DETAILED SPECIFICATIONS

SECTION 1: WELL HOUSE CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(2005) Building Code Requirements for Structural Concrete

AMERICAN FOREST AND PAPER ASSOCIATION (AFPA)

WCD1	(2001) National Design Specification for Wood Frame Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A615	(2006) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C94	(2006) Standard Specification for Ready-Mixed Concrete
ASTM C834	(2010) Standard Specification for Latex Sealants
ASTM C1186	(2008) Standard Specification for Flat Fiber-Cement Sheets
ASTM D312	(2006) Standard Specification for Asphalt Used In Roofing
ASTM E90	(2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E413	(2010) Classification for Rating Sound Insulation
ASTM E136	(2011) Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI / TP 1	(2007) National Design Standard for Metal Plate Connected Wood Truss Construction
ANSI / SDI 100	(Latest Edition) Specification for Steel Doors and Frames
ANSI A151.1	(Latest Edition) Performance Test for Steel Doors, Hinge, Lock, and Exit Device Reinforcing
ANSI A156.13	(2002) Standard for Mortise Locks and Latches

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C20	(2002) Structural Lumber - Fire-Retardant Treatment by Pressure Processes

THE SOCIETY FOR PROTECTIVE COATINGS

SSPC – SP3	Power Tool Cleaning

1.2 GENERAL

The Contractor shall provide all materials, labor, equipment and all other items necessary to construct the well house structures for Well #24 and Well #8 as indicated by the plans and described herein.

1.3 SUBMITTALS

Submit six (6) copies of the following in accordance with the requirements as set forth in Section 4 of the General Requirements.

1.3.1 Shop Drawings

- Manufactured Wood Trusses

1.3.2 Product Data

Manufacturer's descriptive and technical literature or catalog cuts for the following:

- Wall Panels, Ceiling Panels, Facia and Moulding
- Fasteners

- OSB Panels
- Insulation
- Shingles
- Skylights
- Hollow Metal Doors and Hardware
- Paint and Caulking Materials

1.3.3 Test Reports

- Concrete Compressive Strength

1.3.4 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

- Concrete
- Lumber

1.4 DESIGN

1.4.1 Wood Trusses

Trusses shall be designed in accordance with these specifications and where any applicable design feature is not specified herein, design shall be in accordance with applicable provisions of latest edition of National Design Specifications for Wood Construction (NDS) American Forest and Paper Association (AFPA), and National Design Standard for Metal Plate Connected Wood truss Construction (ANSI/TPI 1), and code of jurisdiction.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify all dimensions in the field, and shall advise the Engineer of any discrepancy before performing the work.

1.6 DELIVERY AND STORAGE

Deliver materials in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact. Replace defective or damaged materials with new materials. Stack lumber and plywood to insure proper ventilation and drainage. Protect lumber and plywood from the elements.

PART 2 PRODUCTS

2.1 REINFORCED CONCRETE

Concrete for the foundation and slab shall conform to Tentative Specification for ready-mixed concrete ASTM C 94 and to ACI 318. Slump shall not be more than three inches. The concrete shall have minimum design strength of 4,000 psi.

2.1.1 Reinforcing Steel

Reinforcing steel shall conform to ASTM A-615, Grade 60.

2.2 MANUFACTURED WOOD TRUSSES

Trusses shall be fabricated in a properly equipped facility of a permanent nature. Trusses shall be fabricated by experienced workmen, using precision cutting, jigging, and pressing equipment meeting requirements of ANSI/TPI1-2002, Chapter 3. Truss members shall be accurately cut to length, angle and true to line to assure proper fitting joints within tolerances set forth in ANSI/TPI1-2002, Chapter 3 and proper fit with other work.

2.2.1 Lumber for Manufactured Wood Trusses

Lumber used for truss members shall be in accordance with published values of lumber rules writing agencies approved by board of review of American Lumber Standards Committee. Lumber shall be identified by grade mark of lumber inspection bureau or agency approved by that board, and shall be as shown on the design drawings. Moisture content of lumber shall be no less than 7 percent or greater than 19 percent at time of fabrication. Adjustment for values for duration of load or conditions of use shall be in accordance with National Design Specification for Wood Construction (NDS). Fire retardant treated lumber, if applicable, shall meet specifications of truss design and ANSI/TPI 1-2002, par 6.4.9.1 and shall be redried after treatment in accordance with AWPA Standard C20. Allowable values must be adjusted in accordance with NDS par 2.3.4. Lumber treater shall supply certificate of compliance.

2.2.2 Metal Connector Plates

Metal connector plates shall be not less than .036 inches in thickness (20 gage) and shall meet or exceed ASTM A653 grade 40, and shall be hot dipped galvanized according to ASTM A653, coating designation G60. Working stresses in steel are to be applied to effective ratios for plates as determined by test in accordance with Chapter 5 of ANSI/TPI1-2002. In highly corrosive environments, special applied coatings or stainless steel may be required.

2.3 WALL FRAMING

2.3.1 Lumber for Framing and Blocking

For framing lumber and blocking use ACQ pressure treated indigenous southern yellow pine harvested within 500 miles of the project location and graded in accordance with Southern Pine Associates and dressed four sides. Lumber shall be sound, thoroughly seasoned, well manufactured and free from warp which cannot be corrected in process of bridging or nailing. Moisture content shall not exceed 19% for framing lumber.

2.3.2 Hardware

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated.

2.4 EXTERIOR & INTERIOR VERTICAL WALL PANELS, CEILING PANELS, FACIA, AND MOULDING

Exterior vertical wall panels, facia, and moulding shall be non-asbestos flat fiber cement conforming to ASTM C1186, Grade II, Type A. Dimensions for wall panels, facia, and moulding shall be as indicated. Exterior wall panels, facia, and moulding All materials shall be shop primed shall be non-combustible when tested in accordance with ASTM test method E136. Exterior and interior vertical wall panels shall be Sierra 8” Vertical Siding Panel by James Hardie Building Products or equal. Interior vertical wall panels may alternately be HardieSoffit panels by James Hardie Building products or equal. Ceiling panels shall be HardieSoffit panels by James Hardie Building products or equal.

2.4.1 Fasteners

Exterior fasteners shall be wood framing corrosion resistant siding nails according to panel manufacturer’s recommendations.

2.5 INSULATION

Insulate areas of building as indicated. Insulate over all heated spaces in building. Insulation shall be Batt type complying with Federal Specification H-1-521C, Type 1, Class A. Provide 4” thick insulation between studs of all exterior walls. Provide 6” thick insulations between or over ceiling joists or rafters of all areas of the building.

2.6 ROOFING

2.6.1 Roof Sheathing

Roof Sheathing shall be ½" OSB Panels.

2.6.2 Underlayment

Underlayment shall be one layer of 15 lb. asphalt saturated (inorganic) felt mopped on with steep asphalt ASTM D312, Type III for sloping roof. Fasteners shall be of sufficient length and holding power as required for proper securing of the material.

2.6.3 Asphalt Shingles

Self-sealing shingles shall be Oakridge as manufactured by Owens Corning or equal. Color shall be Chateau Green.

2.6.4 Skylights

Skylight dimensions shall be as indicated. The skylights shall a factory-assembled, self flashed unit built using a one-piece aluminum curb with three seamless vertical corners providing a leak-proof design. It shall include a polyisocyanurate insulated curb, fire rated for safety, complete with a full polyurethane thermal break and weep system to minimize condensation. The skylight shall be double domed with clear acrylic over clear acrylic. The skylight shall be an acrylic domed skylight, VELUX model CAP, manufactured by VELUX America, or equal.

2.7 HOLLOW METAL DOORS

Door type and dimensions shall be as indicated. ANSI SDI-100-85, Grade I, Model 1. Door shall be 1-3/4" thick full flush type. Door panels shall be nominal 20 gauge galvanized steel welded to nominal 16 gauge flush mounted end channels. Door leaf core shall be resin impregnated honeycomb laminated to the door panels. Calculated "U" value shall be 0.41 (R=2.4) and sound transmission shall be STC 30 per ASTM E90-70 and E 413-73 tests. Door frames shall be 4-3/4" deep double rabbeted type of nominal 16 gauge galvanized steel. Door frames shall be attached to the floor with clip angles. Jambs shall have welded brackets for attachment of jambs to the building wall systems. Door and frames shall be painted with one coat of white baked on primer. All doors shall be provided "assembled in their frames with all hardware, except door knobs, installed on the door leaf". Standard door hardware shall consist of Mortise Cylinder Lockset per ANSI A156.13, Series 100 Grade 1, Function F13, 626 satin chrome finish. 4-1/2" x 4-1/2", STD. WT., plain bearing, hinges per ANSI A 5133, 630 satin stainless steel finish with nonrising pins (3 per leaf). 3-11/16" wide x 5/8" high extruded aluminum threshold with vinyl weatherstripping and ¼" x ½" silicon rubber weatherstripping. Door shall be factor glazed with ¼" acrylic.

2.8 PAINT MATERIALS

Paints shall be of type and brands specified in Part 3 under "Painting". Painting materials shall be of highest quality and have identifying labels on containers. All paint shall be delivered on the site in manufacturer's sealed containers. Each container shall be labeled by the manufacturer's label shall give manufacturer's name, type of paint, color of paint, and instructions for reducing. Thinning shall be done in accordance with directions of manufacturer. Job mixing or job tinting may be done when approved by the Engineer. Paints manufactured by Sherwin-Williams, Tnemec, Carboline, Induron or equal shall be the basis for submitting painting bid.

2.8.1 Latex Joint Sealant

Latex joint sealant shall comply with ASTM C834.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

Excavation of footings shall be in properly compacted soil. Where improper soil conditions are encountered for proper soil bearing of footings, the earth shall be excavated to a point where, in the opinion of the Engineers, the soil is determined to be satisfactory and the difference in elevations between that shown on the drawings and the elevation required to obtain satisfactory soil bearing shall be filled with 2,500 psi concrete. Footings only may be poured in unformed excavations provided the excavation is made to establish a neat and true section to form the footing. Backfill required to establish subgrade for support of concrete slabs or other construction bearing on soil shall be compacted mechanically in layers not to exceed 6 inches in thickness of select material of proper moisture content to equal 95% compaction.

3.2 CONCRETE PLACEMENT

Place a vapor barrier with joints lapped six inches under floor slabs. Care shall be used to prevent injury to the vapor barrier membrane before and during placing of concrete. The concrete floors and flat slabs where required shall be machine finished with steel trowel type blade and shall be worked to a slick finish. Areas not accessible to the machine shall be hand finished to match the machine finish. A liquid curing and sealing compound shall be applied in strict accordance with the directions of the Engineers. No concrete shall be poured when the temperature is below 40 degrees and falling or freezing weather is predicted within 24 hours without approval of the Engineers. All necessary openings, inserts, anchor bolts, reglets, trim shapes, shall be complete and inspected and all forms inspected including reinforcing steel and wire mesh prior to placing concrete.

3.3 MANUFACTURED TRUSS INSTALLATION

Trusses shall be handled during fabrication, delivery, and at job site so as not to be subjected to excessive bending. Trusses shall be unloaded on smooth ground to avoid lateral strain. Trusses shall be protected from damage that might result from onsite activities and environmental conditions. Prevent toppling when banding is removed. Handle during installation in accordance with Handling, Installing, and Bracing Wood Trusses (HIB-91), TPI, and ANSI/TPI1-2002. Installation shall be consistent with good workmanship and good building practices and shall be responsibility of truss installer. Apparent damage to trusses, if any, shall be reported to Fabricator prior to installation. Trusses shall be set and secured level and plumb, and in correct location. Trusses shall be held in correct alignment until specified permanent bracing is installed. Cutting and altering of trusses is not permitted. Concentrated loads shall not be placed atop trusses until all specified bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of decking or other heavy materials onto unsheathed trusses. Erection bracing is always required. Professional advice should always be sought to prevent toppling or dominoing of trusses during installation. The Contractor is responsible for obtaining and furnishing the materials used for installation and permanent bracing.

3.4 ROUGH CARPENTRY

Conform to AFPA WCD1 unless otherwise indicated or specified. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICBO UBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings. Walls shall be braced with 1 by 4 diagonal bracing at each corner or by the use of diagonal metal bracing straps. Metal in contact with ACQ lumber must be approved for such use.

3.5 VERTICAL WALL PANEL INSTALLATION

Block framing between studs where siding horizontal joints occur. Place fasteners no closer than 3/8 inch from panel edges and 2 inch from panel corners. Allow minimum 1 inch vertical clearance between roofing and bottom edge of siding. Maintain clearance between siding and adjacent finished grade.

3.6 FACIA AND MOULDING INSTALLATION

Install flashing around all wall openings. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum ¾ inch or full thickness of sheathing. Additional fasteners may be required to ensure adequate security. Place fasteners no closer than ¾ inch and no further than 2 inch from side edge of trim board and no closer than 1 inch from end. Fasten maximum 16 inch on center. Maintain clearance between trim and adjacent finished grade. Trim inside corner with single board. Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten board to board. Allow 1/8 inch gap between trim and siding. Seal gap with high quality, paint-able caulk. Shim frieze board as required to align with corner trim. Install fascia over structural subfascia.

3.7 INSULATION

Obtain complete coverage and tight seal for weather tightness by bedding on sole plate and top bearing plates and around plates of all windows and door framing.

3.8 ROOFING

Roofer shall install roof over a thoroughly smooth clean, dry and firm surface with all vent stacks, other penetrations in place. The roofer is to notify the Engineer in writing if there are any defects. Installation of underlayment, shingles flashings, and other accessories shall be in accordance with instructions published by the manufacturer and printed on back of every shingle bundle.

3.9 HOLLOW METAL DOORS

Prior to installation, the area of floor on which the frame is to be installed, and within the path of door swing, shall be checked for flatness. remove temporary spreaders. Doors and frame product shall be checked for correct size, swing, fire-rating, and opening number. During the setting of the frame product check and correct as necessary for opening width, opening height, squareness, alignment, twist and plumbness. Installation tolerances shall be maintained within manufacturer’s limits.

3.10 PAINTING

All painting shall be done strictly in accordance with the manufacturer's instructions and in a manner satisfactory to the Engineer. Each coat shall be allowed to dry thoroughly before the next coat is applied. Paint shall not be applied during wet or foggy weather or when the air temperature is below 50 degrees Fahrenheit or less than five points above the dew point. No paint shall be applied when the temperature of the surface to be painted is below 45 degrees F. Paint shall not be applied to wet or damp surfaces, and shall not be applied in rain, snow, fog or mist. Paint shall not be applied when the relative humidity exceeds 85%. No paint shall be applied when it is expected that the relative humidity will exceed 85% or that the air temperature will drop

below 40 degrees F. within 18 hours after the application of the paint. Dew or moisture condensation should be anticipated, and if such conditions are prevalent, painting shall be delayed until mid-morning to be certain that the surfaces are dry. Further, the day's painting should be completed well in advance of the probable time when condensation will occur, in order to permit the film an appreciable drying time prior to the formation of moisture.

