

4. Flushing and Testing:
 - a. At the end of the disinfecting period, the disinfecting solution shall be discharged from the pipe and replaced with water furnished by the CITY OF FARMERSVILLE. Meet T.C.E.Q. requirements regarding discharge of chlorinated water.
 - b. Take a sample of water from the disinfected main (not through a fire hydrant) from a suitable tap under the supervision of the ENGINEER or his inspector and submit to an approved testing laboratory of the T.C.E.Q for analysis.
 - c. A minimum of one sample for each 1,000 feet of completed waterline will be required or at the next available sampling point beyond 1,000 feet as designated by the design ENGINEER. Bacteriological samples shall be taken to a lab that is approved by the CITY OF FARMERSVILLE or ENGINEER.
 - d. If the test shows a satisfactory quality of water, the disinfected pipe shall then be placed in service by the CONTRACTOR who shall notify the ENGINEER and assist the ENGINEER in location and operation of all valves installed by the CONTRACTOR.
 - e. If the sample shows unsatisfactory quality of water, the process of disinfection shall be repeated until a satisfactory water sample is obtained. The CONTRACTOR shall furnish to the CITY OF FARMERSVILLE, a certified copy of the laboratory report of satisfactory disinfection of the main.
 - f. All water used by the CONTRACTOR to disinfect water mains beyond the first test shall be purchased from the CITY OF FARMERSVILLE. The CONTRACTOR shall bear all costs of disinfecting. The CONTRACTOR shall also bear all costs of retesting.

3.5 FINAL CLEAN UP

Upon completion of the installation of the water lines, distribution systems, and appurtenances, all debris, including PVC scraps resulting from trenching through abandoned distribution system piping, shall be removed from work areas as disposed of by the CONTRACTOR. In addition, all above ground structures of abandoned valve clusters shall be removed and disposed of by CONTRACTOR. Reusable valve signs, risers, riser tops and mushroom lids in locations of abandoned valve clusters shall be given to CITY OF FARMERSVILLE. Scraps shall not be buried on private, county, or state properties. This does not relieve the CONTRACTOR of the responsibility of ongoing and routine clean-up operations related to the line laying work. All surplus excavated materials resulting from the work shall be removed from the site or spread on site as directed by ENGINEER / CITY OF FARMERSVILLE / STATE / COUNTY. Excess materials shall be mounded along trench lines in order to channel water away from fresh pipe trenches. Excess materials in areas of steep grades shall be utilized to channel water away from trench lines and constructing terracing berms to prevent erosion. ALL disturbed areas shall be seeded according to the Seeding Rate Section of this Specifications Book and fertilized at 200 pounds per acre with 13-13-13. The costs associated with seeding and final clean up shall be included in the line item bid prices of the CONTRACTOR.

END OF SECTION

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SECTION 1005

STRUCTURAL EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

In the event of a conflict between this specification and project plans (drawings) then the plans will take precedence. The scope of the work to be performed follows:

- A. Excavation, backfill, and compaction around structures.
- B. Site excavation and backfilling.
- C. Excavation support systems.
- D. Fill for over-excavation.
- E. Groundwater and surface water control.
- F. Excavation for paving and landscaping.
- G. Line and grade.

1.2 RELATED WORK DESCRIBED ELSEWHERE

Earthwork	Section 201
Trench Excavation Safety Systems	Section 1002

1.3 REFERENCES

- A. Referenced Standards:
 - 1. ASTM D698 - Moisture Density Relationship of Soils using a 5.5 lb hammer and a 12-inch drop.
 - 2. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 3. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.

1.4 QUALITY ASSURANCE

- A. Test material to be used as compacted fill, whether excavated onsite or imported as offsite borrow, for compliance with the requirements of Section 201 prior to placement.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Excavation Support System: CONTRACTOR option, suited for purpose.
- B. Fill Materials: Specification Section 201.

PART 3 - EXECUTION

3.1 PREPARATION AND LAYOUT

- A. Establish extent of structural excavation by area and elevation; designate and identify datum elevation.
- B. Set required lines and levels.
- C. Maintain benchmarks and other reference points.

3.2 PROTECTION

- A. Protect, support, and/or reroute existing utilities.
- B. Protect adjacent work from damage by excavation and backfilling operations.
- C. Protect adjacent structures from undermining.
- D. Support sides of excavations to prevent soil movements, which may diminish the excavation width below width required for working.
- E. Support sides of excavation, which interfere with normal 45 degree bearing splay of any foundation.

3.3 EXCAVATION SUPPORT SYSTEMS

- A. Design, installation, and maintenance of temporary excavation support systems is the responsibility of the CONTRACTOR. Provide support systems at no additional expense to CITY OF FARMERSVILLE.



- B. Design and construct excavation support systems in accordance with OSHA standards and interpretations.

3.4 GROUNDWATER AND SURFACE WATER CONTROL

- A. CONTRACTOR is responsible for designing, providing and maintaining a system for control of groundwater.
- B. Lowering groundwater by pumping from open sumps within foundation limits is not permitted.
- C. Provide adequate swales, dams, ditches, and grades to prevent surface water from flowing into excavation.
- D. Maintain water control until structure is complete and backfill is brought to final grade unless otherwise directed by CITY OF FARMERSVILLE or ENGINEER.
- E. Groundwater or water from other sources may be present in excavations regardless of whether shown on boring logs.

3.5 EXCAVATION

- A. Excavate to lines and grades shown on the Drawings. Excavations shall be either braced or stored or laid back to a slope no steeper than two horizontal to one vertical.
- B. When excavation is essentially complete, verify depths and dimensions as well as soil classification and bearing capacity.
- C. Perform additional excavation only as approved by CITY OF FARMERSVILLE.
- D. Correct unauthorized excavation as directed at no cost to CITY OF FARMERSVILLE.
- E. Fill over-excavated areas under structure bearing surfaces with concrete or compacted sand fill as required by the CITY OF FARMERSVILLE or ENGINEER.
- F. Excavate to within 1 foot of final grade, making final excavation immediately prior to placement of formwork and reinforcing steel. Limit area of final excavation to that which is being prepared for concrete placement. Limit exposure of final excavated surface to 24 hours. If excavated surface is exposed longer than 24 hours or is damaged due to weather conditions, CONTRACTOR shall excavate four inches and provide a concrete seal slab. Keep excavations free of standing water until concrete and backfill operations are complete.
- G. Seal slabs shall be used where called for on the Drawings or as specified in paragraph F above.

3.6 BACKFILLING

- A. Verify fill materials to be reused are acceptable.
- B. Verify foundation perimeter drainage installation has been inspected.
- C. Verify underground tanks are anchored to their own foundation to avoid floatation after backfilling.
- D. Backfill materials shall be as specified in Section 201.
- E. Backfill around structures as soon as possible after approval by the CITY OF FARMERSVILLE or ENGINEER.
- F. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- G. Maintain moisture content of backfill materials as specified in Section 201.
- H. Do not backfill against walls until concrete has been in place at least seven days.
- I. Do not backfill against unsupported foundation walls or partially completed structures until after main floor slabs have been in place at least seven days and placement is approved by the CITY OF FARMERSVILLE or ENGINEER.
- J. Backfill simultaneously on each side of foundation walls and other structures to equalize soil pressures. Provide temporary bracing as required.
- K. Take special care to prevent wedging action against structure. Bench or serrate slopes bounding excavation.
- L. Make grade changes gradual. Blend slope into level areas.
- M. Surplus backfill materials shall be removed from site and disposed of in accordance with all applicable regulations.

- N. Tolerance for Top Surface of Backfilling: Plus or minus 0.1 foot from required elevations. Regardless of tolerances, grading shall be performed in such a manner as to prevent ponding of water on compacted surfaces.

3.7 COMPACTION

- A. Remove shoring and sheeting unless otherwise approved by the ENGINEER. The cost of abandoned shoring and sheeting is to be borne by the CONTRACTOR.
- B. Compact fill materials in accordance with Section 201.
- C. Remove and replace improperly compacted backfill material at no cost to CITY OF FARMERSVILLE.
- D. The City of Farmersville shall call for and pay for initial compaction tests. In the event of a compaction test failure the CONTRACTOR shall pay for any additional testing.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the General Conditions.
- B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM and with the General Conditions.
- C. Proofs roll compacted fill surfaces under structures and paving as specified in Section 201.

3.9 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of General Conditions.

END OF SECTION

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SECTION 1006 CHAIN LINK & WIRE FENCING

PART 1 – GENERAL

1.1 SCOPE OF WORK

This item covers materials used to construct fencing in accordance with the plans and any typical details, which may be shown on the plans. In the event of a conflict between this specification and project plans (drawings) then the plans will take precedence.

1.2 QUALITY ASSURANCE

A. Standards and Applicable Specifications

It shall be understood that when an AWWA, ACI, ASTM, ANSI, or any other such standard is referenced in these technical specifications, that the latest edition of the referenced standard shall be used. All material shall be of domestic origin.

1.3 SUBMITTALS

- A. This data shall include drawings and descriptive information in sufficient detail to show kind, material, and size, (i.e. catalog cut-sheets for all, items, appurtenances, etc.) and dimensions needed for installation and correlation with other materials and equipment. Information shall be submitted by specifications section. Data submitted shall include drawings showing essential details of any changes proposed by the CONTRACTOR with detailed layouts. If the cut-sheets contain information not pertaining to the supplied equipment, all extraneous information shall be clearly crossed out and pertinent information highlighted.
- B. No work shall be performed in connection with the fabrication or manufacture of materials and equipment nor shall any accessory or appurtenance be purchased until the drawings and data thereof have been approved by the ENGINEER and CITY OF FARMERSVILLE, except at the CONTRACTOR's own risk and responsibility.

1.3 WARRANTY

The CONTRACTOR and Manufacturer shall guarantee that the station's piping shall be free from defects in design, materials and workmanship for one year from date of acceptance by the CITY OF FARMERSVILLE.

2 - PRODUCT

2.1 GALVANIZED CHAIN LINK FENCING MATERIALS

- A. Fabric: The base metal of the fabric shall be a good commercial quality of steel wire. The wire shall be woven throughout in the form of approximately uniform square mesh, having parallel sides and horizontal and vertical diagonals of approximately uniform dimensions. The top and bottom of the fabric shall be knuckled or barbed as specified. The sizes of wire and mesh shall be 9 gauge with 2.25 inch mesh unless specified otherwise. The entire fabric shall be zinc coated in accordance with Zinc-Coated Steel Chain-Link Fence Fabric, ASTM Designation A 392.
- B. Posts: Posts may be rolled, formed or tubular in cross section and shall be in accordance with Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence, ASTM Designation F 1043. All posts shall meet the weight and length requirements as shown on the plans.
- C. Rails, Gates, Braces and Fittings: Rails, gates, and braces may be rolled, formed or tubular in cross section and shall be in accordance with Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence, ASTM Designation F 1043. Fittings and appurtenances shall be in accordance with Fence Fittings, ASTM Designation F 626.
- D. Barbed Wire: Barbed wire shall be two strand twisted No. 12 ½ AWS gauge galvanized steel wire with two-point bards of No. 14 AWS gauge galvanized steel wire and conforming to Zinc-Coated (Galvanized) Steel Barbed Wire, ASTM Designation A 121, Class 1.



- E. Concrete: Concrete shall be as specified on the plans and in accordance with the plan sheets of these specifications.
- F. Rejection: Failure to meet all of the specifications contained in this section shall be cause for rejection.

2.2 BARBED & OTHER WIRE FENCING MATERIALS

- A. Fabric: The base metal of the fabric shall be of a good commercial quality of steel or iron as specified. The wire shall be the height and design shown on the plans. The top and bottom wires shall be a minimum No. 10 AWS gauge, and the intermediate wires and vertical stays shall be No. 12 ½ AWS gauge. The entire fabric shall be zinc coated in accordance with Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric, ASTM Designation A 116.
- B. Metal Posts: Metal posts may be rolled, formed or tubular in cross section and shall be in accordance with Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence, ASTM Designation F 1043. All posts shall meet the weight and length requirements as shown on the plans. All posts not galvanized shall be painted with an approved anti-corrosive paint.
- C. Wood Posts: Wood posts shall be the length and dimensions shown on the plans. The timbers shall be sound and free from all decay, shakes, splits, unsound or excessive knots or any other defects that might impair their strength or durability. Knots shall not exceed one-third of the small dimension or diameter of the post. A line drawn between the centers of each end shall not fall outside the center of the post at any point more than by 2". Knots shall be trimmed flush and the ends cut square. Untreated posts may be cedar, redwood, cypress or live oak. Treated posts may be pine, spruce or fir. Treated posts shall have a creosote oil or pentachlorophenol treatment of not less than eight pounds per cubic foot.
- D. Rails, Gates, Braces and Fittings: Rails, gates, and braces may be rolled, formed or tubular in cross section and shall be in accordance with Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence, ASTM Designation F 1043. Fittings and appurtenances shall be in accordance with Fence Fittings, ASTM Designation F 626. All rails, braces and fittings not galvanized shall be painted with an approved anti-corrosive paint.
- E. Barbed Wire: Barbed wire shall be two strand twisted No. 12 ½ AWS gauge galvanized steel wire with two point barbs of No. 14 AWS gauge steel wire and conforming to Zinc-Coated (Galvanized) Steel Barbed Wire, ASTM Designation A 121, Class 1.
- F. Rejection: Failure to meet all of the specifications contained in this section shall be cause for rejection.

PART 3 - EXECUTION

3.1 GENERAL

The chain-link fence shall be constructed in accordance with the details on the plans, and as specified herein, with new materials unless specified otherwise. All work shall be performed in a workmanlike manner satisfactory to the CITY OF FARMERSVILLE.

3.2 CLEARING FENCE LINE

The site of the fence shall be sufficiently cleared of obstructions; and surface irregularities shall be graded so that the fence shall conform to the general contour of the ground. The fence line shall be cleared to a minimum width of two feet on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees or other obstructions, which shall interfere with proper construction of the fence. Stumps within the cleared area of the fence line shall be grubbed or excavated.

The bottom of the fence shall be placed a uniform distance above the ground and as specified on the plans. When shown on the plans, or as directed by the CITY OF FARMERSVILLE, the existing fences which coincide with or are in a position to interfere with the new fence location shall be removed by the CONTRACTOR as a part of the construction work, unless such removal is listed as a

separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel or other material acceptable to the CITY OF FARMERSVILLE; and shall be compacted properly with tampers. The work shall include the handling and disposal of all material cleared, excavated or removed regardless of the type, character, composition or condition of such material encountered.

3.3 INSTALLATION OF FENCE

- A. Post Holes: The excavation for postholes shall be accurately centered along the line of the fence.
- B. Installing Posts: All posts shall be spaced not more than 10 feet apart and as shown on the plans. Terminal (end, corner, and pull) posts, gate posts and line posts shall be set in concrete bases of 3000 psi concrete to the diameter and depth as shown on the plans. The concrete bases for the posts shall be of sufficient depth to provide a minimum of two inches concrete below the bottom of the posts. The top of the concrete bases shall be slightly above the ground, trowel finished and sloped to drain away from the posts. Holes of full depth and size for the concrete bases for posts shall be dug to the size and depth as shown on the plans. All post settings shall be made carefully so that all posts shall be vertical, in true alignment and rigidly secured in position. On terminal (end, corner, and pull) posts and gate posts, the post tops and brace rail clamps around the posts shall be placed before setting the posts in the concrete bases or at such a time that heavy clamps can be installed without spreading them to accommodate the post.

In setting the gateposts, care must be taken to make sure that gateposts are set the exact distance apart as shown on the plans. A line drawn across from the top of one gatepost to the other must be level regardless of the grade of the ground line. If the ground is not level, the upgrade posts shall be set first to get the proper height for the downgrade gatepost. The concrete for post setting shall be allowed to cure for seven days. Tension bar bands and truss bands shall be spread and slipped on end, corner, pull, brace and gateposts as the next operation. Post tops are then inserted on all other posts. Pull posts shall be placed not over 500 feet apart in straight runs and at each vertical angle point, all as directed by the CITY OF FARMERSVILLE. Corner posts shall be placed at each horizontal angle point. Corner and pull posts shall have horizontal braces and truss rods as shown on the plans or as specified. Posts to be placed in concrete structures shall be placed in previously embedded oversize pipe sleeves and then packed with sulphur compound.

- C. Bracing Members: Bracing members shall be provided for each corner and between each steel post and gate post, and shall consist of two 1-5/8" O.D. schedule 40 tubular horizontal braces extending to each adjacent line post at equidistant height intervals (i.e. at 1.3 intervals from top of concrete footings to top of posts) to the fabric. All corner and gatepost brace connections shall be welded instead of bolted. Braces shall also be installed at the top of fabric between each line post. Top rail braces shall be 1-5/8" O.D. schedule 40 tubing with minimum weight of 2.27 lb/L.F.
- D. Tension Bars: Tension bars shall be not less than 3/16 inch x 3/4-inch high carbon steel and shall be of the lengths required for the full height of fabric installed. The tension bars shall be attached to the fabric by threading through the fabric, by clamps or by other positive mechanical means. One tension bar shall be provided for each gatepost and 2 for each corner post.
- E. Bottom Reinforced Wire: Bottom reinforcing coils shall be installed after concrete has set around posts. Means shall be provided as hereinbefore specified, for attaching the bottom coils securely to each corner, line and gate posts; and to the fabric.
- F. Installing Fabric: The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects over the top rail of the fence. The fabric shall be stretched taut to present a smooth uniform surface along the line of the fence and securely fastened to the posts, the top rail and the bottom tension wire. Distortion of the fabric by overstretching shall be avoided. The tension wire shall be installed parallel to the line of the

fabric. The bottom of the fabric shall extend to within two inches of the natural ground or paved surface. However, over irregular ground, this distance may vary between one inch and six inches for a distance not to exceed eight feet. High points of ground shall be excavated to clear the bottom of the fabric; depressions shall be filled and compacted to within two inches of the bottom fabric; and shall be considered as incidental work. For guard fence, the fabric shall extend to within six inches above the concrete surface for structures.

The fabric shall be fastened to end, corner, slope and gate posts with tension bars and not less than No. 12 gauge x one inch steel tension bar bands spaced at 16-inch intervals; and to line posts, top rail and tension wire with tie wires or metal bands. Tie wires or metal bands shall be placed on line posts at intervals of approximately 16 inches; and top rail and tension wire at intervals of approximately 24 inches.

G. Barbed Wire: Barbed wire shall be pulled taut and adequately fastened to extension arms.

H. Installing Gates: The gates shall be hung as to freely swing, and not drag or bind in openings. The hinges shall be so set as not to twist or turn under the action of the gate. The gates shall be easily swung back as far as possible and held in the open position by the stops. The locks shall be of substantial construction and shall be accessible from both sides of the gate. Locks shall be same as existing CITY OF FARMERSVILLE lock configuration. Latches shall be set so as to operate freely.

The widths of any gates to be installed shall be 20 feet or as indicated on the plans. Gates with fabric seven feet or more in height shall have a horizontal stiffener. Vertical stiffeners shall be installed at a maximum of eight-foot centers. A 3/8-inch adjustable tension rod shall be installed on all gates over four feet in width. The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain-link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified; and by suitable tension connectors spaced at approximately 16-inch intervals. The roller mounted slide gates are to be constructed according to the plan drawings

3.4 EXISTING FENCE CONNECTIONS

Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner post with a brace post shall be set at the junction and braced the same as for corner posts. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

3.5 REPAIR OF DAMAGED COATING

On all galvanized parts where zinc coating has been omitted, chipped off or removed, the steel or iron left exposed shall be repaired. Damaged zinc coating shall be repaired by thoroughly wire-brushing the damaged area and removing all loose cracked or weld-burned zinc coating. The cleaned area shall be painted with two coats of zinc-oxide-zinc dust paint conforming to the requirements of federal Specification TT-P-641 b. or approved equal. The paint shall be furnished by the CONTRACTOR at his expense.

