡ Original **maintenance acknowledgement** form (signed by operator and notarized)
- ‡ Engineer-sealed copies attached to the manual:
 - Storm drainage plan
 - Drainage area map
 - Grading plan
 - Pond profiles/elevations
 - Pond landscaping plans
 - Irrigation Plan
- ‡ **Letter-of-conformance** certification from the detention pond design engineer

Please provide the above items for review and approval of the Operation and Maintenance Manual. Contact the Public Works Department at 972-875-1906 for questions and additional information.

Appendix Z – Revision History Table
Brief description of changes to these Design Standards

DATE	HEADING	DESCRIPTION

Section 400: STANDARD DETAILS – Drawing Table of Contents

General Construction Notes

General Construction Notes	GN-1
General Construction Notes	GN-2

Residential Street Details – HMAC

Residential Street Typical Section	ST-1
Mountable Curb & Gutter Detail	ST-1
Valley Gutter Detail	ST-1

Residential Street Details – Concrete

Residential Street Concrete Section	ST-2
Mountable Curb & Gutter Detail	ST-2

Industrial/Commercial and Collector Street Details

Industrial/Commercial and Collector Street Typical Section	ST-3
Integral Curb & Gutter Detail	ST-3

Sidewalk and Curb Ramp Details

Typical Residential Intersection Ramp Layout	ST-4
Typical Industrial/Commercial and Collector Intersection Ramp Layout	ST-4
Curb Ramp Detail	ST-4
Typical Sidewalk Detail	ST-4
Curb Ramp Detectable Warning Detail	ST-4

Miscellaneous Drainage and Street Details

Storm Water Manhole	ST-5
Curb Inlet	ST-6
Drop Inlet Detail – 4', 5', or 6' Square	ST-7
Alley Typical Section Detail	ST-7
Detention Pond Concrete Flume Detail	ST-7
Concrete Pilot Channel Detail	ST-7
Storm Sewer Pipe Embedment Detail	ST-7
Driveway Approach for Concrete Streets with Stand Up Curb	ST-8
Driveway Approach for Concrete Streets with Mountable Curb	ST-8
Driveway Approach for Concrete Streets without Curb	ST-8
Driveway Approach for Asphalt Streets with Stand Up Curb	ST-8
Driveway Approach for Asphalt Streets with Mountable Curb	ST-8
Driveway Approach for Asphalt Streets without Curb	ST-8
Construction Joint Detail	ST-9
Key Joint Detail	ST-9
Sawed Contraction Joint Detail	ST-9
Expansion Joint Detail	ST-9
Concrete Pavement Connection to Existing Asphalt Pavement Detail	ST-9
Street Header for Future Pavement Detail	ST-9
Street Header at Existing Pavement Detail	ST-9
Street Header at Railroad Detail	ST-9

Street Sign Details

Sign Mounting Detail for Small Roadside Signs - Wedge Anchor Steel System	SS-1
Metal Beam Barricade - End of Road	SS-1

Water Meter Details

4" Thru 8' Domestic Single-Jet Water Meter Assembly	UT-1
Water Service Installation - 1"	UT-1
Water Service Installation - 2"	UT-1

Water Valve Details

1" Automatic Flushing Device #9400A	UT-2
2" Automatic Flushing Device #9400	UT-2
Butterfly Valve and Box 16" and Greater	UT-2
Gate Valve Box and Extension Stem	UT-2

Fire Hydrant/Protection Details

Fire Protection System Backflow Preventer	UT-3
Fire Hydrant Assembly	UT-3

Miscellaneous Utility Details

Encasement Pipe and Spacers Detail	UT-4
Pipe Embedment and Pavement Repair Detail	UT-4
Warning Tape Detail	UT-4
Valve Blocking Detail	UT-4
Fittings (Water)	UT-4
Forcemain Tap Detail	UT-5
Air Release Valve	UT-5
Water Main Lowering Below Wastewater Main	UT-5

Wastewater Details

Precast Wastewater Manhole and Base	UT-6
Doghouse Manhole Installed on Existing Main	UT-6
Standard Drop Manhole	UT-6
Wastewater Manhole Line Intersection	UT-6
Abandonment of Manhole Detail	UT-6
Wastewater Lateral with Cleanout	UT-7
Utility Adjustment	UT-7
Standard Manhole Ring and Cover	UT-7
Manhole Vented in Flood Plain	UT-7
Water Line Crossing Over/Under Sanitary Sewer Line	UT-7
Water Main Blocking Details	UT-8

Special Details – For Use as Directed

Water Main Tap Adjacent to Obstruction	SP-1
Steel Valve Marker	SP-1