3.10.1 Exterior Wall Panels, Facia and Moulding

Remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defecting coatings from factory primed surfaces. Allow surface to dry thorougly. Spray, brush or roll two complete coats of 100% acrylic latex at a wet film thickness of four (4) mils.

Sherwin Williams A-100 Exterior Latex

3.10.2 Metal Doors

Remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defecting coatings from factory primed surfaces. Clean and patch prime with identical material any scratched or abraded areas. Brush and roll all primed metal doors with two (2) complete finish coats of high gloss industrial alkyd enamel to a minimum dry film thickness of 2.0 t 3.0 mils per coat (4.0 to 6.0 mils total).

Tnemec Series 2H Hi-Build Tneme-Gloss (color selected by Owner).

3.10.3 Ductile Iron Piping and Valves

Interior ductile iron pipe painting shall occur prior to installation of electrical work of piping appurtenances (tapping saddles, etc.) All piping and valves shall have rusted and abraded areas cleaned by the use of power assisted hand tools as outlined in SSPC-SP3 Power Tool Cleaning. Spray, brush or roll all piping with one (1) complete coat of high-build epoxy to a minimum dry film thickness of 4-5 mils. Allow a minimum of 24 hours drying and solvent release time prior to top coating. Brush and roll all piping and valve surfaces with one (1) complete finish coat of Aliphatic Acrylic Polyurethane to a minimum dry film thickness of 2-3 mils.

TNEMEC Series 104 H.S. Epoxy
TNEMEC Series 73 Endura-Shield (Color Selected by Owner)

PART 4 PAYMENT PROCEDURES

See Section 3 of the General Requirements for Payment Procedure requirements.

PART 5 WARRANTY

The Contractor shall guarantee the work provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. All guarantees for materials, equipment and accessories provided under this section shall be obtained by the Contractor and submitted.

-- End of Section --

DETAILED SPECIFICATIONS

SECTION 2: WATER DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.5	(2009) Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A48	(1994) Standard Specification for Grey Iron Castings
ASTM A47	(1990) Ferritic Malleable Iron Castings
ASTM A126	(1995) Standard Specification for Grey Iron Castings for Valves, Flanges and Pipe Fittings
ASTM A276	(2003) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A536	(1984; R 1993) Ductile Iron Castings
ASTM A563	(1994) Carbon and Alloy Steel Nuts
ASTM B88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM C94	(1994) Ready-Mixed Concrete

ASTM D429	(1999) Standard Specification for Rubber-Property Adhesion to Rigid Substrates
ASTM D1784	(2003) Standard Specification for Rigid PVC Compounds and Chlorinated CPVC Compounds
ASTM D2000	(2005) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2241	(2004) Standard Specification for PVC Pressure-Rated Pipe (SDR Series)
ASTM D3139	(2005) Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3261	(2003) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	(2004) Standard Specification for Polyethylene Plastic Pipe and Fittings Material

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C104/A21.4	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1990; Erratum 1991) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C151/A21.51	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C207	(2001) Steel Pipe Flanges for Waterworks Service
AWWA C502	(1994) Dry-Barrel Fire Hydrants

AWWA C504	(2000) Rubber Sealed Butterfly Valves
AWWA C508	(1993) Swing-Check Valves for Waterworks Service, 2 in. (50 mm) Through 24 in. (600 mm) NPS
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C512	(2001) Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
AWWA C515	(2001) Reduced Wall, Resilient Seated Gate Valves for Waterworks Service
AWWA C550	(2001) Protective Epoxy Coatings for Valves and Hydrants
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(1994) Installation of PVC Pressure Pipe and Fittings for Water
AWWA C651	(1992) Disinfecting Water Mains
AWWA C900	(1997) PVC Pressure Pipe and Fittings, 4" through 12", for Water Distribution
AWWA C901	(2008) Polyethylene Service Pipe and Tubing
AWWA C906	(1999) Polyethylene Pressure Pipe and Fittings, 4" through 63", for Water Distribution and Transmission

NATIONAL SANITATION FOUNDATION

NSF 61	(2003) Drinking Water System, Health Effects

NCAC, TITLE 15A, DENR SUBCHAPTER 18C, WATER SUPPLIES

Par. .0906	Relation of Water Mains to Sewers
Par. .1003	Disinfection of Storage Tanks and Distribution Systems

THE SOCIETY FOR PROTECTIVE COATINGS

SSPC – SP10	Near-White Blast Cleaning

UNDERWRITERS LABORATORIES INC. (UL)

UL 312	(2004) Standards for Check Valves for Fire Protection Service
UL 789	(1993; R 1994) Indicator Posts for Fire-Protection Service

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

The Contractor shall furnish all types of pipe and other incidentals required for the construction of a complete water system as shown on the drawings and as specified herein. Unless otherwise noted, the materials listed below are acceptable to the Owner for use in water distribution systems. Should the Contractor desire to use other materials not listed in these specifications, written permission must be obtained from the Owner's Engineer. All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purposes specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail. New water mains shall be 4-inch Ductile Iron. Connect to existing water mains as indicated. Provide water main accessories, gate valves, fire hydrants, meters, combination air valves, service laterals as specified and where indicated.

1.2.2 Scope of Work

Performance of this contract shall consist of Ductile Iron underground raw water main construction and Ductile Iron above ground well house piping construction including meters, valves, chemical feed system, etc. for Well #24 and Well #8. Piping through the proposed well houses shall be 4” Ductile Iron. Underground Ductile Iron piping shall be push-on joint. Ductile Iron piping inside the well house shall be flanged joint. All Ductile Iron Pipe and fittings including flanged pipe shall be Protecto-401 Lined.

1.3 SUBMITTALS

Submit six (6) copies of the following in accordance with the requirements as set forth in Section 4 of the General Requirements.

1.3.1 Product Data

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

A. Water distribution main piping, fittings, joints, valves, valve boxes and couplings.

B. Water Meter

1.3.2 Instructions

A. Installation procedures for water piping.

1.3.3 Certificates

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

A. Water distribution main piping, fittings, joints, valves, and couplings.

B. Shop-applied lining and coating

C. Water Meter

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench. Store plastic piping, jointing materials and rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Polyvinyl Chloride Pipe (PVC)

2.1.1.1 Dimension Ratio 18

PVC pipe shall conform to AWWA C900 for polyvinyl chloride pressure pipe sizes 4 inch through 12 inch. Class 150, DR 18 pipe or as called for on the plans or in the schedule bid items shall be furnished. The pipe shall be plainly marked with the following information: manufacturer's name, size, material

(PVC) type and grade or compound, NSF seal, pressure class and reference to appropriate product standards. Pipe shall be furnished in 20 ft. laying lengths. Random lengths shall be a minimum of 10 feet long and shall comprise no more than 15 percent of the length of the piping system. Pipe shall be furnished in factory-packaged units. Pipe shall be furnished in cast iron pipe equivalent outside diameters with rubber-gasketed separate couplings or push-on joints. Pipe shall not fail when subjected to the following tests; (1) sustained pressure (2) burst pressure (3) flattening and extrusion quality. Tests shall be conducted as outlined in AWWA C900. Each length of PVC pipe shall pass a hydrostatic integrity test at the factory of 4 times the pressure class of the pipe for 5 seconds. PVC Resin shall meet the requirements of ASTM D1784.

2.1.1.2 PVC Pipe Joints

Joints for pipe shall be push-on joints unless otherwise indicated. Joints at fittings shall be mechanical joints made with ductile iron fittings unless otherwise indicated. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint, subject to the limitations specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

2.1.2 Ductile Iron Pipe

Ductile-Iron Pipe, except flanged pipe, shall conform to ANSI/AWWA C151/A21.51, NSF 61 certified, Pressure Class 350 for pipe 12” diameter and smaller. All larger pipe shall be Pressure Class 350. Flanged pipe, AWWA C115/A21.15. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness. Ductile iron shall conform to ASTM A536, latest revision, Grade 70-50-05.

2.1.2.1 Ductile Iron Pipe and Fittings with PROTECTO 401 Ceramic Epoxy Lining

Ductile-Iron Pipe and fittings shall be supplied with a ceramic epoxy lining where called for on the plans and in the Schedule of Bid Items. The standard of quality is PROTECTO 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.

A. Applicator: The lining shall be applied by a certified firm with a successful history of applying linings to the interior of Ductile Iron pipe and fittings. All Ductile Iron pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface.

B. Surface Preparation and Lining: After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive material. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be reblasted. After surface preparation, the interior of the pipe and fittings shall receive 40 mils nominal dry film

thickness of PROTECTO 401. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

1. Bells and Spigots: Due to the tolerances involved, bell interior and spigot exterior up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum PROTECTO Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the linings.

2. Number of Coats: The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

C. Touch Up and Repair: PROTECTO Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

D. Inspection: All Ductile Iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC PA-2 Film Thickness Rating. The interior lining of all pipe and barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defects found shall be repaired prior to shipment. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

E. Certification and Handling: The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification and that the material used was as specified. PROTECTO 401 Lined Pipe and Fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

2.1.2.2 Ductile Iron Pipe Joints

Joints for pipe shall be push-on joints unless otherwise indicated. Joints at fittings shall be mechanical joints made with ductile iron fittings unless otherwise indicated. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint, subject to the limitations specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

A. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

1. Restrained Push-On Joints: Restrained push-on joints for pipe where indicated shall be designed for a working pressure of 350 psi for 4”-24” pipe. Restrained push-on joints shall be capable of being deflected a minimum of 4 degrees after assembly for pipe through 12” and 3 degrees for pipe 14” – 24”. Restrained push-on joints shall be manufactured, not by specialized gripping segment gasket installation.

B. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

1. Restrained Flexible Bolted Joints: Restrained mechanical joint pipe (and connections to MJ fittings and valves) shall utilize a flexible bolted joint designed for a working pressure of 350 psi for 4” –24” pipe. Restrained flexible bolted joints shall be capable of being deflected a minimum of 4 degrees for pipe through 12”, 3 degrees for 14” and 16” pipe, 2.5 degrees for 18” and 20” pipe and 2 degrees for pipe 24” through 36”.

C. Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A536, Grade 65-45-12, and conform to the applicable requirements of ASME/ANSI B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000-psi tensile strength, heat treated and zinc-coated steel. Gasket for setscrewed flanges shall conform to applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

D. Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

2.1.3 High-Density Polyethylene Pipe and Fittings.

HDPE pipe and fittings shall conform to AWWA C906 for polyethylene pressure pipe and fittings 4” through 63”. HDPE pipe shall be manufactured from resin with a cell classification of PE 345464C according to ASTM D 3350. Pipe will be legibly marked at intervals of no more than five feet with the manufacturer’s name, trademark, pipe size, HDPE cell classification, appropriate legend (DR #, ASTM and AWWA Standards and NSF seal), date of manufacture and point of origin. Pipe not marked as indicated above will be rejected. The material used in the production of potable water pipe shall be approved by the National Sanitation Foundation (NSF).

2.1.3.1 HDPE Pipe Joints

Butt fusion or Electrofusion welded in accordance with ASTM D3261.

2.1.4 Ductile Iron Pipe Fittings for Ductile Iron and PVC Pipe

Ductile iron fittings shall conform to AWWA C-110, latest revision with the exception of the manufacturer's design dimensions and thickness. Fittings shall have a working pressure rating of 350 psi for fittings, 12 inch and under and 250 psi for fittings over 12 inch. Ductile iron shall conform to ASTM A536, latest revision, Grade 70-50-05. Nominal thickness of the fittings shall be equal to Class 51 ductile iron pipe as specified in AWWA C151. Fittings shall have a cement mortar lining and seal coating conforming to AWWA C104, latest revision. Fittings shall have an outside coating of bituminous material in accordance with the manufacturer's specifications. The final coat shall be continuous and smooth being neither brittle when subjected to low temperatures nor sticky when exposed to hot sun. The coating shall strongly adhere to the pipe at all temperatures. Fittings shall have mechanical or flanged joints as indicated and specified herein.

2.1.4.1 Mechanical Joint Fittings

ANSI Specification AWWA C111, latest revision, for three inch pipe and larger. Bolted mechanical joint fittings shall be used with ductile iron pipe, PVC pipe, and where specifically called for on the plans or in the Schedule of Bid Items.

A. Restrained Flexible Bolted Joint (DIP only): Restrained MJ fittings shall be designed for a working pressure of 350 psi for 4"-24" ductile iron pipe. Fittings such as these shall be part of a manufactured flexible bolted pipe restraint system as described above for MJ ductile iron pipe.

B. Megalug Restraint for MJ Fittings (DI or PVC Pipe): Mega Lugs may be used for restraint of mechanical joint fittings. The restraint mechanism shall consist of a plurality of individually actuated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536. The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell. Twist off nuts, sized the same as tee-head bolts shall be used to insure proper actuating of restraining devices. The restraining glands shall have a pressure rating equal to that of the pipe on which it is used. When mechanical thrust restraints are used concrete thrust blocking shall be deleted from the installation.

2.1.4.2 Flanged Joint Fittings

Flanged fittings shall be constructed of ductile iron with flanges drilled and faced per ANSI B 16.1 for both 125 Lb. working pressure.

2.1.5 Valves, Hydrants, and Other Water Main Accessories

2.1.5.1 Resilient-Seated Gate Valves for Buried Piping

Resilient-Seated Gate Valves for buried piping shall conform to AWWA C509 or AWWA C515 unless otherwise specified and shall be NSF 61 certified. 24" valves shall have bevel gearing for horizontal installation. Valves smaller than 24" shall be configured for vertical installation. Valves shall be

nonrising stem type with mechanical-joint ends and shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals, except for those valves for which gearing is specified, in which case use conventional packing in place of o-ring seal. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. The wedge shall be cast iron, completely encapsulated with resilient material. The resilient sealing material shall be permanently bonded to the cast iron wedge with a rubber-tearing bond to meet ASTM D429. The gate valve stem and stem nut shall be copper alloy. The body and bonnet shall be coated both interior and exterior with a fusion bonded heat cured thermo setting material meeting all application and performance requirements of AWWA C550. The minimum design working pressure shall be 200 psi for valves up to 12" and 150 psi for valves larger than 12". Resilient seated gate valves shall be manufactured by Mueller, American Flow Control, M&H, or Kennedy. Valves up to 12" shall be of one manufacturer.