3.6 MEASUREMENT AND PAYMENT

- A. Chain-link and guard-link fences shall be measured in place from center to center of end posts or corner post and shall be the length of fence actually constructed, except the space occupied by the gates. Gates shall be measured in units for each gate installed and accepted.
- B. Payment shall be made at the contract lump sum price or the price per linear foot for chain or guard-link fences whichever is shown on the accompanying Bid Form. This price shall be full compensation for furnishing all material; for all preparation, erection and installation of these materials; and for all labor, equipment, tools and incidentals necessary to complete the work.
- C. Payment shall be made at the contract lump sum price or the price per each for gates whichever is shown on the accompanying Bid Form. This price shall be full compensation for furnishing all

materials; for all preparation, erection and installation of these materials; for all labor, equipment, tools and incidentals necessary to complete the work.

END OF SECTION

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SECTION 1007 FLEXIBLE BASE

PART 1 - GENERAL

1.1 SCOPE OF WORK

This item shall consist of a foundation course for a surface course or for other base courses; shall be constructed as herein specified in one or more courses in conformity with the typical section shown on the plans and to the lines and grades as established by the CITY OF FARMERSVILLE. In the event of a conflict between this specification and project plans (drawings) then the plans will take precedence.

1.2 QUALITY ASSURANCE

Standards and Applicable Specifications

The following specifications of the issues listed below, but referred to thereby by basic designation only, form a part of this specification. All material shall be domestic origin.

PART 2 - PRODUCT

2.1 MATERIALS

Preparation of Subgrade: Six (6) inches of topsoil shall be removed from all areas designated to receive flexible base and the subgrade shall be brought to a uniform finish six (6) inches below the finished top of flexible base elevation indicated by the plans. Fill necessary to bring the subgrade to its finished elevation shall be clean soil with a P.I. less than 15. Topsoil shall not be used as fill. Fill shall be compacted in lifts not exceeding 8 inches. Finished subgrade and subgrade fill shall be compacted to 90% of Texas DOT Method Tex-113-E.

PART 3 - EXECUTION

3.1 THICKNESS

Where the base course exceeds six inches in thickness, it shall be constructed in two or more courses of equal thickness as indicated on the typical section.

3.2 PLACING

- A. Immediately before placing the base course material, the subgrade shall be checked as to conformity with grade and section.
- B. The material shall be delivered in approved vehicles of a uniform capacity. It shall be the charge of the CONTRACTOR that the required amount of specified material shall be delivered to secure the proper thickness of the completed base course. Material deposited on the subgrade shall be spread and shaped the same day. All material shall be moved at least once from the original position in which it is deposited. In the event of inclement weather or other unforeseen circumstances, which render impracticable the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the CITY OF FARMERSVILLE. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to the typical section as shown on the plans.
- C. All areas and "nests" of segregated course or fine material shall be corrected or removed and replaced with well-graded material as directed by the CITY OF FARMERSVILLE. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and applied in the amount directed by the CITY OF FARMERSVILLE. Such binder shall be carefully incorporated with the material in place by scarifying, harrowing, brooming, or by other approved methods. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter-specified under "Density." In addition to the requirements specified for density, the full depth of flexible base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, the CITY OF FARMERSVILLE shall make tests as necessary unless otherwise specified in the special provisions or in the plans. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements.

- D. Throughout this entire operation, the shape of the course shall be maintained by blading. The surface, upon completion, shall be smooth and in conformity with the typical sections shown on the plans to the established lines and grades. On the surface on which pavement is to be placed, any deviation in excess of one-half inch in cross section and in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
- E. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted and refinished at the sole expense of the CONTRACTOR.

3.3 DENSITY

The density required under this item shall not be less than 95 percent compaction as determined by Texas SDHPT Test Method Tex-113-E.

3.4 COURSES

Paving types with flexible base under the curb and gutter shall be placed and compacted at the same time and in the same operation as the flexible base under the pavement. The flexible base shall be placed in two courses, as shown on the plans. The first course shall be placed and compacted under the curb and gutter and under the pavement. The curb and gutter shall then be built upon the first course. The final course of the flexible base shall be placed after sufficient time has elapsed.

END OF SECTION

SECTION 1008
SANITARY SEWER FORCE MAIN PIPES AND FITTINGS

PART 1 - GENERAL

1.1. SCOPE OF WORK

The work to be performed under this section of the specifications shall consist of furnishing and installing Ductile Iron Pipe (DIP), Polyvinyl Chloride Pipe (PVC), and Reinforced Concrete Cylinder Pipe (RCCP) for force main, including pipe laying, jointing, testing, and all incidental work required to complete the pipe installation as shown on the plans and as specified herein. In the event of a conflict between this specification and project plans (drawings) then the plans will take precedence.

1.2. MEASUREMENT AND PAYMENT

A. PIPE

The installation of pipe shall be measured per linear foot and will be paid for at the total unit price as shown in the bid proposal for the size, class, and type specified. The bid price should include all pipe laying, jointing, tack welding, tests and other work required to complete the pipe installation as shown on the plans and as specified herein in which no other applicable bid item has been established. Trenching, embedment and backfilling is a separate pay item.

B. FITTINGS

The installation of ductile iron fittings shall be measured per pound and will be paid for at the total unit price as shown in the bid proposal for "Wrapped Iron Fittings." When reinforced concrete fittings are used, measurement shall be per linear foot, as measured along the major axis, and will be paid for at the total unit price as shown in the bid proposal for the nominal diameter of reinforced concrete cylinder pipe. No separate measurement or payment will be made for fittings used in the installation of fire hydrant leads, or wet connections, other than those shown on the plans.

C. SHOP DRAWINGS

Any additional cost to the contract due to changes contained in the shop drawings shall be presented to the ENGINEER in a written statement when the shop drawings are submitted for approval by the ENGINEER. The CONTRACTOR shall not be compensated for any claims for additional payment unless a written statement containing such costs is submitted to the ENGINEER prior to the final approval of the shop drawings.

1.3. RELATED WORK DESCRIBED ELSEWHERE

Structural Excavation, Backfilling, & Compacting	Section 206
Trench Excavation Safety Systems	Section 1002
Force Main Testing	Section 215
Concrete Thrust Blocks	Section 304
Metal Tracer Tape	Section 205
Waste Water Valves	Section 214

PART 2 - PRODUCTS

2.1 GENERAL

All pipe used in conjunction with this section shall conform to and be approved in the current "APPROVED PRODUCTS LISTINGS" list which is on file with the CITY OF IRVING PUBLIC WORKS DEPARTMENT.

2.2 POLYVINYL CHLORIDE PIPE

For 4" to 36" force mains, PVC pipe shall meet or exceed requirements of ips class PVC ASTM D 2241 with cast iron outside dimensions and with rubber ring joints. Pipes shall be Pressure rated 160 DR 26. PVC force main pipe shall be listed by Underwriters Laboratories and approved for use in cities and towns of Texas by the State Board of Insurance. The rigid PVC pipe shall bear the seal of approval (or "NSF mark) of the National Sanitation Foundation Testing Laboratory for potable water



pipe. Provisions must be made for contraction and expansion at each joint with a rubber ring. All pipe and fittings must be assembled with a non-toxic lubricant. Laying lengths shall be 20 feet \pm 1".

Pipe shall be made in nominal sizes of 4, 6, 8, 10, 12, 14, 16, 18, 20 and 24 inches, and shall meet the physical dimensions as shown in Table 1.

TABLE 1			
P.V.C. MUNICIPAL WATER PIPE DIMENSIONS			
NOMINAL SIZE (INCH)	OUTSIDE DIAMETER (INCH)	MINIMUM WALL ASTM D 2241 DR 26	THICKNESS (INCH) ASTM D 2241 DR 26
4"	4.500	0.173	0.267
6"	6.625	0.255	0.383
8"	8.625	0.332	0.503
10"	10.750	0.413	0.617
12"	12.750	0.490	0.733
14"	14.000	0.538	0.850
16"	16.000	0.615	0.967
18"	18.000	0.692	1.083
20"	20.000	0.769	1.200
24"	24.000	0.923	1.433

Pipe shall be made from NSF approved Class 12454-A or B P.V.C. compound conforming to ASTM resin specification D1784.

Each length of 4" to 12" pipe shall be tested to four (4) times the class pressure for a minimum of five (5) seconds. Each length of 14" to 24" pipe shall be tested to two (2) times the class pressure for a minimum of five (5) seconds.

When requested, the manufacturer shall furnish certification that the pipe meets all requirements of this specification.

Service saddles to be all bronze or approved equals shall be used on all services. NO direct service connections shall be used on services. Fittings shall be mechanical joint.

2.3. PRESTRESSED CONCRETE LINED CYLINDER PIPE

Prestressed concrete cylinder pipe shall comply with the applicable provisions of AWWA STANDARD C-301 or C-303, latest edition.

The pipe manufacturer shall have had a successful experience record in the design and manufacture of concrete cylinder pipe and shall have had a substantial footage of pipe or similar size and with the same joints as offered for this project in successful operation for at least five (5) years. All pipe and fittings shall have the approval of the Underwriters Laboratories, Inc.

All pipes shall be designed for the working pressure or classes and the external load as specified in the AWWA-C301 and/or C-303 standards.

Upon the award of the contract, the CONTRACTOR shall furnish the ENGINEER shop drawings showing the pipe and fittings to be furnished and shall include a location profile and a tabulated layout scheduled as required by the ENGINEER. Such drawings shall be subject to the approval of the ENGINEER.

Unless otherwise indicated, pipe in trenches shall be laid to the grade shown on the approved shop drawings. Each join of pipe shall be laid on an even and uniform grade and to the elevations shown

to avoid the requirements of additional special pipe and/or fittings. The grade line shown on the plans is the invert or flow of the pipeline. The CONTRACTOR shall establish the grade line in the trench or excavation from grade stakes established by the ENGINEER.

The installation of outlets (including blind flanges) and other appurtenances, which are shown on the plans or described elsewhere in these specific items included in the bid schedule, shall be considered a part of the work to be performed and paid for under this section of the specifications.

The CONTRACTOR shall provide a 1" minimum thickness concrete or cement mortar coating in the field for the protection of all exposed steel such as flanges, caulked jointed, threaded outlets, etc.

The cement mortar used shall consist of one (1) part Portland cement to two and one-half (2-½) parts of fine, sharp (plaster) sand.

Any surface receiving a cement mortar coating shall be thoroughly cleaned and wetted with water just prior to placing the cement mortar coating. After placement, measures shall be taken to prevent the mortar coating from drying too rapidly by either using dampened burlap or other approved methods.

Embedment for the prestressed concrete cylinder pipe shall be as specified on the plans.

The CONTRACTOR shall tack weld the pipe as shown on the plans or as directed by the ENGINEER (non-pay item). The pipe shall be designed and constructed to structurally compensate for all tack weld locations (non-pay item).

2.4 IRON PIPE AND PROTECTION

Ductile iron pipe shall only be considered in lieu of PVC pipe after the CONTRACTOR has a soil evaluation performed by the Ductile Iron Pipe Research Association (DIPRA) and a positive recommendation from DIPRA that does not require cathodic protection. Ductile iron pipe may be installed after meeting the above conditions and with written approval from the ENGINEER. Ductile iron pipe shall be encased, as it is placed, in a loose sleeve of 8 mil or 4 mil cross laminated, polyethylene plastic. Where the sleeve is not practical to install, a sheet overlapping one half the circumference of the pipe shall be tied or taped in place to give 100% coverage of the pipe, valves, fittings, and line to the fire hydrants. Iron Pipe Protection shall conform to AWWA standard C105. DIPRA may be contacted at the following address: 245 Riverchase Parkway East, Suite O, Birmingham, Alabama 35244 or telephone number (205) 402-8700.

2.5. LINING

All ductile iron pipe and fittings shall be enamel coated outside and cement lined according to both ASA A21.4 and AWWA C104 specifications, except that the cement lining may be half thickness as specified by Federal Specifications WW-P-421A.

2.6. JOINTS FOR IRON PIPE

All ductile iron pipes shall be jointed with rubber gasket joints. Whether mechanical or siphon joints, the joints shall conform to ASA A21.22, and/or (AWWA C111) specifications. Flanged or restrained joints may be used in locations of restricted area and shall be used as indicated on the plans or as directed by the ENGINEER. Boils for flanged, mechanical, or restrained joints shall be of non-corrosive material.

2.7. FITTINGS

AWWA C110, C111 and AWWA C153 shall be the standard for all force main fittings. Fittings used for service, fire hydrant, or fire line installations shall be mechanical joint, flanged, or other approved restraining type joints or as directed by the ENGINEER.

Full body ductile iron fittings 3" through 30" shall be pressure rated at 250 psi, minimum. Ductile iron compact fittings 3" through 24" shall be pressure rated at 350 psi, minimum.

All fittings shall be cast and machined allowing the bolt holes to straddle the vertical centerline. Flanges shall be ANSI Standard. Class 123, plain faced and drilled in accordance with ANSI B16.1. Only those fittings that are of domestic (USA) manufacturer will be acceptable unless otherwise approved in writing by the ENGINEER.

All fittings shall be furnished with stainless steel or high strength Corten T-Head Bolts and hex nuts with composition, dimensions and threading in accordance with composition, dimensions and threading in accordance with ANSI/AWWA Standard C111/A21.11 1990 or latest revision. All glands shall be preferably made by the same manufacturer as the fittings that are furnished in order to maintain integrity of the water system.

Installation of joint materials for pipe and fittings shall be in accordance with the applicable provisions of ANSI/AWWA Standard C600 *"Installation of Ductile Iron Watermains and Appurtenances"* unless otherwise specified.

All fittings 3" and larger in diameter for water mains shall be cement-lined in accordance with ANSI/AWW Standard C104/A21.4 1995 *"Cement Mortar Lining for Ductile Pipe and Fittings for Water"* or latest revision.

At the request of the ENGINEER, the material supplier and/or CONTRACTOR shall furnish data certified by the fitting manufacturer that the fittings, accessories, and linings are of the material specified.

At the request of the ENGINEER; the manufacturer shall furnish to the ENGINEER certifications that all fittings comply with the following requirements:

All fittings shall be capable of withstanding, without bursting, hydrostatic tests of three times the rated working pressure. The results of the specific tests (AWWA Standards) shall be retained for one year and shall be made available to the CITY OF FARMERSVILLE at the foundry.

All fittings, furnished by the approved manufacturers, shall be cast and machined at one foundry location to assure quality control and provide satisfactory test data.

Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's identification, the country where cast and the number of degrees or fraction of a circle. Ductile-Iron or "DI" should be cast on all ductile iron fittings. Cast letters and figures shall be on the outside body of the fitting and shall have wall dimensions no smaller than those shown in ANSI/AWWA C110 and C153. Country of origin for engineering approval shall be marked and identified on all submittals.

A certified letter shall be required of manufacturers that all fittings and accessories are domestic manufacture. No fittings will be accepted for use on the project until all certificates have been submitted to and approved by the ENGINEER.

PART 3 - EXECUTION

3.1. GENERAL

All 4" to 12" force main pipe shall have a minimum of four (4) feet of cover along improved streets and a minimum of five (5) feet of cover along unimproved streets, or as shown in construction documentation. The depth of cover shall be measured from the top of curb, edge of pavement, or ground, whichever provides the most cover.

The CONTRACTOR shall furnish all labor, equipment, materials and all appurtenances to make the installation and perform the work in a workman-like manner.

3.2. ALIGNMENT AND GRADE

The force main shall be laid and maintained to the required lines and grade with spigots centered in bells. Fittings, valves, and hydrants shall be installed at the required locations. All valve stems shall be plumb.

3.3. EXCAVATION AND PREPARATION OF TRENCH

The trench shall be dug so that the pipe can be laid to the alignment and depth required. No excavation shall be in excess of 300 feet from the end of the finished pipeline.

3.4. PROPER DRAINAGE OF DITCH

The excavated trench shall be drained so that workmen can safely work therein and the presence of water will not interfere with the proper construction of the water line. The CONTRACTOR shall have available at all times the necessary equipment, in proper working order, to dewater the trench. All

water removed from excavation shall in no case create unsanitary conditions, cause injury to persons or property, damage the work in progress, interfere unduly with the use of streets, or private driveways.

3.5. BELL HOLES

Bell holes shall be provided at each joint.

3.6. PIPE FOUNDATIONS

The trench shall be excavated to a depth so as to provide a uniform and continuous bearing and support for the pipe and sand embedment, as shown on the plans, at every point between bell holes. Any part of the bottom of the trench excavation below the specified grade shall be corrected with approved materials and thoroughly compacted as directed by the ENGINEER. Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6" below and on each side of all pipe and fittings. Where the bottom of the trench is found to be unstable or to include ashes, cinders, any type of refuse, or organic material, which in the judgment of the ENGINEER should be removed, the CONTRACTOR shall excavate and remove such unsuitable material to the width and depth ordered by the ENGINEER. Before the pipe is placed in the trench, the subgrade shall be made level by backfill with an approved material and thoroughly compacted as directed by the ENGINEER.

3.7. BLASTING

Use of Explosives: Unless prior written permission is received from the ENGINEER and CITY OF FARMERSVILLE, no blasting will be allowed on this project. Bonds may be required from the blaster prior to receiving such permission. If approved, the CONTRACTOR shall advise the ENGINEER and CITY OF FARMERSVILLE regarding the scheduling of such work. Should the CONTRACTOR elect to use explosives in the performance of the work, they shall be used with utmost precaution, and no blasting shall be done within one hundred (100) feet of the completed work or exposed pipes, conduits, and other related materials, and the CONTRACTOR shall assume all liability for any injury or damage to persons or property resulting from such usage. Only a sufficient quantity of explosives for the immediate day's work shall be kept on hand by the CONTRACTOR. Caps, exploders, and explosives shall be stored separately. The CONTRACTOR shall be responsible for, and shall make good any damage caused by blasting or accidental explosion.

3.8. SHEETING, SHORING AND BRACING

All open-cut trenches, that might endanger life, property, or the progress of work, shall be sheeted or shored and braced to prevent slides, cave-ins, or any movement of the walls of the trench. See Section 1002 "*TRENCH EXCAVATION SAFETY SYSTEMS*" of these specifications.

3.9. INTERRUPTION OF SERVICE

No valve or other control on an existing system shall be operated for any purpose by the CONTRACTOR without approval of the ENGINEER. The CONTRACTOR shall operate all valves only under the supervision of the ENGINEER. When it is necessary to close valves on any of the waterlines, the CONTRACTOR shall give ample notice to customers before the water is shut off.

3.10. LAYING OF PIPE

Proper implements, tools, and facilities satisfactory to the ENGINEER shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of the work. All pipe, fittings, and valves shall be carefully delivered to the site and lowered into the trench, piece by piece, by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials, protective coatings, and linings. Under no circumstance shall force main materials be dropped or dumped into the trench.

The pipe and fittings shall be inspected for defects and, while suspended, be rung with a light hammer to detect any cracks. All lumps, blisters, and excess coating material shall be removed from the bell and spigot ends of each pipe. Additionally, the inside of the bell or coupling and the outside of the spigot shall be wire brushed and wiped clean, dry, and free of all foreign and objectionable material before the pipe is laid. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the ENGINEER may require a watertight plug or other approved method be placed over each end and left in place until the connection is ready to be made. During laying operations, no debris, tools, clothing, or other material shall be placed in the pipe. After placing the length of the pipe in the trench, the spigot end shall be centered in the bell and forced home and brought to the correct line and grade. The pipe shall be secured in place with embedment material tamped under it.

At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the ENGINEER. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry. In no case shall the pipe be used to drain the trench.

The cuffing of pipe for inserting valves, fittings, or closure, shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an electric or oxyacetylene torch, chisel, or cold cut and sledge will not be permitted.

The pipe shall be laid with bell or coupling ends facing in the direction of laying, unless otherwise directed by the ENGINEER.

3.11. JOINTING

No lead or cement joint material shall be permitted. Jointing of pipe shall be with a self sealing gasket of material meeting the requirements of AWWA C111 Standards or approved by the ENGINEER.

3.12. TESTING

Testing shall be performed as specified in Section 215 "*FORCE MAIN TEST*" of these Specifications.

END OF SECTION

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SECTION 1009 SEWER LINE CONSTRUCTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

This work consists of constructing a sewage collection system for the CITY OF FARMERSVILLE. The CONTRACTOR shall provide all tools and equipment required for installing these items. The work also includes furnishing all materials, excavating, bedding, laying pipe, jointing, backfilling, hydrostatic testing, restoration of disturbed facilities and surfaces, line (location) and grade, disposal of all surplus excavation and discarded materials, and other work necessary to complete the items. In the event of a conflict between this specification and the project plans (drawings) then the plans will take precedence.

1.2 LOCATION OF PIPELINES

The CONTRACTOR shall comply with Regulation .005 - Water Distribution, from the "Rules and Regulations for Public Water Systems," adopted by the Texas Department of Health, for locating all proposed pipelines.

1.3 COORDINATION OF WORK

All construction work shall be closely coordinated by the CONTRACTOR with the ENGINEER and the CITY OF FARMERSVILLE. Field changes from the Plans and Specifications will only be allowed upon approval of the ENGINEER.

1.4 SUBMITTAL MATERIAL

The CONTRACTOR shall supply submittal data covering materials proposed for use to the ENGINEER for approval. Submittal data shall include brand name, technical information and the name and address of the material supplier.

1.5 UTILITIES DURING CONSTRUCTION

The CONTRACTOR will be required to make arrangements for and pay for the water, electricity and any other utilities required during construction.

1.6 FIELD STAKING

Unless otherwise specified, all lines and grades shall be furnished by the CONTRACTOR and verified by the CITY OF FARMERSVILLE or his representative. Whenever necessary, construction work shall be suspended to permit performance of this work, but such suspension will be as brief as practicable and the CONTRACTOR shall be allowed no extra compensation therefore. The CONTRACTOR shall give the CITY OF FARMERSVILLE or ENGINEER ample notice of the time and place where lines and grades will need to be verified. All stakes, marks, etc. shall be carefully preserved by the CONTRACTOR, and in case of careless destruction or removal by him or his employees, such stakes, marks, etc. shall be replaced at the CONTRACTOR's expense.

1.7 EXISTING UTILITIES

Existing utilities have been shown at approximate locations; however, the CONTRACTOR shall be entirely responsible for locating and preserving all utilities within the scope of the project and shall bear the entire cost of any necessary alteration or repair of same. It shall be the CONTRACTOR's responsibility to locate and protect any utilities within the limits of construction activities.

Any damage to existing utilities shall be repaired to the satisfaction of the utility CITY OF FARMERSVILLE at the Contractor's expense.

1.8 GUARANTEE

The CONTRACTOR shall guarantee all materials and equipment furnished and work performed for a period of one year from the date of substantial completion. Defects in materials or workmanship shall be promptly repaired by the CONTRACTOR at his entire expense.

1.9 ABBREVIATIONS



Whenever any of the following abbreviations appear in these Specifications, their meanings shall be as follows:

*AWWA	American Water Works Association
*ASTM	American Society for Testing Materials
AASHTO	American Assn. of State Highway Officials The Standard Specifications for Road and Bridge Construction adopted by the Texas State Department of Highways January, 1972, with subsequent revisions
C.S.	Commercial Standards
NSF	National Sanitation Foundation
C.I.	Cast Iron
PVC	Polyvinyl Chloride
C.E.	Ductile Iron
*Latest revision	

PART 2 - PRODUCT

2.1 GENERAL

This item of the Specifications covers the type and/or quality of materials common to other sections of the Specifications. In the event the type or quality of materials that are to be installed on the project are inadvertently omitted from the Specifications, it is the intent that only materials of high quality be furnished and installed by the CONTRACTOR. Such omission of materials specifications shall be directed to the attention of the ENGINEER by the CONTRACTOR and materials shall receive approval by the ENGINEER prior to purchase. All materials to be used on the project shall be new.

2.2 POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS

The PVC sewer pipe for this project shall have a standard diameter ratio (SDR) of 35. The plastic sewer pipe shall be made from NSF Testing Laboratory approved polyvinyl chloride plastic having a cell classification of 12454-B, 12454-C, or 13354-B (with minimum tensile modulus of 500,000 psi) as defined in ASTM D-1784. The fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13343-C as defined in ASTM D-1784. All plastic pipe, fittings, cement, and lubricant shall bear the NSF seal of approval. All plastic pipe and fittings shall be tested at 73.4 degrees Fahrenheit with procedures conforming to ASTM D-2122, D-2444, D-2412, D-2855, and D-2152.

Elastomeric gasket joints providing a water tight seal shall be used. The joints shall be assembled in accordance with the pipe manufacturer's recommendations. Standard manhole couplings shall be provided at each joint. "Y" branches shall be an integral unit made with a 4" bell spur set at a 45 degree angle with the barrel. Each spur shall be thoroughly taped with duct tape to plug the opening.

2.3 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

Where shown on the Plans as Class 160, Class 200, Schedule 40 or Schedule 80, PVC pipe and fittings shall be made from National Sanitation Foundation (NSF) Testing Laboratory Type 1, Grade 1, rigid polyvinyl chloride compounds conforming to ASTM D-1784. Plastic pipe shall meet all requirements of ASTM D-2241 for Class 160, SDR-26 and Class 200, SDR-21 and ASTM D-1785 for Schedule 40 and Schedule 80. Plastic fittings shall meet all requirements of ASTM D-2466 for socket-type Sch. 40, D-2467 for socket type Sch. 80, or D-2464 for threaded Sch. 80. All plastic pipe, fittings and cement shall bear the NSF seal of approval. All pipe and fittings shall be tested at 73.4 degrees Fahrenheit with procedures conforming to ASTM D-1599, D-2444, and D-2152.

2.4 ADDITIONAL PIPE TESTS FOLLOWING DELIVERY

When pipe is delivered to the jobsite, the CITY OF FARMERSVILLE's representative may require additional testing to determine conformance with the requirements of pipe flattening, impact



resistance, pipe stiffness, and extrusion quality. When testing is required, one test pipe shall be selected at random by the ENGINEER from each 1,200 feet or fraction thereof of each size of pipe delivered to the jobsite but not less than one test pipe per lot. A lot shall be defined as pipe having the same identification marking. The length of specimen for each selected pipe shall be a minimum of 8-feet.

Pipe Retest: Pipe which is not installed within 120 days of the latest test shall not be used without prior approval of the CITY OF FARMERSVILLE's representative.

2.5 COUPLINGS

Couplings of the sizes shown on the Plans shall be standard sleeve, straight cast couplings, Dresser Style 38, or approved equal. Transition couplings required to connect two different kinds or sizes of pipe shall be Dresser Style 162, or approved equal.

2.6 GATE VALVES

Gate valves shall be of the iron body, non-rising bronze stem, resilient seated wedge type manufactured to equal or exceed all applicable AWWA standards and the specific requirements outlined in these specifications with hub, mechanical joint, or flanged ends as required by the Plans. Valves shall have a working water pressure rating of 200 psi, and shall open left and be provided with 2" square wrench nuts. Handwheels shall be furnished where called for on the Plans.

Valve body, bonnet, stuffing box and disc castings shall be manufactured of ASTM A-126, Class B, Grey Iron. The disc shall have an integrally cast ASTM B-62 bronze stem nut to prevent twisting or angling of the stem. Designs with loose stem nuts are not acceptable. All internal ferrous metal surfaces shall be fully coated, holiday free, to a minimum thickness of 4 mils with a two-part thermosetting epoxy coating. Coating shall be non-toxic, impart no taste to water and protect all seating and adjacent surfaces from corrosion and prevent build-up of scale of tuberculation.

The sealing mechanism shall allow no leakage at working pressures up through 200 psi with flow in either direction, and shall consist of a replaceable, specially contoured rubber disc seat ring that is internally reinforced by a concentric steel ring and molded separately from the disc. The seat ring shall be secured to the disc with self-locking stainless steel screws and shall seal against an accurately formed surface in the valve body. The shape of the seat ring shall be such that it cannot be installed improperly.

Valves shall be provided with two O-Ring stem seals with one O-Ring below the stem thrust collar and bearing surfaces, and one O-Ring above. The area between the O-Ring shall be filled with a lubricant to provide lubrication of the thrust collar, bearing surfaces and O-Rings each time the valve is operated. An antifriction washer shall be located above the thrust collar to further minimize operating torque. Valves shall be Mueller, Series A-2370, or an approved equal.

2.7 CHECK VALVES

Check valves shall be 4" flanged end, swing check valve, with outside lever and weight, M & H Figure 159, as manufactured by Dresser or equal. Check valves shall have stainless steel hinge pins and O-Ring packing gland and outside lubricated bronze bushing. Check valve shall have iron body and bronze mounting.

2.8 BALL VALVES

Brass ball valves shall have a cast body and brass trim with TFE seats and seals. Valves shall be Jamesbury Clincher Type 2000, or approved equal.

2.9 PRESSURE GAUGES

Pressure gauges shall have a dial size of 4 ½ inches with the range as shown on the Plans. Gauges shall be accurate to 1% of full scale range with bronze brushed rotary-type movement, slotted micro-adjustable pointer, aluminum dial, and phosphor bronze bourdon tube. Pressure gauges shall be Eugene Ernst Products Co. Series WWP/PG-1, or approved equal.

2.10 MANHOLE FRAMES, COVERS, AND CLEANOUTS

All castings for manhole frames, manhole covers, and cleanouts shall be of good quality, gray or

malleable, cast iron which is tough, resilient, and even-grained. Castings shall be should and free of cracks, sand holes, or blow holes. Cast iron shall have a tensile strength of 18,000 psi. All castings shall be of the design shown on the plans and are subject to the approval of the ENGINEER.

A. Manhole Frames and Covers: Manhole frames and covers shall be standard AWWA frames and covers, weighing a minimum of 275 pounds, and having a cover with a minimum diameter of 24 inches. In areas where water-proof manhole frames and covers are called for, and these shall be in accordance with the applicable AWWA specifications.

B. Cleanouts: Cleanouts shall be of the size, type, and design as shown on the Plans.

2.11 MANHOLES

Manholes shall be standard 4 foot diameter with entrance cone and shall meet the requirements of ASTM C-478 for concrete manholes. Manhole sections shall be cast without steps. Drop Manholes are not permitted. Grade rings shall be furnished with concrete manholes to satisfactorily adjust the manhole cover to a point approximately 2 inches above the existing ground grade at the location of the manhole.

Monolithically placed concrete manholes will be allowed, subject to the approval of the ENGINEER. Monolithically placed concrete manholes shall be non-reinforced and shall have a minimum wall thickness of 5 inches. Cement for use with monolithically placed concrete shall be Type II.

For precast concrete manholes, each pipe joint shall be sealed with a mastic pipe joint material which complies with THD Specification 360-4, Joint Filler Compound, Class 2, "Hot Poured Rubber" or a preformed joint sealant, "Ram Neck" or equal in accordance with ASTM C-923, as applicable. Grout to a thickness of 1", filling the width of the joint, will also be an acceptable joint filler.

2.12 CONCRETE

Concrete shall be Class A, 1-½" maximum aggregate, 3,000 psi strength mix for manhole bottoms and walls. Class B concrete shall be used for blocking.

2.13 REINFORCING STEEL

Steel for reinforcement shall be new billet steel of intermediate or hard grade in full accordance with ASTM A-615. Reinforcement shall be of the sizes specified and bent cold in the shop in accordance with the details shown on the Plans. Wire fabric reinforcement, when specified, shall conform with the provisions of ASTM A-185. Reinforcing steel when placed in the work shall be completely free of loose mill scale, rust, dirt, paint, oil, or other foreign materials and shall be placed as outlined under Item 5. All reinforcement used shall be Grade 60.

2.14 GROUT

Grout shall be composed of 1 part Portland cement and 2 parts clean, washed sand, thoroughly mixed with sufficient water to produce a plastic mixture with the degree of workability consistent with the requirements of each particular application.

PART 3 - EXECUTION

3.1 DELIVERY AND TEMPORARY STORAGE OF PIPE AT SITE

A. Onsite Storage Limitation: Onsite pipe storage shall be limited to a maximum of one week, unless exception is approved by CITY OF FARMERSVILLE or ENGINEER.

B. Care of Pipe: At times when the pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hours as well as overnight. In no event shall the sewers be used as drains for removing water which has infiltrated into the construction trenches.

3.2 HANDLING OF PIPE



- A. Moving Pipe: Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.
- B. Inspection Pipe: The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

3.3 PIPELINE CONSTRUCTION

- A. General: The CONTRACTOR shall remove as much of the street or road surfaces as may be necessary; perform clearing and grubbing of existing trees where necessary; excavate the trenches to the required dimensions and grade; sheet, brace, and support the adjoining ground or structure where necessary; construct and maintain all bridges required for traffic control; unload, haul, distribute, construct, and test all pipe and accessories; replace all disturbed utility services, fences, and other structures; provide bedding material for pipe; backfill trenches; remove surplus excavation; clean the site of the work; maintain streets and other surfaces of the trenches for the successful completion of the project.

The CONTRACTOR shall perform trenching operations in such a manner that when ever he is working in city streets the trenching of the ditch will not be greater than 100 feet ahead of the pipe laying operations; or whenever the CONTRACTOR is working in open country, the trenching of the ditch will not be greater than 500 feet ahead of the pipe laying operations. The CONTRACTOR will be limited for his entire operation from the point of trenching to the point of completed backfill, as called for herein, to within the limits of a total street length not to exceed 600 linear feet. Not more than two consecutive cross streets may be closed to traffic at any time. The CONTRACTOR shall provide barricades and other traffic controls and signs to notify the public of the construction operations and shall maintain, flare, and guard the site to protect traffic in the area of construction.

- B. Separation Distances: (as per §TCEQ 317.13 Appendix E) The following rules apply to separation distances between potable water and wastewater treatment plants, and waterlines and sanitary sewers.
 - 1. Water line/new sewer line separation. 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 foot separation distance cannot be achieved, the following guidelines will apply:
 - a. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron or PVC meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.
 - b. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of 6 inches between outside diameters shall be maintained. In addition the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.
 - c. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, a minimum two foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial

backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

- d. Where a sewer crosses over a waterline all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at 5 feet intervals with spacers or be filled to the springline with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.
2. Water line/manhole separation. Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine foot separation distance cannot be achieved, a carrier pipe as described in subsection (1) (d) of this section may be used where appropriate.
- C. Inspection: All pipe and accessories shall be laid, jointed, and tested for defects or leakage as specified herein. All materials found to have cracks, flaws, or other defects will be rejected by the CITY OF FARMERSVILLE's representative, and the CONTRACTOR shall promptly remove such defective materials from the site of the work.

Satisfactory pressure testing apparatus shall be furnished by the CONTRACTOR. The testing shall be supervised by the ENGINEER or his authorized inspector, and procedures and tolerances shall be in accordance with the specifications herein.

- D. Handling Pipe and Accessories: The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter of any nature at all times. Pipe and fittings shall be carefully lowered into the trench in a manner that will not cause damage to the pipe. Pipe handling methods shall at all times be subject to the approval of the CITY OF FARMERSVILLE's representative.
- E. Lines and Grades: All pipes shall be laid and maintained to the required lines and grades within the tolerances as specified herein. Manholes and cleanouts shall be placed in the locations as shown or as may be staked. Temporary support, adequate protection, and maintenance of all underground utilities encountered shall be furnished by the CONTRACTOR at his own expense under the direction of the CITY OF FARMERSVILLE's representative, whether or not such services are shown on the Plans. After the pipe is laid and prior to backfill, the CITY OF FARMERSVILLE or his representative shall be given the opportunity to check the grade and alignment of the pipe.
- F. Damage to Existing Pipe or Existing Utilities: In the event a gas line or other utility line is broken, the CONTRACTOR shall immediately notify the representative of the utility company and make necessary repairs as directed by the utility company, or fully reimburse the utility company for making such repairs at his own expense. The CONTRACTOR shall fully protect the public from the hazards incident to a rupture in an existing gas line.

If a water or sewer line is broken or damaged during construction, the CONTRACTOR shall immediately notify the water and sewer superintendent. Repairs shall be made as directed by the superintendent and to his entire satisfaction.

- G. Equipment: All equipment necessary for construction of the wastewater facility improvements shall be maintained in first class working condition.

3.4 EXCAVATION AND PREPARATION OF TRENCH

The trench for the respective sizes of sewer main shall be dug to the alignment and depth shown on the Plans, braced, and drained if necessary in order that workmen may work therein safety and efficiently. It is called to the CONTRACTOR's attention that the applicable provisions of O.S.H.A.



apply during construction of this project.

All materials excavated shall be unclassified excavation, and it shall be the CONTRACTOR's responsibility to excavate the trench to the depth and grade regardless of the material to be excavated.

Minimum width of the trench for the respective size sewer main shall be outside diameter of the pipe plus 6 inches, and a maximum width of trench shall be 9 inches outside of barrel of pipe on each side of pipe. Sides of trench shall be dug and maintained substantially vertical.

Existing pavement over trenches shall be removed to a width of 6 inches outside the trench on each side by sawing methods and to a neat line. Asphalt pavements shall be sawed for the full depth. Concrete pavement shall be sawed to a depth which will allow the section to be removed smoothly without underbreakage. Brick pavement shall be removed by hand methods in a manner that will not damage bricks, and the bricks removed shall be delivered and hand stacked in a location determined by the CITY OF FARMERSVILLE.

Excavation shall be made to the depth necessary for the pipe to be laid on 4 inches of bedding material as shown on the Plans and specified herein, which shall be placed on undisturbed, sound earthen foundation, cut true and even, and excavated for joints so that barrel of pipe will have a bearing for its full length. Unstable trench walls shall be maintained in a manner conforming to ASTM D-2321 7.1.2. Where an unstable trench bottom is encountered, the CONTRACTOR shall provide an impervious mat into which the unstable soil will not penetrate before laying pipe. The mat material, thickness, and placement shall conform to ASTM D-2321 7.1.3.

Over excavation of the trench in excess of that below the bottom of the pipe for the bedding material shall be filled with the specified compacted bedding material at the CONTRACTOR's expense.

Ledge rock, rock fragments, unyielding shale, limestone, or sandstone shall be removed to provide a clearance of at least 4 inches below or around all parts of the pipe. Adequate clearance for properly jointing pipe laid in rock trench shall be provided at bell holes.

Blasting for excavation will be permitted only when blasting operations are fully bonded and insured. Rock excavation, where encountered, shall be accomplished in a manner to protect all existing utilities, property, and structures.

Trenches shall be dewatered so that all pipe laying operations may be performed in the dry. All water removed from the trenches shall be diverted to natural drainage ways in a manner which will prevent damage to property or the public. Pumps of ample capacity and in duplicate must be provided to insure that once an excavation is made dry, it will remain dry until that part of the construction operation is completed. In no event shall the sewers be used as drains for removing water which has infiltrated into the construction trenches.