2.1.5.2 Resilient-Seated Gate Valves in Valve Pit(s) and Aboveground Locations

Resilient-Seated Gate Valves for installation in vaults or above ground shall conform to AWWA C509 or AWWA C515 unless otherwise specified and shall be NSF 61 certified. Valves shall be nonrising stem type with flanged ends. Valves up to 12" shall be of one manufacturer.

2.1.5.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have ductile iron body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of 200 psi. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. Valves shall be weight-loaded where indicated. Valves shall be of one manufacturer.

2.1.5.4 Globe Style Silent Check Valves for Well House Piping

Two (2) 4" check valves shall be provided as part of the Well House piping as indicated. Check Valves shall be globe style silent. The valve body shall be ASTM A126. Valve plug and seat shall be 316 Stainless Steel. Valve spring shall be 302 Stainless Steel. O-Ring shall be Buna-N. Flanges shall be Class 125. Globe Style Silent Check Valve shall be Golden Anderson Model 280 or equal.

2.1.5.5 Butterfly Valves for Buried Piping (Larger than 12")

Butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504 for Class 150B service and shall be NSF 61 certified. Valve bodies shall be constructed of cast iron ASTM A126 Class B and conform to AWWA C504 for laying lengths and minimum body shell thickness. End connections shall be mechanical joint. Valve discs shall also be made from cast iron ASTM A126 Class B or ASTM A48 Class 40 in sizes 24" and smaller. Disc shall be furnished with 316 stainless steel seating edge to mate with the rubber seat on the body. Valve seat shall be Buna-N rubber located on the valve body. Valves 20" and smaller shall have bonded seats that meet test procedures outlined in ASTM D429 Method B. Sizes 24" and larger shall be retained in the valve body by mechanical means without use of metal retainers or other devices located in the flow stream. Valve shafts shall be 18-8 type 304 stainless steel conforming to ASTM A276. Shaft seals

shall be standard self-adjusting split V packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft. Valve bearing shall be sleeve type that is corrosion resistant and self-lubricating. Valve actuators shall be fully grease packed and have stops in the open/close position. The actuator shall have a mechanical stop which will withstand an input torque of 450 ft. lbs. against the stop. The traveling nut shall engage alignment grooves in the housing. The actuators shall have a built in packing leak bypass to eliminate possible packing leakage into the actuator housing. All internal and/or external surfaces shall be covered with a polyamide cured epoxy coating applied over a sand blasted "new white metal surface" per SSPC-SP10 to a minimum of 6 mils in compliance with AWWA C550. Butterfly valves shall be manufactured by Mueller, Pratt, Dezurik, Keystone or an approved equal.

2.1.5.6 Butterfly Valves for Well House Piping

Two (2) 4” check valves shall be provided as part of the Well House piping as indicated. Butterfly Valves shall be as specified in Par. 2.1.5.5 except that end connections shall be Class 125 flanged. Valves shall be equipped with handwheel actuator and valve position indicator. 4” Butterfly Valves shall be Mueller Lineseal III or equal.

2.1.5.7 Fire Hydrants

Dry-Barrel Fire hydrants shall be manufactured to meet or exceed AWWA C502. Fire hydrants shall be of the compression type with 4-1/2” valve opening designed to close against line pressure. Fire hydrants shall be furnished with a sealed oil or grease reservoir located in the bonnet, so that all threaded and bearing surfaces are automatically lubricated. Teflon washers shall be used for ease of operation. The seat ring shall be bronze and threaded into a drain ring located between the lower barrel and shoe. The hose and pumper nozzles shall be threaded or leaded-in. The threads for nozzles shall be National Standard. The hydrants shall have two (2) 2-1/2” hose nozzles with cap, and one (1) 4-1/2” pumper nozzle and cap. Hydrants shall have a minimum 36” bury and shall stand approximately 30” above ground elevation. Hydrants shall be designed with a breakaway feature that will break cleanly upon impact. This shall consist of a two-part breakable safety flange. The operating nut shall be 1-1/2” pentagonal and shall open counterclockwise. All hydrants shall be cast marked on the outside such that visible identification can be made as to type and design. All hydrants shall receive two (2) exterior shop coats of OSHA safety color “Red” with all caps in a high gloss enamel as specified by AWWA C502. In addition, one finish exterior coat, as described, shall be applied after construction operations are complete, as deemed necessary by the Engineer. The paint used shall be as manufactured by Kyanize, Tnemec, Carboline or equal. Fire Hydrants shall be Kennedy Guardian, M&H Model 129, or Mueller A421 Centurion.

2.1.5.8 Tapping Sleeves and Tapping Valves

A. Mechanical Joint Tapping Sleeves: Tapping sleeve to be manufactured from ductile iron meeting ASTM A536 Grade 65-45-12 (outlet sizes 14" and larger). Tapping Sleeves shall be NSF 61 certified. Side flange seals shall be of the O-ring type of either round, oval or rectangular cross-sectional shape. Tapping sleeve to be used in conjunction with a mating tapping valve from same manufacturer. Outlet flange of sleeve to be counterbored per MSS SP-60 for true alignment of tapping valve and tapping machine. Sizes of outlet to be available through equal

opening of sleeve diameters up to 24". All sleeves shall have a minimum of 150-psi working pressure. All taps shall be of 150 psi working pressure. All taps shall be machine drilled – no burned taps will be allowed. All sleeves are to include the end joint accessories and split glands necessary to assemble sleeve to pipe. MJ bolts and nuts are to conform to ANSI/AWWA C111/A21.11-95. No special tools other than standard socket wrench to be required for assembly of sleeve to main. Sleeve shall be coated with asphaltic varnish per Federal Specification TT-V-51, Military Specification MIL C-450, or equal. Mechanical Joint Tapping sleeves shall be manufactured by Mueller, M&H, American Flow Control or an approved equal.

B. Stainless Steel Fully Gasketed Wrap Around Tapping Sleeve: Tapping sleeve body, strap, flange, lifter bar studs, nuts and washers shall all be constructed of 18-8 Type 304 stainless steel. Welds shall be fully passivated. Nuts and washers shall be fluorocarbon coated. Outlet pipe shall be constructed of Schedule 5, 18-8 Type 304 stainless steel. Tapping Sleeve flange shall conform to AWWA C207 Class D-ANSI 150 lb. drilling. Boltholes shall straddle pipe centerline. Tapping sleeve shall be equipped with a ¾" brass test plug. The outlet gasket shall be gridded virgin Buna-N compounded for water service per ASTM D 2000. Tapping sleeve full gasket shall be gridded virgin SBR compounded for water service per ASTM D 2000 and shall give 360-degree pipe coverage. Tapping Sleeves shall be NSF 61 certified. Stainless Steel Tapping Sleeves 4" through 8" shall have a minimum 250-psi working pressure rating. Sleeves 10" to 24" shall have a minimum 200-psi working pressure rating. Stainless Steel Wrap Around Tapping Sleeves shall be manufactured by Ford, Mueller, or Romac.

C. Resilient Seated Tapping Valves: Tapping Valves shall be resilient-seated gate valves conforming to AWWA C509 and shall be NSF 61 certified. The body and bonnet shall be coated both interior and exterior with a fusion bonded heat cured thermo setting material meeting all application and performance requirements of AWWA C550. The minimum design working pressure shall be 200 psi for tapping valves up to 12" and 150 psi for valves larger than 12". Resilient seated gate valves shall be manufactured by Mueller, American Flow Control, M&H or an approved equal.

2.1.5.9 Combination Air Valves

Combination air release valves shall be installed at high points in the water main as indicated by the plans in order to release air in the main as the main is filling and allow air to enter the system when drowning or subject to negative pressure. The valve shall also release an accumulation of air when the system is under pressure. Combination air release valves shall be manufactured to meet or exceed the requirements of AWWA C512 or latest revision and shall be NSF 61 certified. The valve shall operate through a compound lever system that will seal both the pressure orifice and the air vacuum orifice simultaneously. This lever system shall permit a ¼" orifice to release an accumulation of air from the valve body at a capacity of 98 cfm of air and pressure of 150 psig. The function of the lever system shall also permit a positive disengagement of the main valve from the large orifice. As the float drops and pressure decreases, the disengagement shall be immediate and not be limited to the initial draw of a vacuum. The valves shall be 2" NPT screwed or ANSI Class 125 flanged inlet connection and shall be cast iron body, top and inlet flange (where required), stainless steel float and trim with Buna-n seat. Valves, which operate the pressure plunger via a single lever and fulcrum, will not be acceptable. A protectop shall be supplied to prevent debris from entering the

outlet of the valve. Each valve assembly shall include a 2" NRS, solid disc, inside screw bonnet gate valve with a 200 WOG pressure rating and conforming to Federal Specification MSS SP-80. Each valve assembly shall be installed in a manhole as shown on the detail sheet in the plans. The Combination Air Valves shall be manufactured by Crispin, Apco, Val-Matic, or A.R.I.

2.1.5.10 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.5.11 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.5.12 Sleeve-Type Mechanical Couplings for PVC and Ductile Iron Pipe

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast-iron or steel; and the follower rings shall be of malleable or ductile iron. Cast iron, ASTM Malleable and ductile iron shall, conform to ASTM A47 and ASTM A536, respectively. Steel shall have a strength not less than that of the pipe. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ANSI B18.5.2.1M and ANSI/ASME B18.5.2.2M with hex nuts, ASME/ANSI B18.2.2. Bolts shall be 5/8 inch in diameter; minimum number of bolts for each coupling shall be 8 for 12-inch pipe, 8 for 8-inch pipe, and 6 for 6-inch pipe. Boltholes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.5.13 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.1.5.14 Blowoff Assemblies

Blowoff assemblies shall be the size indicated on the drawings and shall include flap valve and 45 Degree MJ Bend with Megalug Restraint.

2.2 WATER SERVICES (1-INCH)

2.2.1 Tapping Saddles

Tapping saddles shall provide full support around the circumference of the pipe with a designed in safeguard against over-tightening to prevent deforming the pipe. All parts of the saddle shall be constructed of corrosive resistant bronze including bolts and nuts required to assemble. Only saddles designed specifically for the type water main pipe used shall be allowed. Threads shall be AWWA standard cc tapered. Tapping saddles shall be manufactured by Mueller, Ford, or an approved equal.

2.2.2 1" Corporation Stops

Corporation stops shall be of bronze construction and a minimum 3/4" (inlet and outlet). Inlet threads shall be AWWA Standard Taper "CC". Outlets will be IP threads with a brass compression-fitting adapter for copper service tubing. Corporation stops shall be Ford F1000, Mueller H-15008, or approved equal.

2.2.3 PE Pipe for Service Laterals

1" pipe for service lines shall be PE 4710 CTS poly tubing meeting AWWA C901.

2.2.4 Copper Meter Yokes

Not used this contract.

2.2.5 Meter Boxes

Not used this contract.

2.2.6 Teflon Tape

Teflon tape shall be used on all threaded connections to reduce the possibility of leaking joints.

2.2.7 Water Meter for Well House Piping

One (1) 4" turbine water meter and strainer shall be provided as part of Well House Piping as indicated. Turbine meters shall be for cold water measurement for flow in one direction. Valve shall be rated for a maximum pressure of 175 psi. The meter register shall be direct read, center sweep, roll sealed, magnetic drive with low-flow indicator. Measuring element shall be AWWA Class II turbine, hydrodynamically balanced rotor. Turbine water meters shall be Neptune or equal.

2.2.8 Static Mixer for Well House Piping

Provide a static mixer where called for on the plans. Static mixer shall be 6". Body shall be Type 316 Stainless Steel and be equipped with three (3) mixing elements. Flanges shall be according to ANSI B16.5.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all PVC and Ductile Iron pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs. HDPE pipe installation specifications as part of directional bores is described in Section 6 "Earthwork and Borings" for utilities. The Contractor shall furnish all labor, tools, equipment and other incidentals required for the construction of the water distribution system as shown on the drawings and as specified herein. The work shall include laying pipe and setting fittings, valves, hydrants, and services, pressure testing and sterilization of the water distribution system. Materials shall be as specified in previous sections of these specifications.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at the edge of the existing NCDOT or street right of way, unless otherwise indicated. Do not lay water lines in the same trench with gas lines, fuel lines or electric wiring. Minimum requirements for proximity of new water mains with sanitary sewer piping shall be as per NCAC Title 15A, Subchapter 18C "Water Supplies", Section .0906 and as follows:

A. Water Piping Installation Parallel With Sewer Piping

1. Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

2. Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

B. Installation of Water Piping Crossing

1. Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

2. Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

   (a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

   (b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

   (c) Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 3, “Earthwork and Borings for Utilities.” All Ductile Iron and Polyvinyl Chloride (PVC) pipe shall be installed in Type 3 embedment. The pipe shall be bedded in 4” of loose soil. Backfill shall be lightly consolidated to the top of the pipe. Loose soil is defined as native soil excavated from the trench, free of rocks, foreign materials and frozen earth.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until

joints have been properly made. At the end of each workday, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 3 feet or more than 4 feet unless otherwise indicated.

3.1.1.4 Installation of Tracer Wire

Tracer Wire shall be required for all nonmetallic pipe installations by open cut. Tracer wire shall be No. 12 gauge coated copper wire. Bury tracer wire immediately above pipe. Wire splices shall be watertight with an Engineer approved device. Five feet of tracer wire shall be pulled into each line valve box.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure as indicated. In no case shall the Contractor shut off the water or operate the fire hydrants or gate valves of the existing distribution system without the expressed permission of the Engineer and coordination with the Owner. In case it becomes necessary to delay the cut-off, such instructions shall be given and obeyed without recourse. In making connections to the existing distribution system, valves shall be set as shown on the plan, or at such designated place as the Engineer may direct. If due to unforeseen conditions, these locations have to be changed or additional valves or fittings added, the Contractor shall install the valves or fittings at the new locations at the unit price scheduled in the bid items. Payment for special fittings or couplings will not be made unless approved by the Engineer prior to installation.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

A. Push-On Joints: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Clean gasket and spigot and inside of bell thoroughly to remove all dirt and other foreign matter. Insert gasket furnished by the pipe manufacturer into the gasket seat in the bell. Gasket shall be properly seated in the grooves provided in the pipe bell. Using a non-toxic vegetable soap, apply a film by hand to the inside surface of the gasket that comes into contact with the entering pipe and to the first 1" of the spigot end of the entering pipe. Use only lubricant specified by the pipe manufacturer. Align entering pipe with the bell to which it is to be joined. Enter the spigot end into the bell until it just makes contact with the gasket. Apply sufficient pressure to force the spigot end past the gasket up to solid contact with the bell. When it is necessary to field cut pipe with rubber gaskets, chamfer the cut end 1/8 inch x 30 degrees before inserting into a rubber gasket bell.