3.5 BEDDING MATERIAL

After the trench excavation has been made, bedding materials shall be installed in the bottom of the trench to bring the interior pipe invert to the grade as shown on the Plans and specified herein. Bedding material shall be installed in the bottom of the trench to bring the interior pipe invert to the grade as shown on the Plans and specified herein. Bedding material shall be installed to a depth of 4 inches below the bottom of the pipe barrel with a tolerance of $\frac{1}{2}$ inch; however, the minimum depth of bedding shall be such that for a distance of 4 feet either direction from a random point of bedding material measurement there will be at least 30% of the distance having a depth of 4 inches. The remaining 70% of the distance shall be within the depth tolerance set forth above. Bedding material shall also be installed above the bottom of PVC pipe to the top of the pipe and lightly compacted.

Bedding material shall be fine granulated material, containing no rock larger than $\frac{3}{4}$ " diameter that has been excavated from the trench, natural gravel, crushed gravel or stone, or a clean sand.

Fine granulated bedding material from the trench up to a maximum depth of 4 inches below the

pipe may be used for bedding in areas where the depth of cut for the pipe is not over 8 feet to the flow line. This bedding material shall be smoothed along the trench bottom to firmly support the pipe barrel for its full length. CONTRACTOR shall excavate bell holes for the pipe collars or joint in order to provide full barrel support. Bedding material over 4 inches in depth required to bring the pipe to grade shall be natural gravel, crushed gravel, or a clean sand as specified below.

Where depth of cut for the pipe is greater than 8 feet to flow line, natural gravel, crushed gravel or stone, or clean sand as specified below shall be used as the bedding material.

Bedding material installed above the bottom of the pipe shall correspond to the respective bedding material specified above for the respective depth of cut.

The natural gravel or crushed gravel or stone shall be that type of gravel material commonly as Grade 5, meeting T.H.D. Specification Item 302, Class A or B, or equal in accordance with ASTM D-2321 as applicable, with the following adjustments in gradation.

<u>Modified Grade 5 Bedding Material</u>	<u>Percent by Weight</u>
Retained on 3/8" Sieve	0-30
Retained on No. 4 Sieve	15-100
Retained on No. 10 Sieve	90-99

Clean sand for bedding material shall be blow sand, natural sand, or manufactured undersized sand material, and shall have a Plastic Index less than 5. Sand bedding shall be installed with adequate moisture and compacted to 85% Standard Proctor Density.

3.6 LAYING AND GRADING PIPE

Upon installation of the bedding material, the CONTRACTOR shall immediately begin laying and grading operations. The pipe shall be laid substantially to the line and grade shown on the plans. Pipe shall not vary more than one tenth (1/10) foot from the true alignment nor more than one tenth (1/10) foot from the theoretical grades; provided however, that in no event shall the difference in the proposed slope and the installed slope be greater than 10%.

The ENGINEER will set line and grade stakes every 50 feet and furnish the CONTRACTOR with cut sheets. CONTRACTOR shall furnish and set grade boards, grade lines, plumb bobs, and measuring poles necessary for laying pipe within the tolerances allowed. Grade boards shall be set at intervals not to exceed 50 feet, and the CONTRACTOR shall keep at least three grade boards in place during grading and laying operations. Use of Laser control will be acceptable in lieu of grade boards.

The pipe shall be laid on the sound and graded bedding material with the bell end upgrade. Wedging up or blocking up of pipe to obtain proper invert grade will not be permitted. Each pipe section shall have uniform bearing in the bedding material for the full barrel length of the pipe. The CONTRACTOR shall excavate bell holes in the bedding material, being careful not to excavate more than is adequate at the bell of the pipe to obtain uniform bearing for the length of the pipe barrel.

The CONTRACTOR shall take precautions in lowering the pipe into the trench to prevent damage to the pipe, joint material, or trench. Interior of the joints and joint material shall be clean, and the CONTRACTOR shall lubricate the pipe joints as recommended by the manufacturer before jointing the pipe. Socket and spigot of the pipe shall be aligned, and the joint made by asserting steady pressure on the pipe being laid with a bar, by hand, or a come-along. Care shall be taken when using a bar by using a wooding block to cushion the bar pressure and eliminate breakage.

Damaged, broken, or cracked pipe will be rejected and shall be removed from the job site at the CONTRACTOR's expense.

PVC Pipe Curvature: Construction of curved reaches of PVC pipe shall not be accomplished by deflecting joints or by beveling pipe ends. Bending of PVC pipe to achieve vertical or horizontal curves without using deflection fittings shall be limited as follows:



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

When rubber-gasketed pipe is laid on a curve, the pipe shall be fully seated in a straight alignment and then deflected to the curved alignment. If the bell and joint is deflected after laying the pipe barrel in the trench then the careful use of a block and bar shall be used to straighten the alignment to the center of the trench. After the bell and joint is straightened it shall be embedded and/or staked to stay in position. After the bell and joint is secure then move the remaining pipe to the center of the trench and embed to secure placements. Repeat the bell and joint alignment and centering of the pipe until the curve is finished. Never use excavation equipment to deflect pipe.

3.7 BACKFILLING TRENCHES

After pipe has been laid on the specified bedding material, the backfilling of trench shall begin. Except as specified for backfilling trenches in streets, trenches shall be backfilled using material excavated from trenches.

- A. Backfilling Trenches in Open Country: After pipe has been placed to the grade and alignment, the trenches located in open country or fields shall be backfilled with select material excavated from the trench, free of rocks or clods with dimensions greater than 1 ½ inches to a level 12 inches above the top of pipe. This select backfill shall be placed carefully by depositing the backfill material vertically by hand or by machine in such a manner that pipe will not be displaced laterally and the pipe will not be damaged by contact with the backfill material, tools, or equipment. Above this level, backfill may be shoveled or pushed into the ditch by hand or machine, completely filling the trench. In no event shall the backfill material contain rocks larger than 8 inches. The backfill material shall be neatly rounded over the trench and smoothed such that the height of the backfill material mound over the trench does not exceed 14 inches above the original ground surface. Excess excavated material above that required to make the mound above the pipe trench shall be smoothed and leveled on the right-of-way to the satisfaction of the CITY OF FARMERSVILLE. Any deficiency of backfill material shall be supplied by the CONTRACTOR.
- B. Backfilling Trenches in Street Right-of-Way located Outside the Normal Riding Surface and Backfill in Alleys: After the pipe has been placed to the grade and alignment, the trench located in alleys or to the edge of the normal riding surface of a street shall be backfilled with select material excavated from the trench, free of rocks or clods with dimensions greater than 1 ½ inches to a level 12 inches above the top of the pipe. This select backfill shall be carefully placed by depositing the backfill material vertically by hand or machine in such a manner that pipe will not be displaced laterally or damaged by contact with the backfill material, tools, or equipment. Above this level, backfill may be shoveled or pushed into the ditch by hand or machine, completely filling the trench. In no event shall backfill material contain rocks larger than 8 inches.

When backfill is brought even with the original ground surface, the trench shall receive three passes from the wheels of a medium weight front end loader or dozer along the trench length, with the trench being refilled to the original ground level after each pass. The backfill shall then be neatly rounded over the trench a distance of 12 inches above the original ground level in alleys. Remaining backfill shall be leveled and smoothed over the width of the alley in a manner satisfactory to the CITY OF FARMERSVILLE.

- C. Backfilling Trenches under Pavement, Gravel Streets, Highways and Highway Right-of-Way:
 - a. Where the trench crosses or lies within existing or proposed street areas, the trench shall be backfilled with blow sand or granular material to the subgrade elevation for a distance of 8 feet outside the edge of the street section. If blow sand is used, it shall be flooded in

the trench. Caliche material shall be used to fill the top 6 inches below the existing surface of the trench and shall be compacted to 90% Modified Proctor Density. Caliche material for the base course shall meet the requirements of T.H.D. Specification Item 232, Grade. In areas under existing pavement, the base course for caliche backfill shall be primed with 0.25 gallons per square yard of MC-30 oil, and then after allowing a minimum of 48 hours curing time, shall receive 1" of Class "F" Hot Mix-Cold Laid asphalt at a compacted density of 100 pounds per square yard and in such a manner as to be smooth and level with the existing pavement. Type "F" asphalt shall meet the minimum requirements of T.H. D. Specifications Item 350.

Sand or granular material for this backfill shall be as specified under Specification Item 3, Paragraph 3.3.

- b. Where the trench crosses Texas Highway Department right-of-way, or where trench lies parallel to and within T.H.D. right-of-way, all backfill work will be done to the satisfaction of the T.H.D. inspector. All backfill operations performed inside the right-of-way shall, as a minimum, be backfilled in 6 inch lifts with proper moisture content and with mechanical tamps, and shall be compacted as a minimum to the density of the soil adjacent to the pipe trench. As an alternate to mechanical compaction of the material excavated from the trench, the backfill material may be granular or sand material meeting requirements of paragraph 3.5. Sand material shall be flooded in the trench in a manner to prevent settlement of the backfill material. If sand or granular material is used, the top 6 inches of the trench shall be backfilled with material excavated from the trench and shall receive a minimum of three passes with the wheels of a medium weight loader or dozer. All surplus material shall be removed at the expense of the CONTRACTOR, and the highway R.O.W. shall be smoothed and graded to the satisfaction of the Texas Highway Department.

3.8 MANHOLES

Manholes shall be constructed at locations indicated on the Plans or as otherwise directed by the ENGINEER. Development of areas through which the sewer main passes may dictate changes in location or increase number of manholes required. Manholes shall be constructed to the details shown on the Plans. Where there is a drop in the difference of the invert grade shown on the Plans, the elevation drop shall occur through the manhole section.

Sewer pipe that is within limits of excavation of manholes shall be bedded in bedding material as specified in paragraph 3.5.

Excavation for manholes shall be large enough to safely perform the work, and if necessary, the excavation shall be sloped to provide a stable wall. Backfill around manholes shall be made in such a manner to prevent movement of the manhole vertically or laterally, and shall be backfilled as specified in paragraph 3.7.

Manhole construction in the right-of-way of the Texas Highway Department shall be backfilled as specified in paragraph 3.7.C.

Sewer pipe through manholes shall be continuous. At changes in alignment, pipe shall be continuous and either mitered to provide deflection angle or provided with a long radius ell in areas of 90 degrees deflection.

A drop pipe shall be provided for a sewer main or force main entering a manhole at an elevation of 30 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer main or force main and the manholes invert is more than 24 inches, the invert should be filleted to prevent solids deposition.

Joints for precast manholes shall be sealed as set forth in Specification Item 2.10.

Finish Elevation of Manhole Covers: Precast sections shall be assembled so that the cover conforms to the elevation determine by the manhole location as follows, but limited to a maximum of 18-inches from the top of the manhole cone to the top of the ring and cove, unless otherwise

instructed by the CITY OF FARMERSVILLE's representative.

- A. In Paved Area: Top of cover shall be flush with the paving surface.
- B. In Shoulder Areas: Top of cover shall be flush with existing surface where it is in traveled way or shoulder and 0.1 foot above existing surface where outside limits of traveled way but not in the existing roadside ditch.
- C. In Roadside Ditch or Unpaved Open Areas: Top of cover shall be a minimum of 6-inches above the ground surface and surrounded with a concrete collar, per Plans. In special instances, as designated by the CITY OF FARMERSVILLE's representative or as shown on the plans, the top of the cover shall be flush with the surrounding ground surface and within a square concrete pad 2 feet larger than the manhole frame. Guard posts or paddle boards may be required adjacent to manholes in open areas.

Watertightness: It is the intent of these specifications that manholes and appurtenances be watertight and free from infiltration. All manholes are to be banded both inside and outside with cement-mortar grout. Where called for in the plans or supplemental specifications, manholes that are to be given a protective lining or coating shall be free of and seeping or surface moisture. The adequacy of manholes and appurtenances as to watertightness shall be determined by the CITY OF FARMERSVILLE's representative and shall be tested in accordance with Section 3.10.

Sealing Before Completion: In order to prevent accidental use of the new sewer before completion and acceptance, the inlet to existing tie-in manholes shall be sealed with broken brick and mortar. Installation of these plugs shall be approved by the CITY OF FARMERSVILLE's representative. Plugs shall be removed at the time of final inspection or as directed by CITY OF FARMERSVILLE's representative.

The use of brick for adjusting manhole covers to grade is not permitted. The use of brick for adjusting manholes to grade is not permitted.

Manhole covers which lie within a 100-year floodplain must be sealed and gasketed or otherwise provide adequate protection against inflow. Such measures should also be provided to any manholes lying in drainageways or streets subject to carrying drainage flows.

Knock-outs for pipe openings on precast manholes shall be grouted to prevent leakage with a non-shrinking grout, as manufactured by Embeco, Master Builders, or equal. Precast and monolithic manholes shall be made leak proof at the interface of the pipe and concrete by the use of rubber gaskets or rings slipped over the pipe or by use of wall sleeves. The use of gaskets, rings, or wall sleeves shall be in accordance with the pipe manufacturer's recommendations.

3.9 PLACEMENT OF MANHOLE AND CLEANOUT CASTINGS

All cast frames shall be set level, firmly in position, and grouted smoothly in place as shown on the Plans. Grout shall be kept moist for a minimum period of 48 hours.

The frames for cleanouts shall be set in concrete in accordance with the details shown on the Plans, to line and grade as staked. Concrete around cleanout may be made from bagged, pre-mixed cement meeting the approval of the ENGINEER.

3.10 TESTING

The CONTRACTOR shall provide at his expense all equipment and personnel required to perform exfiltration testing on the completed gravity sewer line and pressure testing on the completed force-main as specified below.

- A. Exfiltration Test: An exfiltration test shall be conducted on all non-pressure sewer pipes. In general, each section of pipe shall be tested from manhole to manhole at a minimum test head of 2 feet.

The inlet for the downstream manhole shall be plugged and the upstream manhole shall be filled with water. The amount of water required to maintain the initial water level shall be measured for a minimum of two hours and any leakage into or out of the manholes shall be

considered a part of the pipeline leakage. The maximum allowable exfiltration for not horizontally curved pipes shall be 50 gallons/inch diameter/mile/24 hour day. The maximum allowable exfiltration for horizontally curved pipes shall be 10 gallons/inch diameter/mile/24 hour day. If these rates are exceeded, the necessary repairs will be made, and the test repeated until the exfiltration rate is within the allowable limits. Arrangements for water to perform the test shall be the responsibility of the CONTRACTOR. In addition, the CONTRACTOR shall provide all pipe, fittings, plugs, and connections or tank trucks as necessary to perform the testing.

As an alternate to water testing of the sewer line, the CONTRACTOR may air test the pipe in accordance with ASTM C-828, Low-Pressure Air Test of Vitrified Clay Pipe Lines.

- B. Pressure Test: A pressure test shall be conducted on all force-main sewer pipelines. The pipeline shall be tested so that the pressure at the lowest point in the test section is at least 100%, but not greater than 120%, of the pressure class of the pipe, and the minimum pressure at the highest point in the test section is not less than 85% of the pressure class of the pipe. The maximum amount of leakage for PVC pipeline shall be 1.0 gallon per inch of pipe diameter per mile of pipeline tested per four (4) hours. Should any test of combined sections of pipe laid disclose leakage per mile of pipeline greater than specified, the CONTRACTOR shall, at his own expense, locate and repair the leaks to the extent necessary to obtain an acceptable test of the lines. Arrangements for water to perform the test shall be the responsibility of the CONTRACTOR. In addition, the CONTRACTOR shall provide all pipe, fittings, plugs, pumps, and connections as necessary to perform the testing.

C. Manhole Test:

- a. Hydrostatic exfiltration: All wastewater lines coming into manhole shall be sealed with an internal pipe plug, and then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete. If the manhole fails testing, it is to be repaired and retested until it passes testing.

- b. Vacuum: This test shall be conducted immediately after assembly and prior to backfilling. No grout shall be placed in horizontal joints before testing. All pipes entering the manhole, plugs and seals must be securely braced to prevent them from being dislodged and drawn into the manhole during the vacuum test. All lift holes and exterior joints shall be plugged, as set forth in Specification Item 2.10, prior to testing and the test apparatus is directly applied on top of the concrete surface of the manhole following the manufacturer's recommendations, rather than to the cast iron seating ring. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendation. The test cover shall be secured to the top of the manhole and the external clamps shall be tighten to 60-inch/lb using a torque wrench.

Once all penetrations are sealed, the test proceeds by starting the vacuum and sealing leaks, as needed. After reaching 10 inches of mercury; the vacuum pump is shut-off and the time is recorded for the vacuum pressure to drop to 9 inches. If the time required for the vacuum to drop to 9 inches exceeds 2 minutes the manhole is acceptable.

Leaks can be readily detected by finding the source of a hissing sound as air enters the manhole. Leaks can also be detected by spraying water on the exposed wall surface - escaping air will produce a dry spot. If the manhole fails the initial test, repairs are affected and the assembly is re-tested until a satisfactory test is obtained. Repairs are often performed by placing grout slurry on the exterior of the leak - the vacuum in the manhole pulls the slurry into the needed area and the manhole is sealed.

If the manhole fails a second test repairs should be made and a hydrostatic test shall be performed. If the manhole fails a third time the CONTRACTOR should consider replacing

the manhole. If the manhole is not replaced, then the manhole shall be repaired and retested, hydrostatic only, until it passes testing.

- D. Mandrel Test: A mandrel test shall be conducted on all non-pressure flexible sewer pipes. In general, each section of pipe shall be tested from manhole to manhole at least 30 days after placement and compaction of final backfill. No pipe shall exceed a deflection of 5%. A rigid mandrel shall be used to measure deflection. The test must be performed without mechanical pulling devices. The mandrel's minimum outside diameter is 95% of the pipe inside diameter. The mandrel must have an odd number of runners totaling nine or more. The barrel section of the mandrel must have a length at 75% of the pipe inside diameter. The mandrel shall be constructed of a metal or rigid plastic that can withstand 200 psi without being deformed. Adjustable or flexible mandrels are prohibited. If a pipe fails the test, the pipe shall be repaired and a second test shall be conducted after the final backfill has been in place for at least 30 days.

END OF SECTION

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SECTION 1010 CONCRETE

PART 1 - GENERAL

1.1 SCOPE OF WORK

The work performed under this section of the Specifications shall consist of:

- Furnishing and installing formwork for cast-in-place concrete, with shoring, bracing, anchorage and all necessary accessories. Openings in the formwork for other work shall be provided. All stripping activities shall be included under this section.
- Furnishing and installing reinforcing steel bars, welded wire fabric and accessories for cast-in-place concrete.
- Mixing, placing and curing of cast-in-place concrete.
- Furnishing and installing bolts, anchors, expansion anchors, hangers and brackets, equipment, grating and floor plate(s) for equipment and metal fabrication.
- Furnishing and installing grout.
- Furnishing and installing waterstops.
- Testing.

In the event of a conflict between this specification and project plans (drawings) then the plans will take precedence.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate bar sizes, spacings locations and quantities of reinforcing steel or welded wire fabric, bending and cuffing schedules, supporting and spacing devices, and joint and splice locations. Setting drawings and templates for location and installation of anchorage devices.
- B. Samples: Representative samples of bolts, anchors, and inserts as may be requested for review by the CITY OF FARMERSVILLE or ENGINEER. Review will be for type and finish only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Submit for review manufacturer's specifications and installation instructions for all proprietary products, including sleeves for welded splices.
- E. Submit copies of manufacturer's specifications, materials, load tables, dimension diagrams, and installation instructions for anchorage devices.
- F. Submit a catalog brochure of the waterstop to be used showing dimensions and configuration.

1.3 REFERENCES

- ACI 117 — Standard Specifications for Tolerances for Concrete Construction and Materials.
- ACI 1010 — Standard Specifications for Structural Concrete.
- ACI 306 — Recommended Practice for Cold Weather Concreting
- ACI 315— Details and Detailing of Concrete Reinforcement.
- ACI 318/318R — Building Code Requirements for Structural Concrete and Commentary.
- ACI 347 — Recommended Practice for Concrete Formwork.
- ACI 350 — Environmental Engineering Concrete Structures.
- ACI 614 — Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
- SP-66 — ACI Detailing Manual.
- ANSI/ASTM A82 — Cold Drawn Steel Wire for Concrete Reinforcement.
- ANSI/ASTM A185 — Welded Steel Wire Fabric for Concrete Reinforcement
- ASTM A307 — Carbon Steel Externally and Internally Threaded Standard Fasteners.
- ASTM A320 — Alloy-Steel Bolting Materials for Low-Temperature Service.
- ANSI/ASTM A496 — Deformed Steel Wire Fabric for Concrete Reinforcement.



- ANSI/ASTM A497 — Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- ASTM A615 — Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- ANSI/AWS D1.4 — Structural Welding Code for Reinforcing Steel.
- ANSI/AWS D12.1 — Reinforcing Steel Welding Code.
- ACT 347 — Recommended Practice for Concrete Formwork
- ASTM C33 — Standard Specifications for Concrete Aggregate.
- ASTM C94 — Specification for Ready Mix Concrete
- ASTM C109 — Compressive Strength of Hydraulic Cement Mortars (using, two inch or fifty millimeter Cube Specimens).
- ASTM C144 — Aggregate for Masonry Mortar.
- ASTM C150 — Portland Cement.
- ASTM C260 — Air-Entraining Admixtures for Concrete
- ASTM C309 — Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C494 — Chemical Admixtures for Concrete
- ASIM C191 — Time of Setting of Hydraulic Cement by Vicat Needle.
- CRD C588 — Specifications for Non-Shrink Grout.
- CRSI — Concrete Reinforcing Steel Institute Manual of Practice.
- CRSI 63 — Recommended Practice for Placing Reinforcing Bars.
- CRSI 65 — Recommended Practice for Placing bar Supports.
- PS-1 — Construction and Industrial Plywood.

1.4 DELIVERY, STORAGE AND HANDLING

Store sensitive materials off ground in a ventilated and protected manner to prevent deterioration from moisture.

Waterstops are to be stored under tarps to protect from oil, dirt and sunlight.

Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels. Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.1 CONCRETE

Conforming to ASTM C150, Type I, II or III. Type I shall be used unless type II or III are specifically called for on plans.

A. Strength: As indicated in applicable specifications or as shown on plans.

B. Slump: The following limits of slump shall be used of control of the design and placing of concrete:

<u>Type of Construction</u>	Slump in inches	
	Maximum	Minimum
Case drilled shafts	8	5
Foundations and slabs on the ground	5	3
Slabs, beams and walls	5	3

- C. **Minimum Cement Content:** The minimum cement content expressed in sacks per cubic yard of concrete shall be not less than the following:

<u>Design Strength</u>	<u>Minimum Cement Content</u>
2500 psi	5 sacks (470 lb.)
3000 psi	5.5 sacks (517 lb.)
3500 psi	6 sacks (564 lb.)
4000 psi	6.5 sacks (611 lb.)

D. **Aggregate Gradation**

1. Fine Aggregate:

<u>Sieve</u>	<u>Percent Passing</u>
¾"	100
No. 4	95-100
No. 8	80-100
No. 16	50
No. 30	25-60
No. 50	10-30
No. 100	2-10

Fine aggregate shall not have more than 40% retained between any two consecutive sieves of those listed above, and its fineness modulus shall not be less than 2.3 nor more than 3.1.

Certified sieve analysis of the proposed fine aggregate shall be submitted to the ENGINEER for approval before use.

2. Coarse Aggregate (11,40 nominal):

<u>Sieve</u>	<u>Percent Passing</u>
2	100
1 1/2"	95-100
¾"	35-70
3/8"	10-30
No.4	0-5
No. 200	Less than 1

Other nominal aggregate sizes may be used with written permission of the ENGINEER. All aggregate gradations shall conform to ASTM C-33.

E. **Admixtures**

1. A water-reducing retarder shall be used in all structural concrete. The materials shall be used in quantities recommended by the manufacturer. Conforming to ASTM C494, Type A; Grace "WRDA-HC" or approved equal.
2. An air entraining agent shall be used for all exposed exterior concrete. The total volumetric air content of concrete after placement shall be 4 percent plus or minus 1 percent. Conforming to ASTM C260; Grace "Datex AEA," "Master Builders" MB or approved equal.
3. No admixtures containing calcium chloride may be used.

F. **Membrane Curing Compound:** conforming to ASTM C309; Gifford-Hill "Sealco 800" or approved equal.

G. **Polyethylene Film:** 8 mil thickness.

H. **Paint:** Shall be Perma-Shield manufactured by Secure Incorporated, or approved equal. Color shall be Dove Gray or as approved by CITY OF FARMERSVILLE/ENGINEER.

- I. **Mixing:** Job-mixed concrete may only be used with special permission of the ENGINEER. The batch mixer used shall conform to the Mixer Manufacturers Bureau of the Associated General Contractors requirements and ACI 614.
- J. **Concrete Design Mix:** Furnish a design mix that has been used on another project which meets these specifications along with acceptable compressive test results proving performance according to these specifications. If no design mix is available that meets these specifications, pay for the services of a registered engineer to prepare a concrete mix design for each reinforced concrete mix proposed to be used.
- K. **Ready-Mixed Concrete**
 - a. Conform to the requirements of ASTM C94.
 - b. The truck mixer shall be provided with a closed watertight drum, suitably mounted and fitted with adequate blades capable of combining aggregates, cement and water into a thoroughly mixed and uniform mass of concrete and to discharge the concrete without segregation.
 - c. The truck mixer shall be equipped with a revolution counter. Do not place concrete until the concrete has been mixed for 100 revolutions.
 - d. Submit a delivery ticket to the ENGINEER's field representative at the time of delivery for each load of concrete. Include the following information on the ticket:
 - i. Quantity delivered.
 - ii. Amount of each material in the batch.
 - iii. Time at which the mixer was charged.

2.2 FORM WORK

A. Design Requirements

CONTRACTOR shall be responsible for the design, engineering and construction of formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension. Design and construction of formwork shall take into account live loads, dead loads, weight of moving equipment operating on formwork, concrete mix, height of concrete drop, vibrator frequency, temperature, foundation pressures, stresses, lateral stability and other factors pertinent to the safety of personnel and structures. CONTRACTOR shall provide shores, struts, and trussed supports as necessary.

B. Facing Materials

- 1. **Unexposed Finish Concrete:** Any standard form materials that produce structurally sound concrete. Provide lumber dressed on at least two edges and one side for tight fit.
- 2. **Exposed Finish Concrete:** Materials selected to offer optimum smooth, stain free final appearance and minimum number of joints. Provide materials with sufficient strength to resist hydrostatic head without bow or deflection in excess of allowable tolerances, and as follows:
 - a. Plywood: PS-1 "B-B (Concrete Form) Plywood," Class I, waterproof, resin bonded, Exterior Grade, mill-oiled and edge-sealed.
 - b. Lumber: Southern Pine special, No. 2 grade, with stamp grade clearly visible.
 - c. Steel: Minimum 16 gauge sheet, well matched and tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearances of finished concrete surfaces.
 - d. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Accessories



1. Form Ties:

- a. Metal form ties, snap-off type, 1-1/2 inch break back dimension, galvanized metal, with waterproof washer at mid-point of rod, shall be used to hold forms in place. The ties, when removed, shall leave a smooth opening in the concrete surface not larger than 7/8 inch in diameter. After the tie rods are broken back, the holes shall be thoroughly cleaned to remove all grease and loose particles; then non-shrink cement-sand mortar, as dry as practicable, shall be carefully placed into the holes in small quantities. After the holes are completely filled, all excess mortar shall be struck off flush and the surface finished in such a manner as to render the filled hole as inconspicuous as possible. If these patches appear to be darker than the other surface of the concrete, white cement shall be used in the mortar as required.
- b. "Supertie" fiberglass form tie system as manufactured by RJD Industries, or approved equal. Provide spreader rod, ties, gripper and all necessary accessories and installation devices. Provide gray color rod. Install fiberglass form tie system in accordance with supplier's instructions. After removal of forms, grind fiberglass form tie system flush to walls.

2. Form Release Agent: Colorless mineral oil which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

3. Corners: Chamfered, rigid plastic or wood strip type; 3/4" x 3/4" size; maximum possible lengths. Accurately formed to produce uniformly straight lines and tight edge joints.

4. Nails, Spikes, Lag bolts, Through bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

5. Water stops:

- a. Resilient Type: Polyvinyl chloride, minimum 2,000 psi tensile strength, minimum 50°F (15°C) working temperature range, 6-inch wide for construction joints, 9-inch wide for expansion joints, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing; "Wire Stop" as manufactured by Paul Murphy Plastic Co., or approved equivalent.
- b. Soft Type: Blend of refined hydrocarbons, resins, plasticizing compounds, and mineral fillers extruded in a 5/8 inch by 1-1/2 inch oxidize or evaporate. Water stop shall be: As manufactured by Synko- flex, 2100 Travis, Houston, Texas 77002, (713) 686-8203; "Swellseal" Plus as manufactured by Deneef America, Inc., 122 North Mill Street, St. Louis, Missouri 48880, (517) 681-5791; or approved equivalent. Install in accordance with manufacturer's recommendations. Use primer recommended by manufacturer on surfaces.

D. Allowable Tolerances

- a. The maximum deflection of form work for surfaces exposed to view is 1/240 of the span between supports. Camber form work where necessary to compensate for anticipated deflections in form work due to loads imposed by fresh concrete and construction loads.
- b. The maximum allowable deviation from a true plane is 1/8 inch in six (6') feet for all exposed surfaces.
- c. The maximum deviation from a true circle for circular structures is plus or minus 1/4 inch when measured at the edge of each form.
- d. The maximum allowable deviation from any plan dimension is plus or minus 1/4 inch.

2.3 REINFORCEMENT



A. Materials

1. Reinforcing bars including column ties, beam ties, and stirrups: New, deformed billet steel conforming to ASTM A615, Grade 60 for nonweldable bars and ASTM A706, Grade 60 for weldable bars.
2. Welded Wire Fabric: ASTM A185 for smooth wire and ASTM A457 for deformed wire.
3. Quality: Submit certified copies of mill test report of reinforcement materials analysis, if required.

B. Accessories

1. Tie Wire: Minimum 16-gauge annealed type conforming to ASTM A165, Grade 40.
2. Supports for Reinforcement: Conform to CRSI 63.
3. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: plastic coated steel or stainless steel type.
4. Splices:
 - a. Mechanical Connections:
 - i. Compression: Gateway Building Products "G-Loc" or approved equivalent.
 - ii. Tension: Lenton Anchor or approved equivalent. Connection device shall develop 125 percent of yield strength of bar.
 - b. Welded Splices: "Cadweld", "Thermoweld" or approved equivalent. Size device to develop 125 percent of yield strength of bar.

C. Fabrication

1. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice.
2. Locate reinforcing splices not indicated on Plans at point of minimum stress. Review location of splices with ENGINEER.

D. Allowable Tolerances

1. Fabrication Tolerances
 - a. Sheared length: plus or minus one inch ($\pm 1"$).
 - b. Depth of truss bars: plus or minus one-half inch ($\pm \frac{1}{2}"$).
 - c. Stirrups, ties and spirals: or minus one-half inch ($\pm \frac{1}{2}"$).
 - d. Other bends: plus or minus one inch ($\pm 1"$).
2. Placing Tolerances.
 - a. Concrete cover to formed surface: plus or minus three-eighths inch ($\frac{3}{8}"$).
 - b. Minimum spacing between bars: one-quarter inch ($\frac{1}{4}"$)
 - c. Top bars in slabs or beams.
 - i. Members eight (8") inches deep or less: one-quarter inch ($\frac{1}{4}"$).
 - ii. Members more than eight inches (8"), but not over, two feet (2') deep: plus or minus one-half inch ($\pm \frac{1}{2}"$).
 - iii. Members more than two feet (2') deep: plus or minus one inch ($\pm 1"$).
 - d. Cross of member: spaced evenly within two inches (2").
 - e. Lengthwise of member: plus or minus two inches ($\pm 2"$).

2.4 EXPANSION JOINTS

A. Design Requirements

Expansion joints and devices to provide for expansion and contraction shall be constructed as indicated herein or on as shown on plans.

The bearing area under the expansion ends of concrete slabs, prestressed concrete beams, girders, and slab and girder spans, shall be given a steel trowel finish. These areas shall be finished to the exact grades required. Separation of these surfaces from the substructure concrete shall be made in accordance with the plans.

B. Fabrication

Preformed fiber joint material, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B & S gauge. Such anchorage shall be sufficient to preclude the tendency of the material to fall out of the joint.

C. Workmanship

Careful workmanship shall be exercised in the construction of all joints to insure that the concrete sections are separated completely by an open joint or by the joint material and to insure that the joints will be true to the outline indicated. Immediately after the removal of forms and again where necessary after surface finishing, all projecting concrete shall be removed along exposed edges in order to secure full effectiveness of the expansion joints.

2.5 CONSTRUCTION JOINTS

A. Design Requirements

The joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. When concrete in a structure or a portion of a structure is specified to be placed monolithic, the term monolithic shall be interpreted to mean that the manner and sequence of concrete placing shall be such that construction joints will not be created.

Construction joints will be of the type and at the locations shown on the plans. Additional joints will not be permitted without written authorization from the Engineer. Any additional construction joints shall have details equivalent to those shown on the plans for joints in similar locations.

B. Fabrication

Unless otherwise provided, construction joints shall be square and normal to the forms. Bulkheads shall be provided in the forms for all joints except horizontal joints.

If shown on the plans, construction joints shall be provided with concrete keyways, reinforcing steel dowels, and/or metal flashing strips or plastic water stop. The method of forming keys in keyed joints shall be such as to permit the easy removal of forms without chipping, breaking, or damaging the concrete in any manner.

2.6 ANCHOR BOLTS, EXPANSION ANCHORS AND CONCRETE INSERTS

A. Design Requirements

When the size, length or load carrying capacity of an anchor bolt, expansion anchor or concrete insert is not shown on the Plans, provide the size, length and capacity required to carry the design load times a minimum safety factor of four

Determine design loads as follows:

1. For equipment anchors, use the design load recommended by the manufacturer and approved by the CITY OF FARMERSVILLE or ENGINEER.
2. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides.
3. Allowances for vibration are included in the safety factor specified above.

B. Materials

1. Anchor Bolts:
 - a. Provide bolts complying with ASTM A320.
 - b. In buried or submerged locations, provide stainless steel bolts complying with ASTM A320, AISI Type 316. Other AISI types may be used subject to CITY OF FARMERSVILLE's or ENGINEER's approval.
2. Expansion Anchors:
 - a. Zinc plated anchors complying with ASTM A320, AISI Type 316. Other AISI types may be used subject to ENGINEER's approval.
 - b. Size required for the concrete strength specified.
 - c. Stud type (male thread) or flush type (female thread), as required.

- d. UL or FM approved.
 - e. In buried or submerged locations, provide stainless steel anchors complying with ASTM A320, AISI Type 316. Other AISI types may be used, subject to CITY OF FARMERSVILLE's or ENGINEER's approval.
 - f. Product and Manufacturer: Provide anchors by one of the following:
 - i. Molly Division of USM Corporation.
 - ii. Hilti, Incorporated.
 - iii. Or approved equivalent.
- C. Adhesive Anchors (capsule anchors): Adhesive anchors shall consist of all- thread anchor rod, nut, washer, and adhesive capsule. Anchor rods to be manufactured from:
- 1. Materials meeting the requirements of ASTM A36.
 - 2. A 4140, 4142, 4140H, OR 4145H meeting the requirements of ASTM A193, Grade B-
 - 3. AISI 316 stainless steel, which meets the requirements of ASTM F593-80. Anchor rods shall have rolled threads. The adhesive capsules used shall contain a vinylester resin, quartz and aggregate and hardener as equal to the Hilti HEA adhesive capsules or Molly Parabond capsule anchor.
- D. Concrete Inserts:
- 1. For piping, grating, and floor plate provide malleable iron inserts.
 - 2. Provide those recommended by the manufacturer for the required loading.
 - 3. Finish shall be black.
 - 4. UL and FM approved.
 - 5. Product and Manufacturer: Provide one of the following inserts:
 - i. ITT Grinnell, Figure 282.
 - ii. Hohmann and Barnard, Inc., No. 380.
 - iii. Or approved equivalent.
- E. Powder actuated fasteners and other types of bolts and fasteners not specified herein shall not be used unless approved by CITY OF FARMERSVILLE or ENGINEER.

2.7 GROUT

A. Materials

- 1. Non-metallic, 100 percent solids, and high strength epoxy grout: Use clean, well graded sand with epoxy resins suitable for use on dry or damp surfaces.
Product and Manufacturer:
 - Euco High Strength grout by the Euclid Chemical Company.
 - Sikadur Hi-Mod Grout by Sika Chemical Company.
 - Five Star Epoxy Grout by U.S. Grout Corporation.
- 2. Non-Shrink, Non-Metallic Grout: Pre-mixed non-staining cementitious grout requiring only the addition of water at the jobsite.
Product and Manufacturer:
 - Euco N-S by the Euclid Chemical Company.
 - Masterflow 713 by Master Builders Company.
 - Five Star by U.S. Grout Corporation.
- 3. Ordinary Cement-Sand Grout: Except where otherwise specified, use one part cement to three parts sand complying with the following:
 - Cement: ASTM C150, Type II.
 - Sand: ASTM C33.

Where water repelling and shrinkage reducing requirements are shown or specified, use admixtures.

4. Product and Manufacturers:

- Integral Waterpeller by the Euclid Chemical Company.
- Omicron, Type OM by Master Builders Company
- Hydrocide Powder by Sonneborn-Contech

B. Water: Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies, or organic matter.

2.8 WATERSTOPS

Waterstop manufacturer shall demonstrate 5 year (minimum) continuous, successful experience in production of waterstops

A. Materials

1. Bituminous (Plastic) Waterstops

- a. Meet or exceed all requirements of Federal Specifications SS-S-00210, "Sealing Compound, Preformed Plastic for Expansion Joints, Type I or Type II Such plastic waterstop shall be equal to Synko-Flex as manufactured by Synko-Flex Products Company, Houston, Texas. No asbestos fiber shall be used in the manufacture of the waterstop.
- b. The plastic waterstop shall be produced from blends of refined hydrocarbon resins and plasticizing compounds, and shall contain no solvents, irritating fumes or obnoxious odors. The waterstop shall not contain asbestos. The plastic waterstop shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive on oxidizing, evaporating or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded form of suitable cross section and of a size to seal the joint areas of concrete sections. The plastic waterstop shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half, to facilitate application of the sealing compound.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate footing trenches below the frost line to lines and grades shown on the Plans.
- B. Footing trenches are to be level, without soft spots, plumb with firm and even side walls.
- C. When excavation is essentially complete, verify depths and dimensions as well as soil classification and bearing capacity.
- D. Perform additional excavation only as approved by CITY OF FARMERSVILLE.
- E. Correct unauthorized excavation as directed at no cost to CITY OF FARMERSVILLE.
- F. Add the required cushion/leveling sand as shown on the Plans.
- G. Before the vapor barrier is installed the footing trenches shall be cleared of debris, loose dirt, organic matter, mud and water.
- H. Fill over-excavated areas under structure bearing surfaces with concrete or compacted select sand fill as required by the CITY OF FARMERSVILLE or ENGINEER.
- I. Excavate or place compacted select fill to within 1 foot of final grade or as may be shown on plans, making final excavation or compacted select fill immediately prior to placement of formwork and reinforcing steel. Limit final area to that which is being prepared for concrete placement. Limit exposure of final excavated surface to 24 hours. If surface is exposed longer than 24 hours or is damaged due to weather conditions, CONTRACTOR shall excavate four inches and provide a concrete seal slab. Keep area free of standing water until concrete and backfill operations are complete.
- G. Seal slabs shall be used where called for on the plans or as specified in paragraph I above.