B. Mechanical Joints: Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111. Clean last 8" outside the spigot, and the inside of the bell of mechanical joint pipe or fitting to remove oil, grit, tar (other than standard coating) and other foreign matter from the joint and then paint area clean with an approved soap solution. The ductile iron gland shall then be slipped on the spigot end of the pipe with the extension of the gland toward the socket or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with thick edge toward the gland. Push entire section of pipe forward to seat spigot end in the bell. Press gasket into place within the bell, being careful to have the gasket evenly located around the entire joint. Move ductile iron gland along the pipe into position for bolting, insert all bolts, and screw nuts up tightly with fingers. Tighten all nuts with a suitable (preferably torque-limiting) wrench. Tighten nuts that are spaced 180 degrees apart alternately in order to produce equal pressure on all parts of the gland.

C. Flanged Joints: Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the boltholes; use of undersized bolts to make up for misalignment of boltholes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper-flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer.

D. Sleeved Joints: Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.

E. Fittings: Fittings shall be installed where and as shown on the plans or as directed by the Engineer. All bends (1/16 to 1/4), y-branches, plugs and all other fittings requiring such shall be sufficiently backed, blocked, or braced to preclude the possibility of their blowing off the main.

F. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint. Use concrete, ASTM C94, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Blocking shall be formed and placed in such a manner that the pressure to be exerted at the point of blocking shall be transferred to firm, undisturbed earth at a maximum load of 2,000 lbs., per square foot. The Contractor shall insure that blocking at all tees, bends, plugs, etc., shall be sufficient to contain all pressure exerted by the pipe up to 200 psi hydraulic pressure within the pipe, e.g., pressure at plug = 200 x (area of pipe in inches). Blocking shall be constructed as

shown on the detail sheet contained in the project plans. The Contractor shall also be responsible for any damage or repairs caused by blowouts of any insufficiently blocked pipe.

G. Pipe Cleaning: The Contractor shall clean all new water mains installed in this project by using a flexible polyurethane swab ("pig"). The pig shall be of 5-lb/cf density polyurethane of the proper size for the water mains being cleaned. The pig shall be inserted into the first section of pipe and shall remain there until construction of that line segment is completed. Cleaning shall be accomplished by propelling the pig down the water main by system pressure to the exit point as determined by the Contractor. After the pig exits the pipe, flushing shall be performed until the water is completely clear and the turbidity level is less than 1.0 NTU. Cleaning of water mains with diameters larger than 12 inches or water mains that utilize butterfly valves shall be performed in the same manner excepting that the Contractor will be required to pig the main from valve to valve or in a manner acceptable to the Engineer and the Owner. The Contractor is instructed to coordinate "Pipe Cleaning" with the paragraph entitled "Water Main Sterilization."

3.1.2.2 Installation of Valves and Hydrants

A. Installation of Valves: Install gate valves in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings. Valves shall be set and anchored with steel bars and concrete as shown on the detail sheet contained in the project detailed drawings. All valves set by the Contractor shall include a cast iron or ductile iron valve box set to grade encircled and protected by a precast concrete donut.

B. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicted. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install hydrants with 4 1/2 inch connections facing the adjacent paved surface. Fire hydrants shall be set where shown on the plans or as directed by the Engineer. The hydrants shall be set upon a bed of compacted crushed stone at least thirty-inches (30") square by ten inches (10") in depth. There shall be furnished and installed an approved restraint assembly to securely anchor the hydrant to the main line as shown on the detail contained in the project drawing details. When the restraint assembly is specified, the cost shall be included in the unit price for hydrants and no concrete blocking will be required. When the hydrant is backfilled, crushed stone or gravel shall be placed around the hydrant to a point just above the drain holes of the hydrant.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Provide individual service laterals as directed by the Engineer Locations shall be staked in the field by the Contractor. New service laterals shall terminate with meter and box located at the edge of the existing street or road right of way.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.

3.1.4 Water Main Sterilization

Sterilization of water mains shall be performed in accordance with the requirements of the North Carolina Department of Environment, and Natural Resources, Rules Governing Public Water Systems, NCAC Title 15A, Subchapter 18C Section .1003 and the requirements of ANSI/AWWA C651-92 or latest revision. The pipe shall be sterilized in segments designated by the Contractor and subject to the approval of the Engineer. All reasonable precautions shall be adhered to in protecting the interior of pipes, fittings, and valves against contamination. All openings in the pipeline shall be closed with watertight plugs at the end of the day's work or at other times when pipe laying has ceased. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. If dirt enters the pipe it shall be removed and the interior pipe surface swabbed with a five percent hypochlorite disinfecting solution.

A. Disinfection Procedure: The basic disinfection procedure consists of the following:

    1. Preventing contaminating materials from entering the water main during storage and construction.

    2. Removing, by flushing or other means, those materials that may have entered the water main.

    3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.

    4. Protecting the existing distribution system from backflow due to pressure test and disinfection procedures.

    5. Determining the bacteriological quality by laboratory test after disinfection.

    6. Final connection of the approved new water main to the active distribution system.

B. Continuous-Feed Method of Chlorination: The "tablet method" and the "slug method" of sterilization are <u>not</u> acceptable. The "continuous-feed method" as discussed in AWWA C651

shall be used to chlorinate the water mains. The continuous-feed method of chlorination consists of:

1. Placing calcium hypochlorite granules in the main during construction.

   (a) Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main and at 500' intervals. The quantity of granules shall be as follows:

Pipe Diameter (Inches)	Calcium Hypochlorite Granules (Ounces)
4	0.5
6	1.0
8	2.0
12	4.0
16 & Larger	8.0

2. Completely filling the main to eliminate air pockets.

   (a) The initial filling shall be at a rate such that water within the main will flow at a velocity no greater than 1 foot per second (fps). Precautions shall be taken to insure that air pockets are eliminated.

3. Flushing the main to remove particulates.

   (a) Once the main has been completely filled with potable water and all air expelled, the main shall be flushed to remove particulates at a rate of not less than 2.5 fps. The discharge point for the flushing operation shall be coordinated with the Engineer. In lieu of flushing the Contractor may choose this time to clean the water main as described in the above paragraph entitled "Pipe Cleaning."

4. Filling the main with super-chlorinated potable water so that after a 24-hour holding period in the main there will be a free chlorine residual of not less than 20 parts per million (ppm).

   (a) The procedure for chlorinating the main shall begin with water being made to flow into the newly installed water main at a constant, measured rate. In the absence of a meter the rate may be approximated by a method approved by the Engineer (A hydrant meter is recommended). At a point not more than 10' downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 50-ppm free chlorine. The chlorine concentration should be measured at regular intervals using appropriate chlorine test kits. Chlorine application shall not cease until the entire main (or isolated portion thereof) is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 hours during which time all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At

the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 20-ppm free chlorine.

(1) Chlorine Application: The forms of chlorine that may be used in the disinfection operations are liquid chlorine conforming to AWWA B301, sodium hypochlorite solution conforming to AWWA B300 and calcium hypochlorite granules or tablets conforming to AWWA B300. Liquid Chlorine shall be used only in combination with appropriate gas-flow chlorinators and ejectors and under the direct supervision of a person who is familiar with the physiological, chemical, and physical properties of liquid chlorine. Liquid chlorine may be used only when appropriate safety practices are observed to protect working personnel and the public. Sodium Hypochlorite Solution and Calcium Hypochlorite Granules used to form a solution may be applied to the water to be chlorinated with a gasoline or electrically powered chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be able to withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures created by the pump.

5. Final flushing of the water main to remove super-chlorinated water.

(a) After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. (See AWWA C651 Appendix B for neutralizing chemicals). Where necessary, Federal, State and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. This effort shall be coordinated fully by the by Contractor.

B. Bacteriological Tests: Twenty-four hours after final flushing to remove excess chlorine, representative water samples shall be taken from each water line segment for bacteriological quality tests in accordance with "Standard Methods for the Examination of Water and Wastewater". At least one sample shall be collected from every 2000’ of water main including one set from the end of the line and at least one set from each branch. No portion of the system shall be placed in operation until the tests are approved. If the presence of coliform bacteria is detected in the water samples, the section of pipe shall be resterilized and additional samples shall be taken. If, during construction, trench water has entered the main, or if in the opinion of the Engineer, excessive quantities of dirt or debris have entered the main, bacteriological samples may be required at more frequent intervals. Furthermore at the discretion of the Owner samples shall be taken of water that has stood in the main for at least 72 hours after final flushing has been completed. If the initial disinfection fails to produce satisfactory bacteriological samples, the main may be reflushed

and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be rechlorinated by the continuous-feed of chlorination until satisfactory results are obtained

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Engineer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete. Water for testing and sterilization will be provided by Moore County.

3.2.2 Pressure and Leakage Testing for PVC and Ductile Iron Pipe

Hydrostatic pressure and leakage testing for water mains and water service lines shall conform to AWWA C600 or latest revision for ductile iron water main and AWWA C605 or latest revision for polyvinyl chloride pipe. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Pressure testing shall be performed on all pipe, valves, hydrants, and fittings. The test shall be conducted on line segments from shut valve to shut valve in segments not exceeding 2,000 linear feet. The Contractor shall provide a suitable pump for applying pressure and an accurate gauge for measuring the pressure and an Engineer approved method of determining volume of water used. All newly laid pipe and any isolated sections thereof shall be subject to a hydrostatic pressure of at least 2.0 times the working pressure or 200 psi (whichever is greater). The required pressure shall be relative to the high point of the line regardless of the point at which the test pump or test gauge is connected. The hydrostatic test shall be of at least two-hour duration. Removal of air shall be performed to the satisfaction of the Engineer through use of the air release valve assemblies (automatic and manual) and the fire hydrants. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. If determined necessary by the Engineer, the Contractor shall install additional air taps to be abandoned after all air removal at no additional cost to the Owner. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any isolated section thereof to maintain pressure within 5 psi (35 MPa or 0.35 bar) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time. No installation will be accepted if the leakage is greater than that determined by the following formulas:

When testing Ductile Iron Pipe:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch gauge

When testing Polyvinyl Chloride Pipe:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where:

L = allowable leakage, in gallons per hour
N = number of joints is length of pipeline tested
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. (0.0012 L/h/m) of nominal valve size shall be allowed. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified above, the Contractor shall, at his expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. All visible leaks are to be repaired, regardless of the amount of leakage.

3.2.3 Hydrostatic Leakage Testing for HDPE Pipe

Leakage testing for HDPE pipe shall be accomplished hydrostatically. The testing procedure shall consist of filling, an initial expansion phase, a test phase, and depressurization. The test pressure shall be 1.5 times the system design operating pressure as measured at the lowest elevation in the test section. Fill the test section completely. Begin the initial expansion phase by gradually pressurizing the test section to the test pressure. Maintain the test pressure for three (3) hours by adding test water as required to maintain pressure, as the pipe will expand slightly during this phase. It is not required to monitor the amount of water added. Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain test pressure for two (2) hours. No leakage is indicated when the amount of make-up water needed to maintain test pressure does not exceed the amount listed below.

Pipe Size (Inches)	Make-Up Water Allowance per 100 ft. of Pipe (Gallons)
6”	0.6
8”	1.0
10”	1.3
12”	2.3
14”	2.8
16”	3.3
18”	4.3
20”	5.5

At the conclusion of the test, carefully depressurize the test section by the controlled release of test water.

PART 4 PAYMENT PROCEDURES

See Section 3 of the General Requirements for Payment Procedure requirements.

PART 5 WARRANTY

The Contractor shall guarantee the work provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. All guarantees for materials, equipment and accessories provided under this section shall be obtained by the Contractor and submitted.

-- END OF SECTION --

DETAILED SPECIFICATIONS

SECTION 3: EARTHWORK AND BORINGS FOR UTILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-103	(1990) Concrete Pipe Installation Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D1140	(1997) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	(1993) Maximum Index Density of Soils Using a Vibratory Table
ASTM D4254	(1991) Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	(1995; Rev. A) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1996) Safety and Health Requirements Manual

1.2 DESIGN REQUIREMENTS

1.2.1 Trenching

The trench shall be dug to the required alignment and depth as shown on the plans or directed by the Engineer, and only so far in advance of the pipe installation as the Engineer shall permit. The width of the trench shall be kept at a minimum. The depth of the trench shall generally be sufficient to allow a minimum of three (3) feet of cover over the top of the pipe. The bottom of the trench shall be shaped by hand and shall support the pipe for the entire length. It shall be the responsibility of the Contractor to provide adequate bearing for all pipe lines laid in rocky or uncertain soil conditions. Under no circumstances will the pipe be allowed to come into contact with hard rocks or direct bearing on bedrock. If flooding, rain or other causes should soften the trench bottom, the unsuitable material shall be removed and replaced with suitable material properly shaped and tamped to grade.

1.2.2 Borings

Procedures for boring shall be in accordance with the best-accepted methods of the construction and as shown on the plans and described in these specifications. Casing pipes installed under highways and railroads shall be bored as shown on the detail drawings. Casings will be installed of the type, size, and thickness as specified herein or on the detail drawings.

1.2.2.1 Under Highways

Contractor shall be responsible for notifying the N.C. Department of Transportation at least five days prior to any contemplated work and for securing any required permits for performing the work. All work shall be accomplished under the supervision of the Engineer and the District Engineer of the Department of Transportation or his authorized representative.

1.2.2.2 Under Railroads

All work on railroad rights of way shall be done under the supervision of the Chief Engineer of the railroad, or his authorized representative, who shall be notified at least 15 days before construction is begun. In addition, this work shall only be done in the presence of the authorized representative of the Chief Engineer, and no methods shall be used that, in the opinion of the representative, could be hazardous to the railway.