3.2 FORM WORK

- A. Examination: Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.
- B. Earth Forms: Earth forms are permitted for concrete thrust blocks where practical.
- C. Preparation:
 - 1. Field measurements: Lay out all necessary dimensions required to establish proper placement of forms. Use string lines, chalk lines or other suitable aids to establish lines and grades for form setters. Check all dimensions of erected form work before placing concrete.
 - 2. Clean forms before beginning erection.
 - 3. Install walers, studs, internal ties and other form supports, adequately spaced so proper working stresses are not exceeded.
 - 4. Lubricate, with an approved commercially prepared form lubricant, all portions of the form that will be in direct contact with concrete.
 - 5. Install chamfer strips for all exposed corners.
 - 6. Clean all dirt, mud, water and debris from the forms and any space to be occupied by concrete. All surfaces encrusted with dried concrete from previous placement operations shall be cleaned.
 - 7. Clean all reinforcing steel projecting from previously placed concrete before placing new concrete.
 - 8. Sprinkle semi-porous subgrades sufficiently to eliminate absorption of water from the concrete and seal extremely porous subgrades such as gravel or sand with polyethylene film.
 - 9. The surface of hardened concrete upon which fresh concrete is to be placed shall be rough, clean, and damp. Remove all surface mortar to expose the aggregate. Wash the hardened surface with clean water and keep it saturated before placing the fresh concrete.
 - 10. Accurately and securely place all embedded items such as anchor bolts, water stops and expansion joints. Use templates to assist in locating all embedment whose location is critical.

11. Check all aluminum materials that will be in contact with concrete to insure the surfaces have been coated with bituminous coal tar paint. Correct any deficiencies.
- D. Installation: Provide sloped surfaces steeper than 1.5 horizontal to 1 vertical with a top form to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted. Construct the forms to correct shape and dimensions, mortar-tight, of sufficient strength, braced and tied together so that the forms shall be strong enough to maintain their shape under all imposed loads from the movement of workers, equipment, materials, or the placing and vibrating of the concrete. Camber where necessary to assure level finished soffits unless otherwise shown on the Drawings. Verify the horizontal and vertical positions of forms and correct all inaccuracies before placing concrete in any form. Complete all wedging and bracing before placing concrete.
1. Forms for "Smooth Finish" Concrete: Use steel, plywood or lined board forms uniform in size. Clean and smooth plywood and form liners. Free edges and holes from damage. Form lining shall have close-fitting square joints between separate sheets and shall not be sprung into place. Sheets of form liners and plywood shall be full size wherever possible and joints shall be taped to prevent protrusions in concrete. Use special care in forming and stripping wood forms to protect corners and edges. Level and continue all horizontal joints. Wet wood forms at all times until stripping.
 2. Framing, Studding, and Bracing: Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood. Framing, bracing, centering, and supporting members shall be of adequate size and strength to carry safely, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms. Soffits of all beams forms shall be constructed of material a minimum of 2 inches thick. Distribute bracing loads over base area on which bracing is erected, when placed on ground, protect against undermining, settlement or accidental impact.
 3. Erect formwork, shoring and bracing to achieve design requirements, in accordance with the requirements of ACI 1010.
 4. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
 5. Align joints and make watertight. Keep form joints to a minimum.
 6. Obtain approval from CITY OF FARMERSVILLE or ENGINEER before framing openings in structural members which are not indicated on Drawings.
 7. Provide chamfer strips on exposed edges unless drawings note otherwise.
 8. Do not reuse wood formwork more than three times. Do not patch formwork.
- E. Application – Form Release Agent
1. Apply form release agent on formwork in accordance with manufacturer's recommendations.
 2. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
 3. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings, which are affected, by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
 4. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse any form which cannot be reconditioned to "like new" condition. Apply form coating to all forms in accordance with the manufacturer's specifications, except where "scored finish" is required as shown on the Drawings. Do not coat forms for concrete that is to receive a "scored finish".
- F. Inserts, Embedded Parts and Openings
1. Provide formed openings where required for items to be embedded in or passing through concrete work.

2. Locate and set in place items that will be cast directly into concrete.
 3. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
 4. Provide temporary ports or openings in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
 5. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly filled so joints will not be apparent in exposed concrete surfaces.
- G. Form Cleaning
1. Clean and remove foreign matter within forms as erection proceeds.
 2. Clean formed cavities of debris prior to placing concrete.
 3. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 4. During cold weather, remove ice and snow from within forms. Do not use deicing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.
- H. Formwork Tolerances: Construct formwork so as to maintain tolerances required by ACI 347, except as otherwise noted.
- I. Field Quality Control
2. Independent Testing Agency to inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
 3. Notify the ENGINEER and Independent Testing Agency after placement of reinforcing steel in the forms, but prior to placing any concrete, so that inspection can be made.

3.3 VAPOR BARRIER

- A. Install .006 inch thick polyethylene film vapor barrier under slabs on grade. Film shall be factory fabricated into large sheets. Stretch and weight sheets until sealed together.
- B. Lap joints a minimum of 8-12 inches and seal with tape or mastic..
- C. Repair any damage by lapping and sealing.
- D. Seal entire vapor barrier.

3.4 PLACEMENT OF REINFORCEMENT

- A. Conform to ACI 318 code for concrete over reinforcement.
- B. Clean reinforcement to remove loose rust, mill scale, oil, earth, ice and other materials which might reduce or destroy bond with concrete.
- C. Accurately position reinforcements on supports, spacers, hangers or other approved supports and secured in place with ties or clips. Supporting reinforcement directly on concrete, brick or rocks instead of specified supports is prohibited.
- D. Splices not shown on the plans may be used provided such splices meet the requirements of ACI 318, except where shown on the drawings welding or tack welding of reinforcement is prohibited.
- E. Do not bend reinforcement that is partially embedded in hardened concrete, unless approved.
- F. Do not displace or damage vapor barrier.
- G. Accommodate placement of formed openings.
- H. Lap welded wire fabric a distance equal to the wire spacing, plus two (2") inches.
- I. Place reinforcement to the held in position such that the concrete cover between the outside of any bar and the concrete form conforms to the following schedule.
 2. Slabs, walls and joints not exposed to weather or in contact with earth or water - one (1") inch.

3. Concrete exposed to earth or water.
 - a. #5 bars and smaller – one (1") inch.
 - b. #6 bars and larger – two (2") inches.
4. Concrete cast against earth - three (3") inches.
5. Beams, girders and columns – (1") inch.

3.5 CONSTRUCTION JOINTS

- A. Install construction joint forms to conform to the details shown in the plans.
- B. Locate construction joints as shown on the drawings or as specified below. Do not use construction joints at other locations without the concurrence of the ENGINEER.
 1. Columns and Walls - Locate construction joints at the underside of beams, girders, haunches, drop panels and column capitals and at floor levels.
 2. Beams, Girders - Locate construction joint at mid span.
- C. Locate construction joints perpendicular to the planes of their surfaces and parallel to the main reinforcement.

3.6 WATERSTOPS

- A. As soon as the form lumber is removed from the joint, brush the joint clean to remove all dust and foreign particles. Immediately apply one brush coat of prime recommended by the waterstop manufacturer.
- B. Remove one face of the protective paper and position in the center of the keyway, lapping strips one (1") inch end to end to form a continuous homogeneous waterstop for the entire length of the section.
- C. Immediately before pouring concrete or placing precast members at the joint, completely clean the joint using brushes and compressed air to remove all debris. Only just before the concrete pour is made, remove the protective paper covering from the waterstop.
- D. Schedule: All joints subject to either hydrostatic or earth pressure on either side of the joint and exposed to view on the other side. Bituminous water stops are not required for the elevated tank or ground storage reservoir foundation except where noted.

3.7 TESTING

- A. Slump: A slump test shall be made by the CONTRACTOR for each truckload of concrete delivered to the job. If the slump is greater than that specified, the concrete may be rejected. The slump shall be determined according to ASTM C143. The CONTRACTOR shall perform this test.
- B. Air Content: Make an air content test on the first batch of concrete delivered each day and from each batch of concrete from which concrete compression test cylinders are made. Air content shall be determined according to ASTM C231 (Test for Air Content of Freshly Mixed Concrete by the Pressure Method) or ASTM C173 (Test for Air Content of Freshly Mixed Concrete by the Volumetric Method). The CONTRACTOR shall perform or pay for this test.
- C. Compression Tests:
 1. Prepare concrete test cylinders for each concrete pour. The number of sets of concrete test cylinders to be cast for each concrete pour shall be as follows:

No. CY Concrete Poured	Minimum No. of Sets of Cylinders
0-25	1
25-75	2
75-150	3
150-250	4
250-400	5
400-500	6

2. Test cylinders are taken mid-way through the truck's load, immediately before placement (e.g. from pump nozzle, if pumped), or as directed by ENGINEER or INSPECTOR.
3. A "set" of test cylinders consists of four cylinders, one to be broken at seven (7) days, one broken at fourteen (14) days, and one broken at twenty-eight (28) days, and one to be stored for future use or as directed by ENGINEER. Compression tests will be evaluated according to ACI 214 and ACI 318.
4. Make, cure, store and deliver test cylinders to the laboratory according to ASTM C31 and test according to ASTM C39.
5. Mark or tag each set of compression test cylinders showing the date and time of day the cylinders were made, the location of the work where the concrete represented by the cylinders was placed, the delivery truck or batch number, the air content, the slump, air temperature and concrete temperature.
6. Distribute concrete compression test reports to the CITY OF FARMERSVILLE, ENGINEER, the ENGINEER's or CITY OF FARMERSVILLE's field representative, the CONTRACTOR and other parties designated by the CITY OF FARMERSVILLE.

3.8 PLACING CONCRETE

- A. Concrete shall not be placed unless the ENGINEER or CITY OF FARMERSVILLE's representative has been given 24 hour notice or as maybe agreed to observe the placement of forms, reinforcements and concrete.
- B. Consolidate all concrete by vibration, spading, rodding and forking so that the concrete is thoroughly worked around the reinforcement, around embedded items and into corners of forms, eliminating all air or stone pockets that may cause honeycombing, pitting or planes of weakness. Mechanical vibrators shall have a minimum frequency of 7000 rpm and shall be operated by competent workers. Insert the vibrator into the concrete at intervals from 18 to 30 inches apart, down into the previously placed concrete. Vibrate the concrete sufficiently to consolidate the concrete but avoid over vibrating which may cause segregation of aggregates. The vibrator may not be used to transport the concrete within the forms. Provide a spare vibrator on the job site during all concrete placing operations. Concrete forms are not to be vibrated unless forms are designed for such purposes and approval has been obtained from the ENGINEER.
- C. Place all concrete delivered to the site within 45 minutes after the addition of mixing water to the cement and aggregates, or after the addition of cement to the aggregates when the drum contains residual water. Concrete that had developed initial set when delivered will be rejected.
- D. Cold Weather Concreting
 1. Except upon written authorization by the ENGINEER, do not place concrete when the temperature is below 40° F and falling.
 2. Concrete may be placed when the temperature is 35° F and rising.
 3. No mixed concrete will be accepted which has a temperature of 50° F or less when delivered.
 4. Protect all concrete from freezing temperatures for five days after placement. Use protective coverings, enclosures and/or heat to prevent concrete from freezing. Methods used shall conform to ACI 306 *Recommended Practice for Cold Weather Concreting* and shall maintain a 50° F air temperature around the concrete.
 5. The CONTRACTOR shall be responsible for the quality and strength of concrete under cold weather conditions and all concrete damaged by freezing shall be removed and replaced by the CONTRACTOR at his own expense.
- E. Hot Weather Concreting
 1. Conform to ACI 605, *Recommended Practice for Hot Weather Concreting*.
 2. No mixed concrete will be accepted which has a temperature of 90° F or more when delivered.

3. Add a retarding agent when the concrete temperature exceeds 75° F or when the air temperature exceeds 85° F.
 4. The CONTRACTOR shall be responsible for the quality and strength of concrete under hot weather conditions and all concrete damaged shall be removed and replaced by the CONTRACTOR at his own expense.
- F. Illumination: Do not place concrete before sunrise or later than will normally permit completion of all finishing operations during sufficient natural light.
- G. Protection
1. Do not place concrete during rain, sleet or snow or when such precipitation is imminent.
 2. Concrete damaged by rain water or which has been allowed to increase the mixing water will be removed and replaced at the expense of the CONTRACTOR.

3.9 REMOVAL OF FORMS

- A. The time for removal of forms shall comply with ACI 318. If curing temperatures are below 50°F (15°C), the time for removal shall be increased by fifty percent (50%). In no case shall the forms or bracing be removed until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Forms for columns, walls, sides of beams and any other concrete member not supporting the weight of the concrete may be removed when concrete strength has reached 1500 psi. Concrete strength may be determined from compression tests on field made cylinders or from strength vs. time curves prepared by a testing laboratory from compression tests of the design concrete mix.
- E. Form work for beam soffits, structural slabs and other parts that support the weight of concrete may be removed only after the compression tests of field made cylinders show the concrete has reached the specified 28-day strength.

3.10 CURING

- A. Protect all concrete against the loss of surface moisture for not less than 72 hours from the beginning of the curing operation.
- B. Immediately after the finishing operations have been completed, cover all exterior exposed surfaces of concrete with burlap, or curing compound. Keep burlap wet during the curing process.

3.11 REPAIR OF SURFACE DEFECTS

- A. Patch all repairable defective areas immediately after removing the concrete forms.
- B. Repair minor honeycomb areas and air bubble holes by removing all loose material from the area; applying an approved bonding material, then grouting the area flush with surrounding surfaces. In exposed areas, mix the grout to be used for patching to match the color and texture of the area to be patched.
- C. Cure all patched areas for seven (7) days.
- D. All patching will be subject to the approval of the ENGINEER. Other proven methods of patching defects in concrete may be used subject to the prior approval of the ENGINEER.

3.12 ANCHOR BOLTS, EXPANSION ANCHORS AND CONCRETE INSERTS

- A. Installation
 1. Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer's instructions.
 2. Assure that embedded items are protected from damage and are not filled in with concrete.

3. Expansion anchors may be used for hanging or supporting pipe two inches diameter and smaller. Expansion anchors shall not be used for larger pipe unless otherwise shown or approved by the CITY OF FARMERSVILLE or ENGINEER.
4. Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.
5. Unless otherwise shown or approved by CITY OF FARMERSVILLE or ENGINEER conform to the following for expansion anchors:
 - a. Minimum embedment depth in concrete: Five diameters.
 - b. Minimum anchor spacing on centers: Ten diameters.
 - c. Minimum distance to edge of concrete: Five diameters.
 - d. Increase dimensions above if required to develop the required anchor load capacity.
- B. Cleaning: After embedding concrete is placed, remove protection and clean bolts and inserts.

3.13 GROUT

- A. General:
 1. Place grout as shown in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications, do not proceed until CITY OF FARMERSVILLE or ENGINEER provides clarification.
 2. Dry packing will not be permitted.
 3. It shall be the CONTRACTOR's responsibility to obtain the services of a qualified, full time employee of the manufacturer to aid in assuring proper use of the product under job conditions
 4. Placing grout shall conform to temperature and weather limitations as stated in manufacturer's instructions.
- B. Equipment Bases:
 1. After shimming equipment to proper grade, securely tighten anchor bolts.
 2. Properly form around the base plates, allowing sufficient room around the edges for placing the grout.
 3. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with non-metallic epoxy grout.
- C. Handrails and Railings:
 1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the non-shrink, non-metallic grout.
 2. Bevel grout at juncture with post so that moisture flows away from post.
 3. Side mounted handrails do not require grout.

3.14 SURFACE FINISH

- A. Formed Concrete Surfaces
 1. Minimum Finish For Formed Surfaces
 - a. After being cleaned and thoroughly dampened, fill the tie holes and air holes completely with patching mortar. Patch all tie holes within seven (7) days after removal of forms.
 - b. Remove fins and other surface projections from all formed surfaces except exterior surfaces that will be in contact with earth backfill and are not specified to be dampproofed. Use a power grinder if necessary to remove projections and provide a flush surface.
 - c. This finish is required before any of the following finishes are to be applied.
 2. Rubbed Finish: Apply the rubbed finish to freshly hardened concrete after all patching and repair specified above has been done. Wet all surfaces to be finished and rubbed with a Carborundum brick or other abrasive until uniform color and texture are produced. No

cement grout or slush shall be used other than the cement paste drawn from the green concrete itself by the rubbing process.

- a. All exterior exposed vertical surfaces to a point one (1') foot below ground.
 - b. Exposed horizontal surfaces not normally subjected to foot traffic.
 - c. All interior vertical surfaces.
3. Paint-Type Finish:
- a. After the concrete has cured a minimum of twenty eight (28) days, remove all efflorescence, flaking coatings, rust, mill scale, dirt, oil and other foreign substances from surfaces to be finished. Point with mortar, all air hole marks and repair all surface blemishes which, in the opinion of the ENGINEER, will not be corrected by applying the paint finish. Apply coatings only to surfaces that are free from surface moisture as determined by light and touch. Formed surfaces are to receive minimum finish before paint is applied. Shield or mask all surfaces that are not to be coated.
 - b. Apply the concrete paint as recommended by the manufacturer.
 - c. All exterior exposed vertical surfaces of the ground storage reservoir foundation and elevated tank foundation to a point one (1') foot below ground and exposed horizontal surfaces not normally subjected to foot traffic, including the exposed underside of slabs.
- B. Unformed Surfaces
1. Float Finish:
 - a. After the concrete has been properly placed and struck off use a wood float to produce an even, smooth finish.
 - b. The maximum variation in surface tolerance shall be $\frac{1}{2}$ " in ten (10') feet and within plus or minus $\frac{1}{4}$ " of plan grade. If variations greater than this exist, the ENGINEER may direct the CONTRACTOR to grind the concrete to bring the surface within the requirements. Patching of low spots will not be permitted.
 - c. This finish is required before any of the following finishes are to be applied.
 2. Troweled Finish:
 - a. The finish may be applied using either hand or power trowels. Troweling may be begun as soon as no cement paste clings to the blades. Continue troweling until the surface is dense, smooth and free of all minor blemishes such as trowel marks.
 - b. Apply a final hand troweling to remove slight imperfections left by troweling machines and to bring the surface to a dense, smooth polished surface.
 - c. Finish for all floors inside the building and elevated tank bell.
 3. Brush Finish:
 - a. After the surface has received a float finish, lightly broom the surface with a hair broom to produce a smooth but somewhat gritty texture.
 - b. Broom the surface while the concrete is still plastic enough to be lightly marked or scratched by the fibers.
 - c. The degree of surface roughness applied to the concrete shall be as directed by the ENGINEER.
 - d. Apply brush marks parallel to the lines of the plan of the structure.
 - e. All exterior horizontal surfaces normally subject to foot traffic including sidewalks, steps, slabs and the floor of the meter vaults.

END OF SECTION

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SECTION 1011 PRECAST CONCRETE VAULTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

The work performed under this section of the Specifications shall consist of:

- The design, construction, handling and installation of precast concrete vaults.
- Furnishing and installing grout on equipment bases, foundations and wherever so indicated on the plans.
- Furnishing and installing waterstops.
- In the event of a conflict between this specification and project plans (drawings) then the plans will take precedence.

1.2 REFERENCES

- ACI 318/318R — Building Code Requirements for Structural Concrete and Commentary
- ANSI/ASTM A185 — Welded Steel Wire Fabric for Concrete Reinforcement
- ASTM A305 — Specifications for Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement
- ASTM A432 — Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement with 60,000 psi Minimum Yield Point
- ASTM A615 — Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- ASTM C33 — Standard Specifications for Concrete Aggregate
- ASTM C150 — Portland Cement.
- ASTM C857 — Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- ASTM C858 — Standard Specification for Underground Precast Concrete Utility Structures
- ASTM C891 — Standard Practice for Installation of Underground Precast Concrete Utility Structures
- ASTM C1037 — Standard Practice for Inspection of Underground Precast Concrete Utility Structures

1.3 DESIGN CRITERIA

Vaults shall be designed in accordance with ASTM C857 and C858 or as shown on plans.

1.4 SUBMITTALS

Submit six (6) prints of detailed shop and installation drawings and if required design calculations by a registered engineer for review by ENGINEER. CONTRACTOR shall be responsible for errors in design and fabrication and for correct fit. Each concrete vault shall be identified by a standard mark to be listed in a schedule shown on the manufacturer's submittal and placed legibly on each piece at time of manufacture.

Submit a catalog brochure of the waterstop to be used showing dimensions and configuration.

1.5 DELIVERY, STORAGE AND HANDLING

Waterstops are to be stored under tarps to protect from oil, dirt and sunlight.

Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels. Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE VAULTS

- A. Concrete for concrete vaults shall be a structural concrete mix having a minimum compressive strength of not less than 4,000 psi at 28 days.
- B. Aggregates shall comply with ASTM C33.



- C. Cement shall conform to ASTM C150, Type I or Type III.
- D. Reinforcing bars shall comply with ASTM A615, ASTM A432, and ASTM A305.
- E. Wire mesh shall conform to ASTM A185.

2.2 FABRICATION

- A. All hatches and other similar items shall be embedded in the precast vault in a monolithic pour (no leave-outs) unless otherwise shown on the plans.
- B. While being placed the concrete shall be consolidated by the use of a sufficient number of mechanical vibrators to insure optimum consolidation in the forms and around reinforcement and weld plates.
- C. Temperature of the concrete shall be maintained at 40°F or above from the time placing commences until the curing cycle is complete.
- D. Concrete vaults shall be moist cured. The entire top surface of all concrete vaults shall be exposed to wet burlap at a temperature not to exceed 160°F.
- E. Concrete vaults shall be provided with securely anchored lifting lugs.
- F. All exterior exposed edges shall have a formed 3/4" chamfer.
- G. The tops of all members shall have a fine broom finish.

2.3 GROUT

A. Materials

1. Non-metallic, 100 percent solids, and high strength epoxy grout: Use clean, well graded sand with epoxy resins suitable for use on dry or damp surfaces.
Product and Manufacturer:
 - Euco High Strength grout by the Euclid Chemical Company.
 - Sikadur Hi-Mod Grout by Sika Chemical Company.
 - Five Star Epoxy Grout by U.S. Grout Corporation.
2. Non-Shrink, Non-Metallic Grout: Pre-mixed non-staining cementitious grout requiring only the addition of water at the jobsite.
Product and Manufacturer:
 - Euco N-S by the Euclid Chemical Company.
 - Masterflow 713 by Master Builders Company.
 - Five Star by U.S. Grout Corporation.
3. Ordinary Cement-Sand Grout: Except where otherwise specified, use one part cement to three parts sand complying with the following:
 - Cement: ASTM C150, Type II.
 - Sand: ASTM C33.

Where water repelling and shrinkage reducing requirements are shown or specified, use admixtures.
4. Product and Manufacturers:
 - Integral Waterpeller by the Euclid Chemical Company.
 - Omicron, Type OM by Master Builders Company
 - Hydrocide Powder by Sonneborn-Contech

- B. Water: Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies, or organic matter.

2.4 WATERSTOPS

Waterstop manufacturer shall demonstrate 5 year (minimum) continuous, successful experience in production of waterstops.

A. Materials



1. Bituminous (Plastic) Waterstops

- a. Meet or exceed all requirements of Federal Specifications SS-S-00210, "Sealing Compound, Preformed Plastic for Expansion Joints, Type I or Type II Such plastic waterstop shall be equal to Synko-Flex as manufactured by Synko-Flex Products Company, Houston, Texas. No asbestos fiber shall be used in the manufacture of the waterstop.
- b. The plastic waterstop shall be produced from blends of refined hydrocarbon resins and plasticizing compounds, and shall contain no solvents, irritating fumes or obnoxious odors. The waterstop shall not contain asbestos. The plastic waterstop shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive on oxidizing, evaporating or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded form of suitable cross section and of a size to seal the joint areas of concrete sections. The plastic waterstop shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half, to facilitate application of the sealing compound.

PART 3 - EXECUTION

3.1 ERECTION

- A. Inspect the subgrade conditions to insure that subgrade is at the proper elevation, is sufficiently firm to support the weight of the vault and is dry.
- B. Install concrete vaults in accordance with the manufacturer's recommendations in a neat and workmanlike manner. Place waterstop material between individual sections. Repair all water leaks in joints to present a waterproof structure. Concrete vaults sections shall be properly aligned and leveled by methods approved by the ENGINEER.
- C. Remove all lifting lugs.
- D. Point all air holes and voids with cement-sand mixture containing an acrylic bonding agent.
- E. Apply two coats of Ferma-Shield as manufactured by Secure Incorporated, Waxahatchie, Texas to all exterior vertical surfaces as may be required or if shown on plans.
- F. Precast vaults with concrete floors shall be constructed and assembled to prevent ground water from entering the vault. Evidence of water entering the vault at a rate that exceeds normal evaporation rates will be cause for rejection.

3.2 WATERSTOPS

- A. As soon as the form lumber is removed from the joint, brush the joint clean to remove all dust and foreign particles. Immediately apply one brush coat of prime recommended by the waterstop manufacturer.
- B. Remove one face of the protective paper and position in the center of the keyway, lapping strips one (1") inch end to end to form a continuous homogeneous waterstop for the entire length of the section.
- C. Immediately before pouring concrete or placing precast members at the joint, completely clean the joint using brushes and compressed air to remove all debris. Only just before the concrete pour is made, remove the protective paper covering from the waterstop.
- D. Schedule: All joints subject to either hydrostatic or earth pressure on either side of the joint and exposed to view on the other side. Bituminous water stops are not required for the elevated tank or ground storage reservoir foundation except where noted.

3.3 GROUT

- A. General:
 1. Place grout as shown in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications, do not proceed until CITY OF FARMERSVILLE or ENGINEER provides clarification.



2. Dry packing will not be permitted.
 3. It shall be the CONTRACTOR's responsibility to obtain the services of a qualified, full time employee of the manufacturer to aid in assuring proper use of the product under job conditions
 4. Placing grout shall conform to temperature and weather limitations as stated in manufacturer's instructions.
- B. Equipment Bases:
1. After shimming equipment to proper grade, securely tighten anchor bolts.
 2. Properly form around the base plates, allowing sufficient room around the edges for placing the grout.
 3. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with non-metallic epoxy grout.
- C. Handrails and Railings:
1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the non-shrink, non-metallic grout.
 2. Bevel grout at juncture with post so that moisture flows away from post.
 3. Side mounted handrails do not require grout.

3.3 GUARANTEE

The CONTRACTOR shall guarantee the structure against any defect in materials or workmanship for a period of one year from date of acceptance. If any materials or workmanship prove to be defective within one year they shall be replaced or repaired by the CONTRACTOR.

3.4 MEASUREMENT AND PAYMENT

The precast concrete vault shall be paid for at the lump sum price in accordance with the bid. The payment shall be full compensation for a complete and working unit.

END OF SECTION

SECTION 1012 INSTRUMENTATION AND TELEMETRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope

1. This section describes the work to be performed to install a complete instrumentation and telemetry system as described herein and as shown on the plans.
2. It is the intent of these specifications that all equipment specified herein or indicated on the plans shall be furnished and installed with all necessary wiring, piping, accessories, devices, and appurtenances ready for operation. The installation shall be complete in all respects, shall be checked and adjusted by a qualified representative of the equipment manufacturer and shall perform its functions in a completely satisfactory manner as a condition of acceptance of the installation. Any item(s) not specifically specified but necessary for the intended operation set forth herein shall be furnished and installed at no additional cost to the City of Farmersville.

B. Related Work Specified Elsewhere

1. Section 909- Turbine Flow Meters
2. Section 703 - Wires and Cables

C. Work Performed by Others

This instrumentation and telemetry system will be used in conjunction with the other systems. It is a responsibility of the Contractor to familiarize himself with the work done and provide whatever additional work is required to produce a complete operating system.

D. Description of System

The instrumentation and telemetry system shall provide the following functions:

- a. Control over the motor operated valve at the North Texas Municipal Water District (NTMWD) metering vault;
- b. Instrumentation for monitoring level and flow,
- c. Other functions as required by the contract documents or as required for proper operation of new facilities.

1.2 QUALITY ASSURANCE

A. Referenced Standards

1. American Society for Testing and Materials (ASTM)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. Instrument Society of America (ISA)
4. National Electrical Manufacturers Association (NEMA)
5. National Electrical Code (NEC)

1.3 SYSTEM DESCRIPTION

- A. The instrument and control system consists of all primary elements, transmitters, switches, controllers, indicators, panels, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and other devices required to provide complete control of the facility as specified in the Contract Documents.
- B. Unless otherwise required for instrument compatibility electric control signals shall be 4 to 20 milliampere DC.
- C. All signals shall be directly linearly proportional to measured variable unless specifically noted otherwise.

1.4 PERFORMANCE AND DESIGN REQUIREMENTS

A. System Operating Criteria

1. Stability

After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two cycles per minute or a magnitude of movement of 0.5 percent full travel.

2. Response

Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.

3. Agreement

Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.

4. Repeatability

For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.

5. Sensitivity

Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.

6. Performance

All instruments and control devices shall perform in accordance with manufacturer's specifications.

B. Equipment Surge Protection

1. Provide power supplies for electronic equipment to successfully withstand surges in AC power circuits per the wave form, voltage amplitude, current amplitude, and frequency per IEEE C62.41.

2. Successfully withstanding transients requires neither erroneous output, component failure or calibration change results from a AC power surge or transient.

1.5 SUBMITTALS

A. Shop Drawings

Submit the following data to the Engineer for his review:

1. Manufacturer product literature on all components.

2. A complete loop and ladder diagrams of the instrumentation and control.

3. Control schematics. Diagrams shall include the following:

a. Terminal identification

b. Unique identification of all control devices and contacts. Utilize City of Farmersville's device identification numbers where applicable.

c. Wire identification

d. Equipment identification

e. Indication of remote and local devices and wiring

f. Overcurrent protection indication

g. Voltage

h. All control logic.

4. Comprehensive set of point-to-point Wiring diagrams showing all interconnections between packaged systems or equipment control panels, motor control centers, instrumentation and all other electrical equipment as required to depict a complete and functional facility-wide electrical control system. Instrumentation wiring already shown on loop diagrams need not

be included on point-to-point wiring diagrams. Diagrams shall provide the following minimum information:

- a. Terminal block identification including terminals on remote equipment furnished by Others.
- b. Ground points.
- c. Interconnection requirements to existing systems or equipment furnished by others.

Diagrams shall be provided on drawings of sufficient size to minimize the number of drawings. Drawings shall be prepared on either 11" x 17" or 24" x 36" sheets.

5. Remote Terminal Units (RTU)

Submit product technical data including the following:

- a. Manufacturer's standard product literature
- b. Detailed specifications for specified PLC showing memory and storage capacities, speed, accuracies, features, accessories, allowable environmental conditions and other data to show compliance with the specifications.
- c. Software programs for PLC systems.
 - (1) Submit program for logic in ladder diagram format as used for the specific PLC system. Annotate program listing to include the following:
 - (a) Written description of each rung's function.
 - (b) Reference to control loop number for each rung where applicable.
 - (c) Reference to instrumentation tag number of I/O devices for each rung where applicable.
 - (2) Submit all programs for the RTU's on 3.5" diskette to Engineer.
- d. Arrangement drawings for RTU system components.
- e. Warranty of equipment, accessories and spare parts.

6. Instrumentation and Terminal Panels

- a. Panel and materials of construction.
- b. Panel and dimensions.
- c. Internal wiring and terminal block drawings.
- d. Scaled and dimensioned panel face instrument and nameplate layout drawings.

7. Provide copies of all equipment warranties and a list of factory authorized service agents.

B. Operation and Maintenance Manual

1. The equipment supplier shall provide four (4) complete operation and maintenance manuals describing all types of equipment supplied, as well as the overall theory of operation of the system. The manual shall include suggested maintenance and operational tips, including suggested procedures for coping with radio failure and power failure at remote and central panels.
2. The manual shall include all manufacturers product literature, product data sheets, drawings, installation instructions, and operators handbooks, manuals or instructions.
3. Include all software operator's manuals and programming manuals. Provide a copy of all PLC and PC programs on 3.5" diskettes.
4. Submit maintenance procedures available to City of Farmersville. Include the location and phone numbers of service centers (including 24 hr. "hot lines"). Provide specific information including operation and maintenance requirements, programming assistance, troubleshooting guide, parts ordering, field service personnel requests, and service contracts.

C. Spare Parts

The Contractor shall furnish the following spare parts to the Engineer for subsequent delivery to the City of Farmersville:

1. One (1) year supply of charts for each indicating recorder.
2. 10% spares of all fuses.
3. 10% spares of plug-in interposing and control relays
4. 10% spares of all bulbs or as specified herein.

All spare parts shall be packaged and placed in sealed boxes. Place type written waterproof adhesive label on each box clearly describing the contents in detail.

D. As-Built Drawings

After the installation of the equipment and panel is complete, submit to the Engineer for approval, six (6) copies of "as-built" drawings of the completed facility. Include final PLC program listings. One (1) copy of the approved drawings is to be placed in a plan pocket located inside the telemetry panel at each site. The remainder are to be delivered to the City of Farmersville.

E. Review by Other Agencies

All submittals for equipment being installed in the meter vault, on the ground storage reservoir, and at the pump station, or that is to be operated or maintained by NTMWD are subject to review by NTMWD. The determination of suitability of all materials and products to be installed in these locations and applications will be made by NTMWD and their decision shall be final. No additional compensation will be paid to the Contractor for meeting all the requirements of NTMWD.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials

Unload and store equipment as it arrives in the original packing crate. Do not uncrate or unpack equipment until the manufacturer's representative service representative has been notified and is present to check the incoming equipment for damage.

B. Storage of Materials and Equipment

1. All equipment specified in this section shall be stored inside a weatherproof and heated building until such time the equipment is to be installed.
2. Every effort should be made to prevent condensation of moisture in the equipment. Place heating devices in enclosures.
3. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

C. Handling of Materials and Equipment

Where possible, all equipment should be left in the original packing boxes and crates until after the materials have been delivered to the location at which they are to be installed and have been placed in position for final installation.

D. Protection of Equipment after Installation

After the equipment has been installed, protect the equipment from potential damage by placing a protective cover over each piece of equipment. Place protective boards around the instrumentation panel to prevent denting and abrasions to the surface of the panel during subsequent construction.

1.7 GUARANTEE

The equipment manufacturer shall furnish, through the Contractor, a guarantee for a period of one (1) year from the date of start-up to protect the City of Farmersville against defective workmanship and materials. The guarantee shall cover the accuracy and correctness of the entire system, as well as each piece of equipment. The manufacturer of the equipment shall also guarantee the individual

components will perform according to the standards which have been published by the manufacturer in any of his literature. Any claim made by the manufacturer regarding performance of his equipment shall be guaranteed to perform accordingly.

PART 2 - PRODUCTS

2.1 ULTRASONIC LEVEL GAGE

A. Description

The level gage shall measure level using an ultrasonic signal echo from an overhead transducer. The gage shall utilize a N.P.T. threaded transducer suitable for mounting on a tapped steel flange.

B. Transmitter

The level transmitter shall be fully electronic and be enclosed in a NEMA 4X polycarbonate enclosure. The transmitter shall have the following additional features:

1. One 4-20 ma analog outputs.
2. 5 form "C" programmable relay outputs
3. Rangeability - 0 - 16 feet with not more than 12 inches blanking distance.
4. Display - the transmitter shall be furnished with a LCD level indicator. The indicator shall display the following information:
 - a. Depth in feet
 - b. Percent of scale
 - c. Loss of echo
 - d. Cable loss of echo
5. Analog output - 4-20 ma adjusted for full scale reading at 24 feet.
The transmitter shall perform on board diagnostics. Should any part of the transmitter fail or if no signal is received from the transducer, the transmitter output shall drop below 3 ma.

C. Quality Assurance

The accuracy of the level gage shall be $\pm 0.25\%$ of actual depth over the specified range of the meter.

D. Electrical Characteristics

The transmitter shall operate with an electrical power supply of 120v, single phase, 60 Hz

E. Acceptable Products

The level gage shall be Milltronics HydroRanger I or approved equal product.

2.2 PACKAGED REMOTE TERMINAL UNITS (RTUs)

A. General

The packaged remote terminal unit shall provide all equipment, wiring, enclosures to accomplish point-to-point communication between remote wide area network RTUs and point-multipoint communication with Supervisory Control and Data Acquisition (SCADA) systems. Included in the packaged RTU shall be power supply, radio modem, I/O modules for controlling and monitoring field devices PLC central processing unit (CPU) and UPS.

RTU shall be used for communication between the N.T.M.W.D. in Wylie and Wylie Northeast Water Supply Corporation. This unit shall use a MDS licensed radio modem.

B. Components

1. Power supply

Furnish power supply for 115 V ($\pm 10\%$) AC, 60 Hz supply voltage. Furnish power supply for PLC and radio modem. Furnish surge suppressor and lightning arrestor. Furnish battery backup of sufficient capacity to operate all equipment in the RTU with normal operation for 60 minutes.

2. PLC

- a. I/O Capability - Onboard I/O, 16 discrete inputs, 12 discrete outputs, 4 analog inputs, 2 analog outputs. PLC shall be expandable to 15 I/O modules.
- b. Memory - 2 Kbytes ladder logic, 1820 registers, capacitor backed
- c. Execution time - 2.5 msec/k
- d. PLC shall be Modicon 61200, no equal
- 3. Radio Modem (NTMWD RTU) - Micro Data Systems MDS 2310 A with 4800 BPS modem and remote diagnostics, licensed radio, no equal.
Program CTS delay to 15 sec.
- 4. Uninterruptible power supply (UPS) 60 m 12OVAC. Furnish Best "Patriot" or equal.
- 5. Enclosure - NEMA 4 painted steel. Furnish steel backpanel. Meet requirements for wall mounted panels in this section.
- 6. Wiring - Meet requirements for wall mounted panels in this section. All wiring shall terminate at numbered terminal strips with screw terminals. All wiring shall be labeled with PVC numbered labels
- 7. Accessories
 - a. Interior lighting with switch.
 - b. Utility duplex outlet, 115 V AC, GFCI, 15 amp.
 - c. Interposing relays for all outputs and inputs that are used for this application.
 - d. PC to PLC interface & connector cable
- C. Acceptable Product - Square D RTU-PAK, Class 6370 or approved equal product
- D. PLC Programming
Furnish PLC program required to process all signals, both analog and discrete as shown on the drawings. NTMWD will provide programming for their RTU.