1.2.3 Directional Borings Utilizing HDPE Pipe

Directional boring is a method of trenchless construction using a surface launched steerable drilling tool controlled from a mobile drilling frame, and includes a field power unit, mud mixing system and mobile spoils extraction system. The drilling frame is sited and aligned to bore a pilot borehole that conforms to the planned installation of the main. The drilling frame is set back from an access pit that has been dug (typically at the location of a proposed manhole or

other appurtenance) and a high-pressure fluidjet toolhead that uses a mixture of bentonite clay and water is launched. Pits are normally dug at the start point and endpoint of the proposed pipe installation and are used to align the toolhead, attach other equipment, and to collect and remove excess spoils. Using an electronic guidance system, the toolhead is guided through the soil to create a pilot borehole. Upon reaching the endpoint joint, the toolhead is removed and a reamer with the product pipe attached is joined to the drill string and pulled back through the borehole. In large diameter installations, pre-reaming of the borehole will usually be done prior to attaching the product pipe for the final pullback. A vacuum spoils extraction system removes any excess spoils generated during the installation. The connections, manholes or other appurtenances are then completed at both the start point and endpoint locations and the surface restored to its original condition.

1.2.3.1 Site Conditions for Directional Borings

Drilling operations must not interfere with, interrupt or endanger surface and activity upon the surface. Contractor must comply with all applicable jurisdictional codes and OSHA requirements. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operations are encountered, the Contractor and Engineer shall review the situation and jointly determine the feasibility of continuing drilling operations.

1.3 EARTHWORK DEFINITIONS

1.3.1 Backfill

Material used in refilling a cut, trench or other excavation.

1.3.2 Cohesive Materials

Soils classified by ASTM D2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when fines have a plasticity index greater than zero.

1.3.3 Cohesionless Materials

Soils classified by ASTM D2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.3.4 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D698 or ASTM D1557 for general soil types or ASTM D 4253 or ASTM D4254 (Relative Density) for isolated cohesionless materials, abbreviated in this specification as "95 percent ASTM D698 maximum density."

1.3.5 Granular Pipe Bedding

A dense, well-graded aggregate mixture of sand, gravel, or crushed stone (mixed individually, in combination with each other, or with suitable binder soil) placed on a subgrade to provide a suitable foundation for pipe (NCDOT #57 or #67). Granular bedding material may also consist of poorly graded sands or gravels where fast draining soil characteristics are desired.

1.3.6 Hard Material

Weathered rock, dense consolidated deposits, or conglomerate materials (excluding man made materials such as concrete) which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.7 In-Situ Soil

Existing in place soil.

1.3.8 Lift

A layer (or course) of soil placed on top of subgrade or a previously prepared or placed soil in a fill or backfill.

1.3.9 Porous Fill

A granular soil material having a large void ratio when placed and compacted, allowing a free flow of fluid to or from the surrounding soil, with no more than 5 percent of the material passing the No. 100 Sieve.

1.3.10 Refill

Material placed in excavation to correct overcut in depth.

1.3.11 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed solely to increase production.

1.3.12 Satisfactory Backfill Material

Non-plastic soils as defined by ASTM D2487 such as SW, SM and SC free of rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste, frozen material, muck, roots, vegetation, and other deleterious matter.

1.3.13 Select Backfill (Borrow)

Satisfactory material obtained from borrow areas or commercial sources used as backfill.

1.3.14 Topsoil

In natural or undisturbed soil formations, the fine-grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Topsoil may be a dark-colored, fine, silty, or sandy material with a high content of well-decomposed organic matter, often containing traces of the parent rock material. Gradation and material requirements specified herein apply to all topsoil references in this contract. The material shall be representative of productive soils in the vicinity.

1.3.15 Unyielding Material

Rock rib, ridge, rock protrusion, or soil with cobbles in the trench bottom requiring a covering of finer grain material or special bedding to avoid bridging in the pipe or conduit.

1.3.16 Unsatisfactory Backfill Material

In-Situ soil or other material, which can be identified as having insufficient strength characteristics or stability to carry intended loads in the trench without excessive consolidation or loss of stability. Also backfill material, which contains refuse, frozen material, large rocks, debris, soluble particles, and other material, which could damage the pipe or cause the backfill not to compact. Materials classified as PT, OH, or OL by ASTM D2487 are unsatisfactory.

1.3.17 Unstable Material

Material in the trench bottom, which lacks firmness to maintain alignment and prevent joints from separating in the pipe, conduit, or appurtenance structure during backfilling. This may be material otherwise identified as satisfactory which has been disturbed or saturated.

1.4 SUBMITTALS

Submit six (6) copies of the following in accordance with the requirements as set forth in Section 4 of the General Requirements.

1.4.1 Product Data

A. Steel Casings

B. Carrier Pipe Support and Spacer

C. Casing End Seals

D. Bentonite drilling mud products (for Directional Boring) information (MSDS); special precautions necessary; method of mixing and application; and method of removing spoils.

E. HDPE pipe for Directional Boring shall conform to the requirements in Section 1 “WATER DISTRIBUTION”.

1.4.2 Statements

A. Shoring and sheeting plan

B. Dewatering plan

1.4.2.1 Shoring and Sheeting Plan

Describe materials of shoring system to be used. Indicate whether or not components will remain after filling or backfilling. Provide plans, sketches, or details along with calculations by a professional engineer registered in any jurisdiction. Indicate sequence and method of installation and removal.

1.4.2.2 Dewatering Plan

Describe methods for removing collected water from open trenches and diverting surface water or piped flow away from work area. Describe the basic components of the dewatering system proposed for use and its planned method of operation. Dewatering plan, as a minimum, shall address those requirements outlined in paragraph entitled "Drainage and Dewatering."

1.4.3 Qualifications

1.4.3.1 Directional Boring Contractors

Directional boring Contractors will have actively engaged in the installation of pipe using directional boring techniques for a minimum of three years. Field supervisory personnel employed by the Directional Boring Contractor will have at least three years experience in the performance of the work and tasks. Submit documentation indicating experience. Information

must include, but not be limited to, date and duration of work, location, pipe information (i.e., length, diameter, depth of installation, pipe material, etc.), project owner information, (i.e., name, address, telephone number, contact person), and the contents handled by the pipeline (water, wastewater, etc.). Submit a list of field supervisory personnel and their experience with directional boring operations. At least one of the field supervisors listed must be at the site and be responsible for all work at all times when directional boring operations are in progress. Directional boring operations will not proceed until the resume(s) of the Contractor's field supervisory personnel have been received and reviewed by the Engineer.

1.4.4 Drawings

1.4.4.1 Directional Boring

Working drawings and written procedure describing in detail the proposed method of installation. This will include, but not be limited to, size, capacity and setup requirements of equipment; location of drilling and receiving pits; dewatering if applicable; method of fusion and type of equipment for joining pipe; type of cutting tool head; and method of monitoring and controlling line and depth. If the Contractor determines that modifications to the method and equipment as stated in the submittal is necessary during construction, the contractor will submit a plan describing such modifications, including the reasons for the modification.

1.4.5 Test Reports

A. Maximum Density and Compaction Tests

1.4.5.1 Compaction Tests

Submit within 5 days of test date.

1.5 REGULATORY REQUIREMENTS

Materials and workmanship specified herein with reference to NCDOT State Standard shall be in accordance with the referenced articles, sections, and paragraphs of the standard except that contractual and payment provisions do not apply.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials in a manner to prevent contamination, segregation, freezing, and other damage. Store synthetic fiber filter fabric to prevent exposure to direct sunlight.

1.7 CRITERIA FOR BIDDING

Base bids on the following criteria:

A. All excavations will be considered “unclassified”.

B. Surface elevations are as indicated.

C. No pipes or other man-made obstructions, except those indicated, will be encountered.

D. A subsurface investigation has not been performed for this project. However, in preparing the bid, the Contractor shall assume that "Rock" or "Hard Material", defined in the paragraph entitled "Definitions", will likely not be encountered.

E. The Contractor should be aware of the likelihood of encountering material not suitable for foundation or backfill material in the excavation for this project, defined as either "Unsatisfactory Material" or "Unstable Material" in the paragraph entitled "Definitions".

F. Compensation for removal and replacement of an estimated volume of material not suitable for foundation or backfill is detailed in Part 4 of this specification.

1.7.1 Rock Excavation

Rock excavation consists of the blasting and excavation and disposal of rock material in cut areas. Rock excavation shall be labeled as material that cannot be removed with normal construction equipment such as pan scrapers or bulldozers with “rippers”, and requires the construction practice of blasting.

1.7.1.1 Classification

Rock shall be defined as sandstone, limestone, flint, granite, quartzite, slate, or similar material in masses more than ½ cubic yard in volume or in ledges 4 inches or more in thickness that cannot be excavated with a 25 metric ton hydraulic excavator equipped with rock teeth on a 24-inch wide bucket. Should rock be encountered in two or more ledges, each ledge being not less than 3-inches thick and with interlaying strata of earth, clay or gravel not more than 12-inches thick in each stratum, the entire volume between the top ledge and the bottom of the bottom ledge will be classified as rock.

1.7.1.2 Construction Requirements: Blasting

The use of explosives shall be performed in strict accordance with all Federal, State, County and local regulation and only after the approval of the Engineer. The Contractor shall be responsible for all damage caused by blasting operations. Suitable methods shall bee employed to confine all materials that may be displaced by blasting; i.e., prevent projectiles. When rock is encountered, all lines and grades will be held in accordance with the plans or adjusted only after approval of the Engineer. Rock shall be excavated within the same limits as that of earth except that the trench shall be made 6-inches deeper than if no rock were encountered. The lower 6-inches shall be filled with #67 stone or other equivalent material approved by the

Engineer and compacted prior to installing pipe. When rock is encountered within the limits of construction, the Contractor shall notify the Engineer's representative prior to any removal. Upon the Engineer's authorization, the Contractor shall remove the rock.

1.8 PROTECTION

1.8.1 Dewatering Plan

Base site surface and subsurface conditions on available soil and hydrological data.

1.8.2 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until the Engineer grants approval for backfill. Report damage to utility lines or subsurface construction immediately to the Engineer and the Owner of the utility.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, ice, or other deleterious and objectionable materials.

2.1.1 Backfill

Bring trenches to grade as indicated on the drawings using material excavated on the site of this project unless deemed unfit for use as backfill by the Engineer. Replace unsuitable material with suitable material as defined in Paragraph 1.3.12. "Satisfactory Backfill Material". This material will be considered unclassified and no testing other than for compaction will be required before use as backfill except that the liquid limit of the material cannot exceed 35 percent when tested in accordance with ASTM D4318, the plasticity index cannot exceed 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight can be finer that the No. 200 sieve when tested in accordance with ASTM D1140.

2.1.2 Pipe Bedding

2.1.2.1 Ductile Iron, PVC, and HDPE Force Mains

Pipe bedding shall be a minimum of 4" using the same backfill material excavated on site unless deemed unfit for use as determined by the Engineer (Type 3 embedment). Replace unsuitable material with suitable material as defined in Paragraph 1.3.12. "Satisfactory Backfill Material". Material surrounding pipe shall have ½" maximum particle size.

2.1.2.2 Ductile Iron and PVC Gravity Sewer Mains

Pipe bedding shall consist of a minimum 4" NCDOT #57 or #67 stone gravel base. Compacted stone shall continue as backfill to the springline of the pipe for all gravity sewer mains (Type 3 embedment). For installation depths greater than 12 feet, stone gravel base must be continued to the top of the pipe.

2.1.3 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as NCDOT #57, NCDOT #67.

2.1.4 Topsoil Material

Free of subsoil, stumps, rocks larger than 3/4 inch in diameter (with maximum 3 percent retained on 1/4 inch sieve), brush, weeds, toxic substances, and other material or substance detrimental to plant growth. Topsoil shall be a natural soil representative of productive soils in the vicinity.

2.1.5 Borrow (Select Backfill Material)

Where excavated material is deemed unfit for use backfill, provide select backfill material meeting the definition described in Paragraph 1.3.12 "Satisfactory Backfill Material". Obtain borrow materials in excess of those unfit from excavations specified herein from borrow areas specified by the Contractor and approved by the Engineer.

2.2 CASING PIPE FOR HIGHWAYS AND RAILROADS

Pipe material shall be new smooth wall carbon steel pipe that conforms to ASTM A139, Grade B without hydrostatic tests. Steel casing shall have a minimum yield strength of 35,000 psi. Steel pipe joints shall be welded and be in at least 18' lengths. All steel pipe shall be square cut with beveled ends for welding. Steel casing shall have a roundness such that the difference between the major and minor outside diameters shall not exceed 1% of the nominal outside diameter or 0.25", whichever is less. Steel casing shall have a outside circumference that is within 1% of the nominal circumference or 0.50", whichever is less. Steel casing pipe shall have a minimum

allowable straightness deviation in any 10’ length of 1\8 inch. The exterior of the casing pipe shall be coated with coal tar epoxy or bituminous asphalt with a minimum coating thickness of 2 mils.

2.2.1 Casing Dimensions

The inside diameter of the casing pipe shall not be less than 2 inches greater than the largest outside diameter of the joints and couplings for carrier pipe less than 6" O.D., and 4" greater for carrier pipe 6" and larger. In all cases, it shall be great enough to easily remove carrier pipe without disturbing the casing pipe. The minimum steel casing size for Ductile Iron “slip joint” carrier pipe shall be as follows:

Nominal D.I. Carrier Pipe Dia. (Inches)	Steel Casing Minimum O.D. (Inches)	Min. Wall Thickness For Highways (Inches)	Min. Wall Thickness For Railroads (Inches)
3	8.625	0.250	0.250
4	10.750	0.250	0.250
6	14.0	0.250	0.250
8	16.0	0.250	0.312
10	18.0	0.250	0.312
12	20.0	0.250	0.312
14	24.0	0.250	0.312
16	26.0	0.250	0.312
18	28.0	0.312	0.500
20	30.0	0.312	0.500
24	34.0	0.375	0.500

2.2.2 Carrier Pipe

Carrier pipe used under highways shall be of an approved material and installed to the satisfaction of the District Engineer of the Department of Transportation. Carrier pipe shall be as indicated on the project drawings unless otherwise noted.

2.2.3 Casing Spacers

Casing spacer bands shall be 14-gauge steel of two-piece construction. Liners shall be minimum 0.90” thick PVC. Risers shall be 10-gauge steel MIG welded to band. Nuts bolts and washers shall be Grade 5. Runners shall be glass reinforced plastic spaced equally around the circumference. Casing spacer ferrous components shall be coated with corrosion resistant enamel paint.

2.2.4 Casing End Seals

Casing End Seals shall be 1/8" thick synthetic rubber designed to withstand the weight of the backfill material. Stainless steel bands shall be used to attach the seals to the carrier and casing pipes.

2.3 HDPE PIPE FOR DIRECTIONAL BORES

HDPE pipe shall be accordance with requirements specified in Section 5, "WATER DISTRIBUTION".

2.4 DRILLING FLUID FOR DIRECTIONAL BORES

Drilling fluid will be a mixture of water and bentonite clay. The fluid will be inert.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring trench boxes and sheeting where required, according to subsurface conditions and depth of trench. In addition to Section 25 A and B of COE EM-385-1-1, include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

c. Allow for the abandonment of shoring and sheeting materials in place in critical areas as the work is completed. In these areas, backfill the excavation to within 3 feet of the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.

3.1.2 Drainage and Dewatering

Plan for and provide the structures, equipment, and construction for the collection and disposal of surface and subsurface water encountered in the course of construction.

3.1.2.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall

be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.1.3 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet below the working level. Operate dewatering system until work below existing water levels is complete. Measure and record performance of dewatering system. Have back-up pump and system available for immediate use.

3.1.4 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Moore County Public Utilities regarding location of existing utilities.

3.1.5 Structures and Surfaces

Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, or any other damage. Repair and reestablish damaged or eroded grades and slopes and restore surface construction prior to acceptance. Protect existing streams, ditches, and storm drain inlets from water-borne soil by means of as indicated on the contract drawings.

3.1.5.1 Disposal of Excavated Material

Dispose of excavated material so that it will not obstruct the flow of runoff, streams, endanger a partly finished structure, impair the efficiency or appearance of any facilities, or be detrimental to the completed work.

3.2 SURFACE PREPARATION

3.2.1 Stockpiling Topsoil

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for

the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.2 Cutting Pavement, Curbs, and Gutters

Saw cut with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. When the saw cut is within 5 feet of an existing joint, remove pavement to the existing joint.

3.3 GENERAL EXCAVATION AND TRENCHING

Keep excavations free from water while construction is in progress. Notify the Engineer immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. Over excavate soft, weak, or wet excavations. Use bedding material placed in 6-inch maximum layers to refill overdepths to the proper grade. At the Contractor's option, the excavations may be cut to an overdepth of not less than 4 inches and refilled to required grade as specified. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe on undisturbed soil, or bedding material as indicated or specified at every point along its entire length except for portions where it is necessary to excavate for bell holes and for making proper joints. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation. Trench dimensions shall be as indicated.

3.3.1 Shoring and Sheeting

Shore and sheet excavations as described in the plan submitted with various member sizes arranged to prevent injury to persons and damage to structures. Arrange shoring and sheeting to preclude injurious caving during removal. Obtain approval from the Engineer prior to removing shoring, sheeting, or bracing in excavations adjacent to on-grade slabs, foundations, or other structural elements.

3.4 BEDDING

3.4.1 Ductile Iron, PVC, and HDPE Pressure Mains

For water main construction, all Ductile Iron and Polyvinyl Chloride (PVC) pipe shall be installed in Type 3 embedment. The pipe shall be bedded in 4” of loose soil. Backfill shall be lightly consolidated to the top of the pipe. Loose soil is defined as native soil excavated from the trench, free of rocks, foreign materials and frozen earth. Bedding shall be material excavated

from the trench unless otherwise directed by the Engineer. Place bedding in 6-inch maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

3.4.2 Ductile Iron and PVC Gravity Sewer Mains

For gravity sewer main construction, all Ductile Iron and Polyvinyl Chloride (PVC) pipe shall be installed in Type 3 embedment. The pipe shall be placed on a minimum 4" stone gravel base. Consolidated backfill shall continue as backfill to the springline of the pipe. Installation depths greater than 12 feet require stone backfill to the pipe springline. For installation depths greater than 18 feet, stone gravel base must be continued to the top of the pipe.

3.5 BACKFILLING

Construct backfill in two operations (initial and final) as indicated and specified in this section. Place initial backfill in 6-inch maximum loose lifts to one foot above pipe unless otherwise specified. Ensure that initially placed material is tamped firmly under pipe haunches. Bring up evenly on each side and along the full length of the pipe, structure. Ensure that no damage is done to the utility or its protective coating. Place the remainder of the backfill (final backfill) in 12-inch maximum loose lifts unless otherwise specified. Compact each loose lift as specified in the paragraph entitled "General Compaction" before placing the next lift. Do not backfill in freezing weather or where material in the trench is already frozen or is muddy, except as authorized. Provide a minimum cover from final grade of 2 feet for sewer mains and storm drains. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Coordinate backfilling with testing of utilities.

3.6 COMPACTION

Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings. Compact material in accordance with the following unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet specified compaction requirements.

3.6.1 Compaction of Material in Subcuts or Overexcavations

In soft, weak, or wet soils, tamp refill material to consolidate to density of adjacent material in trench wall. In stable soils, compact to 95 percent of maximum density at optimum water content as determined by the Standard Proctor Test, ASTM D698.

3.6.2 Compaction of Pipe Bedding

Compact to 95 percent of ASTM D 698 maximum density.

3.6.3 Compaction of Backfill

Compact initial backfill material surrounding pipes to 95 percent of ASTM D698 maximum density. Under areas to be seeded or sodded, compact succeeding layers of final backfill to 85 percent of ASTM D698 maximum density. For utilities under structures, pavements and road shoulders compact succeeding layers of final backfill as specified under paragraph entitled "Special Earthwork Installation Requirements

3.7 SPECIAL EARTHWORK INSTALLATION REQUIREMENTS

3.7.1 Manholes and Other Appurtenances

Provide at least 12 inches clear from outer surfaces to the embankment or shoring. Remove rock as specified herein. Remove unstable soil that is incapable of supporting the structure to an overdepth of one foot and refill with gravel to the proper elevation. Stabilize soft, weak, or wet excavations as indicated. Refill overdepths with gravel to the required grade and compact as specified.

3.7.2 Compaction for Structures, Pavements and Road Shoulders

Place final backfill in 6-inch maximum loose lifts. If a vibratory roller is used for compaction of final backfill, the lift thickness can be increased to 9 inches. Compact all backfill surrounding pipes, ducts, conduits, and other structures to 95 percent of ASTM D698 maximum density except compact the top 12 inches of subgrade to 98 percent of ASTM D698 maximum density. Backfill to permit the rolling and compacting of the completed excavation with the adjoining material, providing the specified density necessary to enable paving of the area immediately after backfilling has been completed.

3.8 CASING PIPE INSTALLATION

Procedures for casing pipe installation shall be in accordance with the best-accepted methods of the construction and as shown on the plans and specified and detailed in these specifications.

3.8.1 Borings Under Paved Roads and Highways

The minimum depth from the roadway surface to the top of the casing pipe at its closest point shall be three feet. The casing pipe ends shall be sealed to the carrier pipe as described in the paragraph above entitled “Casing End Seals”. The casing pipe shall extend a minimum of 5’ beyond the edge of pavement on either side unless otherwise noted on the plans or specified herein. Contractors shall be required to provide shoring of boring pits and trenches more than 6

feet deep in accordance with the North Carolina Department of Transportation and Federal Occupational Health and Safety Act.

3.8.2 Borings under Railroads

The depth from the base of the railway rail to the top of the casing at the closest point shall not be less than 5-1/2 feet. Also, there should not be less than 3 feet from the bottom of the side ditches to the top of the casing pipe. The casing pipe ends shall be protected from the entrance of foreign materials. The casing shall extend a minimum of 25 feet either side of the centerline of the railroad track unless otherwise noted on the plans or specified herein. Contractors shall be required to shore all pits used for boring if it is over 6 feet deep.

3.9 DIRECTIONAL BORING FOR HDPE PIPE INSTALLATION

3.9.1 General

This section includes the installation of HDPE pipe by directional boring, including connecting to the existing main. Directional Boring shall conform to ASTM F1962. The Contractor will furnish all labor, components, materials, tools and appurtenances necessary or proper for the performance and completion of the contract. The Engineer shall be notified immediately if any obstruction is encountered that stops the forward progress of drilling operations.

3.9.1 Preparation

Excavate required pits in accordance with the working drawings. The drilling procedures and equipment shall provide protection of workers, particularly against electrical shock. As a minimum, grounding mats, grounded equipment, hot boots, hot gloves, safety glasses and hard hats shall be used by crewmembers. The drilling equipment shall have an audible alarm system capable of detecting electrical current. Removal of trees, landscaping, pavement or concrete shall be performed as specified.

3.9.2 Equipment

The drilling equipment must be capable of placing the pipe within the limits indicated on the contract plans. The drilling equipment shall also be capable of 79,000 pounds of pull back force. Directional boring equipment shall consist of a surface launched steerable drilling tool controlled from a mobile drilling frame, and include a field power unit, mud mixing system and mobile spoils extraction system. The number of access pits shall be kept to a minimum and the equipment must be capable of boring the following lengths in a single bore. The directional boring system will have the capability of boring and installing a continuous run without intermediate pits of a minimum distance for the following pipe diameters:

Product Pipe Size	Minimum Boring Distance
1 – 1 ½ inches	500 feet
2 – 4 inches	450 feet
6 inches	400 feet
8 inches	350 feet
10 – 18 inches	300 feet

The guidance system shall have the capability of measuring vertical (depth) position, horizontal position and roll. The guidance system must meet the following specifications in soft homogenous soils:

A. Accuracy

1. Vertical position:
   ± 1 inch at 18-96 inches of depth
   ± 2 inches at 97-144 inches of depth
   ± 4 inches at 145-180 inches of depth
   ± 6 inches at 181-300 inches of depth
   ± 10 inches at 301-480 inches of depth

2. Horizontal position:
   ± 2 inches at 18-96 inches of depth
   ± 4 inches at 97-144 inches of depth
   ± 6 inches at 145-180 inches of depth
   ± 12 inches at 181-300 inches of depth
   ± 24 inches at 301-480 inches of depth

3.9.2.1 Safety Equipment

During drilling operations all equipment shall be effectively grounded and incorporate a system that protects operating personnel from electrical hazards. The system shall be equipped with an audible alarm that can sense if contact is made with an energized electric cable. Proper operation of the alarm system will be confirmed prior to the drilling of each tunnel. All equipment will be connected to ground with a copper conductor capable of handling the maximum anticipated fault current. Crew members operating drilling equipment and handling rods will do so while standing on grounded wire mesh mats, ensuring that all equipment is grounded, and wearing hot boots, hot gloves, safety glasses and hard hats. Crewmembers operating handheld locating equipment will wear hot boots.

3.9.3 Pilot Hole Boring / Adjustments / Restarts

The entry angle of the pilot hole and the boring process will maintain a curvature that does not exceed the allowable bending radii of the product pipe. The Contractor shall follow the pipeline

alignment as shown on the Drawings, within the specifications stated. If adjustments are required, the Contractor shall notify the Engineer for approval prior to making the adjustments.

3.9.4 Product Pipe Installation

After the pilot hole is completed, the Contractor shall install a swivel to the reamer and commence pullback operations. Pre-reaming of the tunnel may be necessary and is at the option of the Contractor.

a. Reaming diameter will not exceed 1.5 times the diameter of the product pipe being installed.

b. The product pipe being pulled into the tunnel will be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation. The drilling fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill with the annulus of the pipe and tunnel.

b. Pullback forces will not exceed the allowable pulling forces for the product pipe.

c. The Contractor shall allow sufficient lengths of product pipe to extend past the termination point to allow connections to the diffuser assembly. Pulled pipe will be allowed 24 hours of stabilization prior to making tie-ins. The length of extra product pipe will be at the Contractor's discretion.

d. The contractor shall allow at a minimum of 20 linear feet of directional-drilled pipe on each end of the installation. The additional pipe lengths shall be on a parallel plane with the existing grade at the point of connection to the Ductile Iron or PVC main.

3.9.5 Cleanup and Disposal of Drilling Fluid

The Contractor shall maintain the work site in a neat and orderly condition throughout the period of work and after completing the work at each site, remove debris, surplus material and temporary structures erected by the Contractor. The site shall be restored to a condition equal to the existing condition prior to being disturbed. Disposal of excess drilling fluid and spoils will be the responsibility of the Contractor who must comply with all relevant regulations, right-of-way, and work space and permit agreements. Excess drilling fluid and spoils will be disposed at an approved location. The Contractor is responsible for transporting all excess drilling fluid and spoils to the disposal site and paying any disposal costs. Excess drilling fluid and spoils will be transported in a manner that prevents accidental spillage onto roadways. Excess drilling fluid and spoils will not be discharged into sanitary or storm drain systems, ditches or waterways.

a. Drilling fluid returns (caused by fracturing of formations) at locations other than the entry and exit points will be minimized. The Contractor will immediately clean up any

drilling fluid that surfaces through fracturing. Clean up of excess drilling fluid shall be accomplished by the means of mobile spoils removal equipment.

b. Mobile spoils removal equipment capable of quickly removing spoils from entry or exit pits and areas with returns caused by fracturing will be present during drilling operations to fulfill the requirements of paragraph a above. The Contractor shall not commence drilling operations without the presence of drilling fluid removal equipment. All excess drilling fluid shall be removed from the site(s) and disposed of properly.

c. The Contractor will be responsible for making provisions for a clean water supply for the mixing of drilling fluid. Water purchased from Hoke County must be metered through fire hydrants and paid for by the Contractor.

d. The contractor shall contain all drilling fluids from the site until such time that the excess fluid may be removed from the site by mobile spoils removal equipment.

e. At no time shall the contractor allow excess drilling fluids to drain into water bodies such as streams, rivers, lakes, wetlands etc.

3.9.6 As-Builts

The Contractor shall provide to the Engineer a bore plan (boring log) to provide the as-built condition of the bore. This information shall include the pipe depth at intervals of 50 lf, which shall indicate the horizontal alignment with respect to a horizontal baseline.

3.10 FINISH OPERATIONS

3.10.1 Grading

Finish to grades indicated within one-tenth of a foot. Provide sod or topsoil in areas to be seeded or sodded in accordance with requirements specified in Section 4, "SITEWORK FOR PIPELINES." Grade areas to drain water away from structures and to provide suitable surfaces for mowing machines. Grade existing grades that are to remain but have been disturbed by the Contractor's operations.

3.10.2 Spreading Topsoil

Clear areas to receive topsoil for the finished surface of materials that would interfere with planting and maintenance operations. Scarify subgrade to a depth of 2 inches. Do not place topsoil when the subgrade is frozen, extremely wet or dry, or in other conditions detrimental to seeding, planting, or grading Spread topsoil to a uniform depth of 4 inches over the designated areas.

3.10.3 Borrow Area

Grade to drain properly. Maintain and restore borrow pits.

3.10.4 Disposition of Surplus Material

Surplus or other soil material not required or suitable for filling, backfilling, or grading shall be disposed of by the contractor.