2.3 ANTENNA SYSTEMS

- A. General
Furnish a complete radio antenna system compatible with the radio modem specified herein including antenna, mounting hardware, coaxial cable, surge suppressor and accessories.
- B. Materials
 - 1. Antenna - "Yagi" type, directional, 10 dB gain, Scala Model TY-900, no equal.
 - 2. Cable and accessories shall be manufactured by Andrew Corporation
 - a. Coax cable - ½" Heliax.
 - b. Super flexible foam coax cable - ½" Andrew FSJ4-50B
 - c. Connectors - Andrew RG-393/U, Type N
 - d. Clamps - Andrew 31670-3
 - e. Hangers - Andrew 43211
 - 3. Surge Suppressor - Polyphaser IS-850
 - 4. Conduit
 - a. For coax cable – 1 ½" Rigid Galvanized Steel
 - b. For antenna mast – 2 ½" Rigid Galvanized Steel or other size as shown on the Drawings.
 - 5. Bolting - Stainless steel

2.4 MISCELLANEOUS



A. Level Control Relay

Electrode relay shall be B/W Series 1500 suitable for potable water. Provide one relay and one electrode assembly. Electrode holder shall be 4" cast iron with 125 lb. flanges. Furnish B/W type E-55. Wire suspension electrodes shall be B/W type E-1 P with type SW suspension wire.

Level control relay shall be used to close the NTMWD motorized butterfly valve in the event of high reservoir level. Provide NEMA 4 enclosure for wall mounting. Furnish electrode wire lengths as required to place one electrode seven inches below the tank overflow and one electrode one inch below the tank overflow or as directed by NTMWD.

B. Power Conditioners

Power conditioners shall be type that both regulates and buffers load from line impulses. Provide Sola type MCR or equal with capacity equal to the sum of all loads served by the power conditioner.

PART 3 - EXECUTION

3.1 INSPECTION

Each piece of equipment shall be inspected for damage in the presence of the manufacturer's representative as soon as it is uncrated. Check the shipment for missing parts and reorder immediately.

3.2 INSTALLATION

A. General

1. Coordinate the installation of the equipment with electrical and mechanical trades.
2. Instrumentation and appurtenances requiring electrical wiring shall be wired in accordance with such approved wiring diagrams of the manufacturer as set forth in the applicable provisions of the electrical section of these specifications.
3. Transmitters shall be connected to their associated devices in a manner indicated by the manufacturer's drawings and as directed by the Engineer. Transmitters shall be mounted on the respective mounting brackets and securely attached to the wall or floor. Anchor bolts used in installing the transmitters shall be no less than 1/8" smaller than the diameter of the mounting holes provided by the manufacturer. Where connections are to be made to water lines, such connection shall be made with copper tubing and fittings. All lines shall be valved and unions installed to permit removal of these devices.
4. Failure to specify or to indicate in the plans all miscellaneous wiring or piping, of whatever nature required to satisfy operation and compliance with this section of the specifications will not relieve the Contractor from such work. No additional payment will be made for such work. The Contractor shall familiarize himself with the work to be performed.

B. Instrument Valve Installation

1. Orient stems for proper operation.
2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
3. Provide a minimum of 2" inches clearance between valve handles where there are multiple valve handles appearing in a straight line.
4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line. When cool, reassemble the valves.
5. Support each valve individually. The tubing system does not qualify as support for the valve.
6. Stainless Steel Tubing
 - a. Cut by sawing only and debur.
 - b. Make each bend with tube bender of the correct size for the tube.
 - c. Make all bends smooth and continuous.
 - d. Rebending is not permitted.

- e. Make bends true to angle and radius.
 - f. Maintain a true circular cross section of tubing without buckling or undue stretch of tube wall.
 - g. Allowable tolerance for flattening out of tubing bends: Maximum of 8 percent of the OD for stainless steel tubing.
 - h. Minimum bending radius shall be three times the nominal diameter of the tubing.
- C. Threaded Connection Seals
 - 1. Use Tite-Seal or acceptable alternate.
 - 2. Use of lead base pipe dope or Teflon tape is not acceptable.
 - 3. Do not apply Tite-Seal to tubing threads or compression fittings.
- D. Use bottom entry for all conduit entry to instruments and junction boxes.
- E. Install electrical components per Division 16.
- F. Instrument Mounting
 - 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
 - 2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
 - 3. Mount instruments level, plumb, and support rigidly.
 - 4. Mount to provide protection from heat, shock, and vibrations, accessibility for maintenance and freedom from interference with piping, conduit and equipment.
 - 5. Do not mount current-to-pressure transducers on the control valves unless the valve mounted transducers are received from the manufacturer or specific instructions to valve mount the transducers are given on the Drawings.
- G. Field Wiring
 - 1. Install all wiring without splicing in raceways.
 - 2. Size raceways per the requirements of NEC.
- H. Connect surge arresters to ground.
- I. Panel Installation
 - 1. Anchor wall mounted panels rigidly into wall system with approved anchorage devices.
 - 2. Assure each panel-mounted device is bonded or otherwise grounded to panel or panel grounding system by means of locknuts or pressure mounting methods.

3.3 TESTING AND CALIBRATION

- A. General
 - 1. After all equipment is installed, provide and pay for the services of a factory trained technician to adjust all instruments. Demonstrate to the Engineer that all equipment is functioning properly and that each device will accurately measure and record each variable over the full span of the instrument.
 - 2. Provide to the City of Farmersville all additional piping, devices, and equipment necessary for this calibration. For some devices it will be necessary to artificially control the variable being measured, in order to calibrate the instruments across the entire span.
 - 3. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.
 - 4. Field Calibration of the Elevated Tank Level Transmitter

The technician shall connect a hose to the existing tap on the tank riser to provide measured head to calibrate the instrument. The hose shall be extended up the shaft of the tank a measured distance and filled with water. The instrument reading shall be adjusted to indicate the same reading as measured along the hose. The level gage shall be calibrated to provide the specified accuracy at three points; tank full, tank half full and tank empty.

B. Loop Checkout

1. Check control signal generation, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal in the loop at the instrument connections. Use actual signals where available. Closely observe controllers, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components. Make corrections as required.
2. Following any corrections, retest the loop as before. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
3. Check all interlocks to the maximum extent possible.
4. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the City of Farmersville.

C. Provide verification of system assembly, power, ground, and I/O tests.

D. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

E. During the demonstration period, observe each signal circuit for the existence of electrical noise. Utilize noise suppression techniques given in Section 6.5, "Suppressive Techniques, of IEEE 518 for all circuits for which electrical noise introduces an error greater than the instrumentation accuracy.

END OF SECTION

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SECTION 1013 SCADA-READY CONTROLS SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. CITY OF FARMERSVILLE contemplates the installation of a global SCADA system in its operation and has indicated that the control equipment to be installed in the work herein specified to be SCADA-READY in order to integrate seamlessly into a system-wide SCADA system at an undetermined future date. The scope of work contemplated under this specification includes:
 - 1. Remote Terminal Unit w/Operator Interface Terminal installed at the "enter location" Site.
 - 2. A Remote Terminal Unit w/Operator Interface Terminal installed at the "enter location" Site.
- B. A single pre-approved SCADA Vendor (VENDOR) shall furnish all services and equipment defined herein and in other Specification Sections as required to provide for a SCADA-READY System.

1.2 QUALIFICATIONS OF VENDORS

- A. The VENDOR shall provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system. The VENDOR shall design and coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these Specifications and with related existing equipment.
- B. In order to ensure a complete and successful project, the SCADA VENDOR must demonstrate a history of successful references and financial stability, and five years of sustained business activity in the SCADA industry serving water and wastewater utilities in Texas.
- C. In order to ensure quality control and compatibility with existing operations, the individual integrator(s) to complete the work must be specified in the proposal and their experience must be acceptable, without limitation, in the following areas:
List specific qualifications including:
 - 1. Integration experience with radio telemetry and at least ten projects of successful reference within the State of Texas.
 - 2. Integration experience of water utilities serving similar geographical or county-wide areas of at least ten projects of successful reference for radio telemetry SCADA with the State of Texas.
- D. In order to ensure adequate response to emergencies and service needs, the VENDOR must have a service facility within a 250 mile radius of the City of Farmersville office.
- E. The following SCADA Equipment Specifications will be required as presented. See Section on "Substitute Equipment."
- F. The VENDOR shall provide a warranty and non-warranty technical support. The VENDOR must demonstrate a history of providing excellent follow-up support of constructed systems well beyond the warranty period.
- G. The VENDOR shall be a "systems house" regularly engaged in the design and the installation of computer systems and their associated subsystems as they are applied to the retail public water utility industry.
- H. The VENDOR shall maintain a fully equipped office/production facility with full-time employees capable of fabricating, configuring, installing, calibrating, troubleshooting, and testing the system specified herein. The VENDOR shall be required to provide a reference list of a minimum of five (5) years recent, past experience in the design, assembly, and commissioning of instrumentation and control systems of comparable size, type, and complexity to the proposed project. The VENDOR shall be required to have his/her own in-house capability to handle complete system engineering, fabrication, and testing.
- I. The VENDOR shall indicate that he/she has in his/her employ capable personnel for detailed

engineering, coordination, drafting, procurement and expediting, scheduling, constructing, testing, inspection, installation, training, and start-up service for calibration and commissioning and warranty compliance for the period specified.

1.3 SUBMITTALS

- A. The General Contractor must name his/her proposed SCADA VENDOR on the bid document. Only approved suppliers will be accepted. The VENDOR shall be one of the following:
 1. TraC~n~trol, Inc.
PO Box 5056
Georgetown, TX 78627
(512) 930-5721
Larry Brown
 2. Approved Equal - All approved equals shall be listed by addendum following pre-qualification under this section.
- B. Listed VENDORS shall not be required to submit a qualification proposal. VENDORS interested in being listed as an equal shall submit three copies of a qualifications proposal to the ENGINEER no later than four days before the bid opening date. A list of approved equals will be issued no later than two days before the bid opening date.
 1. The qualifications proposal shall provide details and a description of how the VENDOR proposes to fulfill the requirements set forth in this Specification. The VENDOR shall also be capable of satisfying the CITY OF FARMERSVILLE's future needs with regard to a fully functional SCADA System. The VENDOR shall present the proposal in sufficient detail so that proper evaluation regarding the experience and capabilities of the VENDOR can be performed.
 2. The proposal shall contain evidence that the VENDOR has sufficient financial resources to meet the obligations incidental to the performance of the work including bonding. (This requirement may be provided in the form of a verifiable or certified financial report for the company's latest fiscal year).
 3. The proposal shall contain a list of personnel available for assignment to the responsible positions of Project Manager, Project Engineer, Lead Programmer, Installation Supervisor, and Area Service Representative. Also, include a concise resume of each individual's education, training, work experience, and accomplishments.
 4. The proposal shall contain the following specific information:
 - a. Location of service center in relation to the CITY OF FARMERSVILLE's office.
 - b. Technical validation samples of recently completed and similar scope projects.
 - c. A description of how the supplier plans to execute the various functions and locations where the various work can be performed, including existing locations to integrated into the future projects as designated by the CITY OF FARMERSVILLE.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. To facilitate the CITY OF FARMERSVILLE's future construction, operation, and maintenance, products shall be by the same major instrumentation and SCADA equipment manufacturer, with panel mounted devices of the same type and model as far as possible.
- B. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner such that the monitoring and control functions are available when the equipment is ready to be placed into service.
- C. The VENDOR will specify equipment, sizes and quantities which are proposed to be used for the project. All equipment specified shall be non-proprietary and universally available to all vendors. All computer and computer related equipment shall be compliant for date-based functionality. A compliance certificate shall be required from the VENDOR stating compliance



with these requirements.

- D. The SCADA-READY system shall be a micro-processor based monitoring and control system consisting of "enter number" Remote Terminal Units (RTU) via radio telemetry. The proposed "enter location" Site RTU shall be constructed to communicate with other future RTU's for the purpose of meeting regional or pressure-plane-specific requirements as the CITY OF FARMERSVILLE implements a fully functional SCADA system (not a part of this project). Each monitoring and control site (current and future) at which commands will be executed shall be locally controlled with a Programmable Logic Controller (PLC). The SCADA system shall be fully expandable to meet future needs without loss of investment in equipment to be installed under this proposal. The RTU shall be supplied with required peripherals in order to meet SCADA requirements. The SCADA system shall be fully expandable to meet future needs without loss of investment in equipment to be installed under this proposal. The RTU's and Operator Interface Terminal's (OIT) shall be supplied with required peripherals in order to meet SCADA requirements.
- E. The "enter location" shall be controlled by an on-site SCADA-Ready Controller (RTU). The controller shall execute commands via Programmable Logic Controller (PLC). The controller specified for this project shall receive analog and digital inputs and provide discrete outputs for "enter location" (e.g. booster pump motor on/off control, tank level maintenance via pressure/level transmitter to be provided with the controller, and disinfection system activation/deactivation upon open/close of ground storage tank fill valve). The controllers shall have a panel mounted operator interface terminals (Maple Systems 3165A or equal) for on-site tank level adjustments. Data shall be reported to the RTU's via radio frequency from radio modem (MDS 4710A or equal). An alarm dialer shall be installed at the office/elevated tank location for reporting of abnormal tank level conditions and loss of site power via dial-out alarming. Telephone service shall be provided by CITY OF FARMERSVILLE. The controller shall be housed in a 24x24x08" NEMA-12 steel painted enclosure, contain all required power supplies, relays, surge protection and auxiliary equipment to make the controller fully functional under this specification.

2.2 SYSTEM EQUIPMENT SPECIFICATIONS:

- A. Remote Terminal Unit (RTU): The RTU is the PLC-based controller installed at "enter location(s)" Site for the control of the plant equipment and monitoring of operating parameters of each site. Each RTU shall contain a PLC, Panel-mounted Operator Interface Terminal, Power Supplies, Relays, Wiring, Conduit, Antenna, Cabling, Power/Surge Suppression Protection, and NEMA 4 rated Enclosures. The RTU shall be configured to be fully functional with the future SCADA system contemplated by the CITY OF FARMERSVILLE. Alarm dialer shall be a Zetron Sentridial 1512 or approved equal. The controller specified for this project shall be a Model TNT-SR-2A by TraC-n-trol, Inc. (Contact Larry Brown, 512-930-5721), Or Approved Equal.
- B. Radio Frequency: The radio communication shall be via UHF radio frequency for data communications, licensed in the name of the "enter customer name" . Initial licensing shall be the responsibility of the VENDOR. Renewal licensing shall be the responsibility of the CITY OF FARMERSVILLE. VENDOR shall be required to submit an approved path study for the RF conditions.
- C. Warranty and Technical Support: VENDOR shall provide a one-year parts and labor warranty.

2.3 SUBSTITUTE EQUIPMENT

- A. VENDOR shall recognize that the CITY OF FARMERSVILLE has determined that the material and equipment specified in this specification is best suited to fulfill the design requirements for this project. The VENDOR's price shall include all items as specified and shall be detailed on all engineering drawings.
- B. Some equipment and materials are not identical and cannot be offered interchangeably for the same function price. Also, there may be equipment or materials available that are well or better



suited for the intended application than those specified.

- C. The VENDOR must base its lump sum bid on the equipment listed in these specifications. If the VENDOR desires to supply alternative equipment, he must clearly indicate the substitute manufacturer in the proposal in clear and concise terms, and include the change in price of the substitute bid item. In order for the CITY OF FARMERSVILLE to determine if the proposed equipment is a satisfactory alternative to the equipment specified, the following items should be submitted with the proposal for the substitute equipment proposed:
- a. One set of drawings and specifications
 - b. Full descriptive material list
 - c. List of installations with five years of operation of such equipment
 - d. VENDOR's assessment of construction changes resulting from substitution

PART 3 – EXECUTION

- A. After the "enter project name" Contract is awarded, the CITY OF FARMERSVILLE shall review any substitute equipment offered by the successful VENDOR. If any substitute equipment is selected, the amount of the contract shall be altered by change-order to reflect any additive or deductive costs as shown on the substitute equipment proposal.

END OF SECTION

SECTION 1014 STANDBY GENERATOR SET

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install standby generator sets as shown and herein specified.

1.2 RELATED WORK

- A. Concrete for equipment pad is as specified elsewhere in these Specifications.
- B. Automatic transfer switch if specified elsewhere in these Specifications.

1.3 SUBMIT

- A. Submit to the City of Farmersville, shop drawings and product data, for the following:
 - 1. Equipment outline drawings showing elevation and plan views, dimensions, weight, anchor details, and required operating clearances.
 - 2. Conduit entrance drawings.
 - 3. Product data sheets and catalog numbers for the engine. AC generator, battery charger, generator set control system, electronic governor system, control stations, meters, relays, pilot lights, circuit breaker, etc. List all options and accessories furnished specifically for this project.
 - 4. Provide control systems engineering showing inter-wiring and interlocking to remote mounted devices, control signals, remote alarms, etc. Show wire and terminal numbers. Indicate special identifications for electrical devices per drawings.
 - 5. Instruction and renewal parts books.
 - 6. Itemized list of spare parts furnished specifically for this project, including quantities, descriptions and part numbers.

1.4 REFERENCE STANDARDS

- A. Equipment shall conform to the following applicable standards:
 - 1. NFPA 110 for level 1 system.
 - 2. OSHA for rotating parts.
 - 3. NEMA MG1 temperature limits.
 - 4. UL508
 - 5. CSA282-M1989
 - 6. IEC 8528 part 4
 - 7. Mil—Std 461C part 9
 - 8. IEC Std 801.2, 801.3, 801.5
 - 9. IEEE587
 - 10. ASTM D2794-93
 - 11. ASTM D2247-92
 - 12. UL listing for fuel tanks

1.5 QUALITY ASSURANCE

- A. The standby generator set shall be the product of a manufacturer who shall also be the manufacturer of the engine and alternator supplied.
- B. All sections of the set shall have a UL label where an applicable standard exists.

1.6 OPERATING AND MAINTENANCE MANUALS

- A. Operating and maintenance manuals shall be furnished.
- B. The manuals shall be bound and shall also include:
 - 1. Automatic and manual startup and shutdown sequences.



1.7 MANUFACTURERS

- A. The standby generator set shall be of the following products or equal:
 - 1. Cummins/Onan
 - 2. Detroit Diesel
 - 3. Caterpillar

1.8 SPARE PARTS

- A. Provide the following spare parts in the quantities specified:
 - 1. 2 air cleaner elements of each type.
 - 2. 2 Fuses of each type.
 - 3. 2 Radiator hoses of each type.
 - 4. 2 Fuel filters of each type.
 - 5. 2 Oil filters of each type.
 - 6. 2 Belts of each type.

PART 2 - PRODUCTS

2.1 RATING

- A. Voltage: 480 volts, 3 phases, 4 wires, 60Hz.
- B. Power Standby, size as shown on the Drawings, at .8PF, based on site elevation of 500 feet and ambient temperatures up to 50 degrees C.

2.2 PERFORMANCE

- A. Voltage Regulation: Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
- B. Frequency Regulation: Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
- C. Load Pick Up: The diesel engine-generator set shall be capable of picking up the loads at each site in the steps shown, with starting and running voltage dips not exceeding 20% and frequency variation not less than $\pm 5\%$:
 - Step 1. First pump
 - Step 2. Second pump

2.3 ENGINE

- A. General: The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:
 - 1. Governor System: An electronic governor system shall provide automatic isochronous frequency regulation.
 - 2. Radiator and Cooling System: Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.
 - 3. Electric System: An electric starter(s) capable of three complete cranking cycles without overheating.
 - 4. Lubrication Oil Pump: Positive displacement, mechanical, full pressure, lubrication oil pump.