3.10.5 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.10.6 Pavement Repair

Repair pavement, curbs, and gutters as specified in Section 4, "SITEWORK FOR PIPELINES." Do not repair pavement until trench or pit has been backfilled and compacted as specified herein. Provide a temporary road surface of gravel crushed stone over backfilled portion until permanent pavement is repaired. Remove and dispose of temporary road surface material when permanent pavement is placed. As a minimum, maintain one-way traffic on roads and streets crossed by trenches. Fully open roads and streets to traffic within 14 days.

3.11 FIELD QUALITY CONTROL

Test backfill for moisture-density relations in accordance with ASTM D 698 as specified herein. Perform density and moisture tests in randomly selected locations and in accordance with ASTM D 1556 as follows:

A. Backfill in Road Shoulders: One test per 2,500 linear feet in each lift.
B. Backfill in Pavement Cuts: One test per 250 linear feet in each lift.
C. Backfill in Cleared and Grubbed Areas: One test per 1,000 linear feet in each lift.

PART 4 PAYMENT PROCEDURES

All excavations shall be considered unclassified earth excavations. See Section 3 of the General Requirements for Payment Procedure requirements.

PART 5 WARRANTY

The Contractor shall guarantee the work provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. All guarantees for materials, equipment and accessories provided under this section shall be obtained by the Contractor and submitted.

- END OF SECTION -

DETAILED SPECIFICATIONS

SECTION 4: SITEWORK FOR PIPELINES

PART 1 GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M140	(2005) Recommended Performance Guidelines for Emulsified Asphalt Slurry Seal

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C33	(2008) Standard Specifications for Concrete Aggregates
ASTM C602	(1995; Rev. A) Agricultural Liming Materials
ASTM E11	(1995) Wire-Cloth Sieves for Testing Purposes

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	Fertilizer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION STD. SPECIFICATIONS FOR ROADS AND STRUCTURES

Sections 846-1 through 846-3	(1991) Concrete Curb and Gutter, Curb and Gutter
Sections 848-1 through 848-3	(1991) Concrete Sidewalks and Driveways
Sections 850-1 through 850-3	(1991) Concrete Paved Ditch

1.2 SITE PREPARATION

1.2.1 Existing Facilities

The Contractor shall provide protection for all existing structures, buildings, and utilities against all construction activity. The Contractor shall protect and preserve the Owner harmless against damage and claims resulting from these activities.

1.2.2 Streets and Highways

Effective barricades, danger signals and signs on all streets and in other locations where required for the protection of the work and the safety of the public, shall be provided, erected and maintained by the Contractor. Barricades and obstructions that encroach on, or are adjacent to, public rights of way shall be properly lighted between the hours of sunset and sunrise. The Contractor shall conform to all city, state and local laws and regulations in the use of streets and highways. The Contractor shall be responsible for all damages occurring due to neglect or failure to meet these requirements. When dictated by conditions that might endanger the public, a watchman shall be provided to fulfill the requirements stated herein.

1.2.3 Traffic Flow and Continuance of Services

The work shall be arranged in a manner that will cause a minimum of disturbance to vehicular and pedestrian traffic. Adequate ingress and egress to both private and public property shall be provided by the Contractor during all stages of construction. Without written approval from the city or utility company, existing services shall not be interrupted by the construction work.

1.3 PRELIMINARY WORK

1.3.1 Rights of Way

Adequate working space shall be cleared along the pipe lines and space shall be provided for control stakes and hubs. Trees and permanent structures not located within the right of way shall be removed only as directed.

1.3.2 Valuable Trees and Shrubs

When the construction work involves the removal of valuable trees and shrubs on existing public rights of way, the work shall be done in cooperation with the city, county, or state.

1.3.3 Protection of Private Property

The Contractor shall provide protection for privately owned trees and shrubs bordering the right of way and shall take full responsibility for any damage that does occur.

1.3.4 Roadways and Bridges

Existing roads, subject to interference by the Contractor's work, shall be kept open in all cases. The Contractor shall provide, erect and maintain, at his own expense, effective barricades on which shall be placed acceptable warning and/or detour signs at each side of any road obstruction caused by the operations of the Contractor. All barricades shall comply with OSHA requirements and State or local laws, whichever is most strenuous. The Contractor shall protect all public roads and bridges, which may be damaged by, interfered with, or given undue, wear by reason of the work, and shall repair or replace them if damaged, at his own expense, to the satisfaction of governmental authorities and the Owner. When questions arise as to safe methods or suitable protection, the Contractor shall confer with the Owner but full responsibility for results shall rest with the Contractor.

1.4 FENCES AND GATES

The Contractor shall not cut temporary openings or take down fences until he has contacted the property owner, tenant or occupant and arranged the ingress and egress to the right-of-way. The Contractor shall replace all fences and gates removed for construction in like kind. Payment for fence and gate removal and replacement shall be by the Contractor. In each case where the fence is opened, braced posts shall be installed capable of holding the tension in the fence wires so that the adjacent fence spans will not become slack. Where temporary openings are immediately adjacent to the corner post, the fence shall be firmly attached to the brace post, and the fence wire shall be removed or cut at the corner post. At other locations the fence openings shall be made by cutting the wires near one of the braced fence posts. In both the above cases, a gate shall be installed by the Contractor. The Contractor shall be held responsible for damage to crops, livestock, or other property caused by his failure to keep fences, gates, and gaps in proper condition. Damage claims resulting from the Contractor's negligence with respect to construction and maintenance and use of these gates, fences and gaps shall be the Contractor's full responsibility.

1.4.1 Electric Fences

The continuity of electric fences shall be maintained at all times.

1.5 ARCHEOLOGICAL

If the Contractor, during the prosecution of work, encounters an unidentified archaeological or other cultural resource within the work area, the Contractor shall immediately stop work and notify the Engineer.

PART 2 MATERIALS

2.1 PATCHING MATERIALS

Asphalt and concrete patching materials shall be as described on the detailed drawings.

2.2 SEED

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with DOA FSA and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.2.1 Lime

ASTM C602, commercial agricultural limestone containing a minimum of 85% of total carbonates and 15% magnesium. Provide the following ASTM E11 graduation: 50% will pass through a 50 mesh screen and 90% will pass through a 10 mesh screen. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.

2.2.2 Fertilizer

Fertilizer mixtures not to exceed one percent granular dust and CID A-A-1909, as specified below. Organic, granular fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

10 percent available nitrogen
20 percent available phosphorus
20 percent available potassium

2.2.3 Mulch

Acceptable mulch shall be the materials listed below or any approved locally available material that is similar to those specified. Low grade, musty, spoiled, partially rotted hay, straw, or other materials unfit for animal consumption will be acceptable. Mulch materials, which contain matured seed of species that would volunteer and be detrimental to the proposed overseeding or to surrounding farmland, will not be acceptable. Straw or other mulch material which is fresh and/or excessively brittle, or which is in such an advance stage of decomposition as to smother or retard the planted grass, will not be acceptable.

2.2.3.1 Straw

Straw shall be the threshed plant residue of oats, wheat, barley, rye or rice from which grain has been removed as approved by the Engineer.

2.2.3.2 Asphalt Binder

Asphalt binder material shall conform to the requirements of AASHTO M140, Type SS-1, or RS-1 as appropriate.

2.3 EROSION CONTROL MATERIALS

All erosion control matting, silt fencing, etc.; shall be as detailed on the project drawings.

2.4 DRIVEWAY STONE

ABC stone meeting NCDOT standards unless otherwise described on the project drawings.

PART 3 EXECUTION

3.1 GRAVEL DRIVEWAY REPAIR

Replace gravel in cut portions of driveways with 6” of compacted ABC stone

3.2 CLEARING AND GRUBBING

Clearing and grubbing shall be performed in areas indicated and where required for construction.

3.2.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Cut off flush with or below the original ground surface trees, stumps, roots, brush, and other vegetation in areas to be cleared, except for trees and vegetation indicated or directed to be left standing. Apply herbicide in accordance with the manufacturer’s label to the top surface of stumps designated not to be removed.

3.2.2 Tree Removal

Where indicated, remove designated trees and stumps from areas outside those areas specified for clearing and grubbing.

3.2.3 Pruning

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.2.4 Grubbing

Remove and dispose of roots larger than 3 inches in diameter, matted roots, and designated stumps from the indicated grubbing areas. Excavate this material together with logs, organic and metallic debris, brush, and refuse and remove to a depth of not less than 18 inches below the original soil surface in areas indicated to be grubbed and in areas indicated as construction areas under this contract Fill depressions made by grubbing with suitable material and compact to make the new surface conform with the existing adjacent surface of the ground.

3.2.5 Disposal of Cleared and Grubbed Material

All refuse from the clearing and grubbing operation shall be disposed of either by burning or removal to a dump area that is approved by the Owner. The Contractor shall obtain a burning permit from the city fire chief before any burning is started. Burning, if approved, shall be done in such a manner that does not create hazards such as damage to existing structures, trees and vegetation, interference with traffic and construction in progress. When the construction site is outside the city limits and burning is required, proper permits shall be obtained from the city, county or state officials. All disposals by burning shall be kept under constant supervision until all fires have been extinguished. All burning shall comply with all state and local laws relative to the building of fires.

3.3 PAVEMENT REMOVAL AND REPLACEMENT

3.3.1 Removal

When pipe is to be laid in or across existing paved streets, driveways, sidewalks and swales, the pavement shall be cut to true and neat lines as directed by the Engineer. Power driven cutting saws are preferred; pavement breakers driven by air compressors are acceptable if approved by the Engineer. All broken pavement shall be removed before trenching is started.

3.3.2 Replacement

The pipe trench shall be backfilled with granular select material to within 8 inches of the pavement surface, compacted and finished per the plan details or as directed by the N.C. Department of Transportation. Base and sub-base shall be maintained in a workmanlike manner until the surface has been replaced in a manner consistent with the plans and specifications. Cut areas shall be maintained by the Contractor in a safe, passable condition until paved. Should the area create a

dusty condition, the Contractor shall remedy this condition by the use of water or calcium chloride.
Special care shall be given to the areas cut in traffic lanes and intersections by placing crushed stone and maintaining in a smooth condition at the Contractor's expense.

3.3.2.1 Asphalt Replacement

The edges of the asphalt shall be neatly trimmed to a new face and mopped with asphalt cement. The asphalt surface shall be placed and thoroughly rolled to a smooth, dense surface true to adjacent areas of the street. The asphalt surface course shall consist of Type I-2 bituminous concrete surface course in accordance with North Carolina Department of Transportation Specifications.

3.3.2.2 Concrete Replacement

Concrete replacement shall be performed in accordance with North Carolina Department of Transportation Standard Specifications for Roads and Structures, 1991, Sections 848-1 through 848-3 and 850-1 through 850-3.

3.3.2.3 Curb and Gutter Replacement

Existing curb and gutter removed, disturbed or destroyed by construction, shall be replaced or repaired in a manner consistent with North Carolina Department of Transportation Standard Specifications for Roads and Structures, 1991, Sections 846-1 through 846-3.

3.3.2.4 State Highway Crossings

All construction related to state highway crossings shall be in full compliance with all requirements of the permit and to the satisfaction of the Department of Transportation.

3.4 WETLANDS

In wetland areas where a compaction of the backfill cannot be obtained the Contractor shall install compacted gravel 6" below the pipe and up to the centerline of the pipe. Crushed stone or crushed gravel used for pipe bedding shall meet ASTM C33 gradation 57.

3.5 SEEDING AND MULCHING

3.5.1 General

Provide soil preparation, fertilizing, seeding, sprigging, and surface top dressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor’s operations.

3.5.2 Soil Preparation

Remove existing topsoil to a minimum depth of 2 inches and stock pile. After areas have been brought to finish subgrade elevation, thoroughly till to minimum depth of 6 inches by scarifying, disking, harrowing, or other methods approved by the Engineer. Remove debris and stones larger than one inch in any dimension remaining on surface after tillage. Spread stock piled topsoil evenly to provide positive drainage. Provide off-site topsoil to meet indicated finish grade. Do not spread topsoil when frozen or excessively wet or dry. Thoroughly mix subgrade and topsoil and off-site topsoil to a depth of 8 inches by disking, harrowing, tilling or other method approved by the Engineer. Correct irregularities in finished surfaces to eliminate depressions. Protect finished prepared soil areas from damage by vehicular or pedestrian traffic. Provide off-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, soil conditioners into soil a minimum depth of 6 inches by disking, harrowing, tilling, or other method approved by the Engineer. Remove debris and stones larger than one inch in any dimension remaining on the surface after tillage. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.5.3 pH Adjustment

Lime shall be applied at the rate of 4,000 lbs. per acre and mixed thoroughly with the topsoil as the seed bed is prepared. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original condition before being used. Fertilizer Application

Fertilizer used for topdressing on all project areas except slopes 2:1 and steeper shall be 10-20-20 grade and shall be applied at the rate of 500 lbs. per acre (560 kg per hectare). On slopes 2:1 and steeper the grade shall be 16-8-8. Upon written approval of the Engineer, fertilizer rate can be adjusted provided the ratio for each grade remains the same to provide the same amount of plant food as the original analysis.

3.5.4 Seeding

Do not seed when ground is muddy frozen snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Engineer starting the special conditions and proposed variance. Apply seed within twenty-four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

Seed shall be a sewed per acre according to the following schedule:

January 1 – December 31

50#	(55 kg)	Tall Fescue
5#	(6 kg)	Centipede
50#	(55 kg)	Pensacola Bahiagrass
500#	(560 kg)	Fertilizer
4000#	(4500 kg)	Limestone

Slopes 2:1 and steeper and Waste and Borrow Locations:

January 1 – December 31

75#	(85 kg)	Tall Fescue
500#	(560 kg)	Pensacola Bahiagrass
500#	(560 kg)	Fertilizer
4000#	(4500 kg)	Limestone

Add 10# Kobe or Korean Lespedeza to the above mixtures May 1 – August 31. On cut and fill slopes 2:1 or steeper add 30# Sericea Lespedeza January 1 – December 31.

Quantities stated are in terms of total seed of the specified quantity. The types of seed shall be mixed thoroughly prior to sowing. All sowing of seed shall be completed within the time limit of the contract, or unless otherwise authorized by the Engineer.

3.5.4.1 Broadcast and Drop Seeding

Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.5.4.2 Drill Seeding

Use grass seed drills. Drill seed uniformly to average depth of 1/2 inch.

3.5.4.3 Hydroseeding

Mix seed, fertilizer, and wood cellulose fiber in required amount of water to produce a homogeneous slurry. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Cover shall allow rainfall or applied water to percolate to underlying soil.

3.5.4.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.5.5 Mulching

Mulch shall be applied immediately after seeding. The spreading of the mulch shall be by hand methods, blower, or other mechanical methods, provided a uniform covering is obtained. Mulch material shall be furnished, hauled and evenly applied on the area shown on the plans or designated by the Engineer. Straw shall be spread over the surface to a uniform thickness at the rate of three (3) tons per acre to provide a loose depth of not less than 1-1/2 inches nor more than three (3) inches. Mulch may be blown on the slopes and the use of cutters in the equipment for this purpose will be permitted to the extent that at least 95% of the mulch in place on the slope shall be 6 inches or more in length. When mulches applied by the blowing method are cut, the loose depth in place shall be not less than one (1) inch or more than two (2) inches.

3.5.5.1 Securing Mulch

The mulch shall be held in place by asphalt binder on all slopes greater than 3 to 1 or as directed by the Engineer. Where mulches have been secured by either of the asphalt binder methods, it will not be permissible to walk on the slopes after the binder has been applied.

3.5.5.2 Care and Repair

The Contractor shall care for the mulched area until final acceptance of the project. The Contractor shall be required to, at his expense, repair or replace any mulching that is defective or becomes damaged until the project is finally accepted. If the "Asphalt Spray" method is used, all mulched surfaces shall be sprayed with asphalt binder material so that the surface has a uniform appearance. The binder shall be uniformly applied to the mulch at the rate of approximately 8.0 gallons per 1,000 square feet, or as directed by the Engineer, with a minimum of 6.0 gallons and a maximum of 10 gallons per 1,000 square feet, depending on the type of mulch and the effectiveness of the binder securing it. Bituminous binder material may be sprayed on the mulched slope areas from either the top or the bottom of the slope. An approved spray nozzle shall be used. The nozzle shall be operated at a distance of not less than four (4) feet from the surface of the mulch and uniform distribution of the bituminous material shall be required. A pump or an air compressor of adequate capacity shall be used to ensure uniform distribution of the bituminous material.

3.6 EROSION CONTROL

The Contractor is instructed to control sedimentation runoff by methods approved by the Engineers during the course of construction of this project. The Contractor is reminded that all

work shall meet all applicable requirements of the rules and regulations of erosion and sediment control as published by the Department of Environment and Natural Resources, North Carolina Sedimentation Control Commission.

3.6.1 Sequence

A. Begin pipe laying activity.

B. Road shoulders and cleared and grubbed areas shall be seeded and mulched as per the specifications within 30 working days of pipe installation on all portions of the project. approval of final grade for disturbed road shoulders must be received from North Carolina DOT District Engineer prior to seeding and mulching.

C. Install erosion control devices as detailed in project plans as directed by the Engineer.

D. Call for on-site inspection by the sedimentation and erosion control inspector.

E. When construction is complete and all road shoulders are stabilized, call for inspection by the sedimentation and erosion control office.

F. When the site is approved, remove temporary silt fence and sediment basins and seed and mulch resulting disturbed areas.

G. When vegetation is established call for final site inspection.

3.6.2 Temporary Erosion Control Measures

All temporary erosion control features such as silt fence, sediment traps and stream bank stabilization measures shall be constructed according the project drawings.

3.7 MOWING

Mowing is not required.

PART 4 PAYMENT PROCEDURES

See Section 3 of the General Requirements for Payment Procedure requirements.

PART 5 WARRANTY

The Contractor shall guarantee the work provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. All guarantees for materials, equipment and accessories provided under this section shall be obtained by the Contractor and submitted.

-- END OF SECTION --

DETAILED SPECIFICATIONS

SECTION 5: CHEMICAL FEED SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1	(1998) Hazardous Industrial Chemicals - Material Safety Color Data Sheets - Preparation

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1785	(1999) Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 1998	(1997) Polyethylene Upright Storage Tanks
ASTM D 3299	(2000) Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM D 5421	(1993) Contact Molded "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
ASTM E 1067	(1989; R 1996) Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B501	(1998) Sodium Hydroxide (Caustic Soda)
AWWA B502	(1994; Addendum 1997) Sodium Polyphosphate, Glassy (Sodium Hexametaphosphate)
AWWA B503	(1994; Addendum 1997) Sodium Tripolyphosphate

HYDRAULIC INSTITUTE (HI)

HI 7.1-7.5	(1994) Controlled Volume Pumps
HI 9.1-9.5	(1994) Pumps - General Guidelines

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 7	(2003) Enclosures for Indoor Use in Hazardous Locations
NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment

1.2 GENERAL

The Contractor shall provide all materials, labor, equipment and all other items necessary to install, test and place into operation liquid transfer pumps and liquid metering pumps including valves, fittings, markings, control panels, etc. necessary for a complete functioning system.

1.3 SUBMITTALS

Submit six (6) copies of the following in accordance with the requirements as set forth in Section 4 of the “General Requirements”.

1.3.1 Shop Drawings

Detail drawings containing complete piping, wiring, schematic, flow diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and

appurtenances, and equipment relationship to other parts of the work including clearances for installation, maintenance and operation.

1.3.2 Product Data

Manufacturer's descriptive and technical literature, catalog cuts, performance charts, and pump curves. List of materials, list of equipment, including a complete list of parts and supplies with current unit prices and source of supply. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly. Material safety data sheets in conformance with ANSI Z400.1 each chemical. Installation instructions and framed instructions. List of parts recommended by the manufacturer to be replaced after 1 and 3 years' service.

1.3.3 Test Reports

A copy of the ASTM E 1067 test report shall be furnished with each fiberglass tank. Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

1.3.4 Certificates

Two copies of certification stating that each chemical supplied meets the specified requirements.

1.3.5 Operation and Maintenance Data

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. The instructions shall include as-built drawings of the piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. Flow diagrams shall be included in the instructions. Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble-shooting guides.

1.4 SYSTEM DESCRIPTION

Chemical feed systems shall consist of a chemical supply storage tank from which the chemical solution shall be pumped through piping or tubing, as appropriate, to the point of application. Each chemical feed system shall include controlled volume pumps, tanks, mixers, gauges, back pressure regulators, strainers, pressure relief valves, sight glasses and flow metering devices, check valves, and hand valves.

1.4.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site.

1.4.2 Design Requirements

Design and fabrication of the pumps shall be in accordance with HI 7.1-7.5 and HI 9.1-9.5 except as modified herein. Pump stands and platforms shall be adequate to support the pumping system.

1.4.3 Performance Requirements

Capacity and design of the chemical feed systems and accessories shall be suitable for 24-hour full load service in ambient, non-freezing conditions.

1.4.4 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.4.5 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify all dimensions in the field, and shall advise the Engineer of any discrepancy before performing the work.

1.6 DELIVERY AND STORAGE

Material and equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation, dirt, dust, or other contaminants.

1.7 AUXILIARY EQUIPMENT AND SPARE

Concurrent with delivery and installation of the specified equipment, auxiliary equipment and spare parts shall be furnished as follows:

a. Spare parts for each different item of material and equipment specified including all of the parts recommended by the manufacturer to be replaced after 1 and 3 years' service.
b. For each machine: one extra of each part used that is made from glass, hard rubber, or clear plastic; one extra set of solution-hose connections; one extra set of diaphragms, two filler plug seal washers; two ball checks; two seats; two complete sets of all gaskets; one spare diaphragm for each back pressure regulator; one hydraulic plunger assembly for each different size metering pump; one of each type of material back pressure regulator, with three spare springs and fluorocarbon resin diaphragms for each; one spare diaphragm and air valve for pulsation dampener.
c. For each different size of direct current motor one SCR circuit board with 12 drive motor fuses and 12 SCR controller fuses; overload replacement elements for each size and type of motor.
d. One set of special tools for each type of equipment including calibration devices, and instruments required for adjustment, calibration, disassembly, operation, and maintenance of the equipment.
e. One residual-chlorine comparator employing permanent color standards and 13- or 26-millimeter viewing depth sample tubes, with corrosion-resistant case, color disk reading from 0.0 to 1 part per million, and sufficient DPD tablets for 100 tests.
f. Two pairs of safety goggles and/or face shields, two chemical resistant aprons, and two pairs of chemical resistant gloves in one or more wall mounted steel cases.
g. One assembly tool for tubular diaphragm.
h. One lever type grease gun or other lubricating device for each type of grease required.
i. One or more steel tool cases mounted on the wall in a convenient location complete with flat key locks, two keys, and clips or hooks to hold each special tool.

PART 2 PRODUCTS

2.1 CHEMICALS

A 30 day supply at the maximum pumping rate for each feeder or pair of duplexed feeders shall be provided. Chemicals shall conform to the following:

2.1.1 Bases

AWWA B501 caustic soda, AWWA B511 potassium hydroxide, AWWA B201 soda ash (sodium carbonate).

2.1.2 Disinfecting Agents

AWWA B302 ammonium sulfate, AWWA B300 hypochlorites.

2.1.3 Sequestrants

AWWA B502 sodium polyphosphate, glassy (sodium hexametaphosphate), AWWA B503 sodium tripolyphosphate.

2.2 LIQUID CHEMICAL FEED EQUIPMENT

2.2.1 General

The liquid chemical feed system shall meter chemicals shown on the drawings to the points of application as shown on the plans. All chemical metering pumps, accumulators, pressure gauges, ball valves, check valves, unions, pressure relief valves, and calibration columns as specified herein and shown on the contract plans shall be supplied and coordinated by one supplier. All equipment shall be suitable for utilization with the chemical specified. Pumps shall be controlled volume pumps as defined by HI 7.1-7.5. Each pump shall be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and shall be capable of continuous operation at rated capacity. Accuracy shall be plus or minus 2 percent over a 100 to 1 range from the required maximum capacity to the minimum pumping rate. Net positive suction head required shall not exceed 90 percent of the net positive suction head available, as installed. Construction shall be as simple as practicable to provide equipment isolation, bypass and reliable service and to be readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

2.2.1.1 Chemical Feed Control Signals

The chemical feed pumps shall start and stop in response to flow switch status. Regardless, the chemical feeders shall have DC motors, the speed of which may be paced from a 4-20 mA signal if so desired by the Owner.

2.2.2 Metering Pumps

The pumps shall be of the hydraulically balanced diaphragm type, wherein a measuring plunger reciprocates within a cylinder and causes hydraulic oil to deflect a tubular diaphragm. The pump shall be self-priming and capable of indefinite operation without process fluid. All pumps shall be capable of handling the treatment chemicals in their full commercial strength. All pumps shall be provided with a cast or stainless steel pump base which will be interchangeable with the heads of each pump for spare parts purposes. Pumps shall be supplied with food grade intermediate fluid oil. The pumps shall be equipped with integral process fluid suction and discharge ball check valves that can be removed without dismantling the piping. Pump check valve clamp plates and bolt assemblies shall be of the same material as the pump head. The pump system shall be hydraulically balanced by three automatic valves. A make-up valve shall permit the flow of replacement oil from the oil reservoir to the area between the plunger and the diaphragm. Mechanically actuated meter pumps will not be accepted. A bypass valve shall release oil and terminate the pumping action when the oil ahead of the plunger is under excess pressure from accidental valve closure of the stoppage to protect the pump mechanism. A bleeder valve shall automatically and continuously release any oil or air vapors. The chemical solution being

pumped through the reagent head shall be isolated from the rest of the pump by means of a diaphragm. The pump shall be leak-free. The pump's internal working components shall be completely submerged in oil with no interval lubricator pumps. All drive components must be provided with a two (2) year warranty from the manufacturer. The pump must be supplied with an optic oil indicator for the operator to easily check the oil without the removal of any pump parts. No stuffing box shall be allowed. Leakage past the piston shall be replenished on the suction stroke by an automatic compensator valve, which draws oil from the oil reservoir. The drive end of the pump shall be of the cycloidal motion type. The pump capacity shall be adjustable from 0 to 100 percent of the rated capacity by automatic adjustment with manual override, and shall be accurate to +/- 1 percent of maximum over a 100 to 1 flow range. Stroke adjustment shall be accomplished using a micrometer adjustment with over 20 turns. Mechanically actuated diaphragm pumps shall not be permitted. The automatic stroke controller shall contain a SCR drive for 4 to 20 ma input for auto stroke control. The auto stroke controller shall have on board calibration, operator interface with LCD readout, on board batch and turndown programming and all contained in a NEMA 7 enclosure. If the internal SCR is provided within the auto stroke controller in a NEMA 7 housing on the pump, the drive control panel for the will not be required. The metering pump supplier shall provide one half gallon of touch-up paint for the chemical feed pumps. Any manufacturers bidding must have at least five (5) years' experience with tubular diaphragms in service. Paint shall be suitable for use with chlorine and fluoride fumes in the atmosphere. Metering pumps shall be Pulsatron or equal.

2.2.2.1 Metering Pump Accessories

The metering pump supplier shall supply metering pump accessory equipment as specified herein and as indicated in the contract drawings including pressure gauges, calibration chamber, pulsation dampeners, pressure relief valves, and back pressure valves.

a. Pressure Gauge: Supply a pressure gauge for installation by the Contractor on the discharge piping of each metering pump. Pressure gauge shall be plastic with a clear acrylic gauge guard or equivalent with Type 1, Grade 1, PVC and a 2-1/2" diameter dial indicator. Mounting of the gauge shall be 1/4" NPT. A diaphragm protector shall be supplied with each gauge to include a Teflon O-ring seal at the gauge, liquid filled upper housing, flexible diaphragm, and a 1/2" process connection. The gauge shall be provided with a chemical protector for the internals of the gauge.
b. Pulsation Dampener: Supply a pulsation dampener for each metering pump. Pulsation dampener shall have a gas volume of 38 cubic inches and shall have a bottom chamber of 316 stainless steel. The diaphragm material shall be supplied for the specific chemical for which the dampener is used without corrosion, wear, or other cause of abnormally short life. Each dampener shall be equipped with a charging valve and gas pad pressure gauge. The pulsation dampener shall be rated for 200 psig with over range protection up to 300 psig. Process connection to be 1/2" female NPT.
c. Pressure Relief Valve: Supply a pressure relief valve for each metering pump. The ball, seat, ball guide, and lower body shall be constructed of 316 stainless steel, or material suitable for solution. The diaphragm shall be Viton-A. Valve set pressure shall be coordinated by the metering pump supplier. The capacity of the valve at set pressure shall be not less than 6 gym. The valve

shall be 1/2" diameter and shall be nonchattering with screwdriver adjustment of pressure settings.

d. Back Pressure Valve: Supply a back pressure valve for each metering pump. The body and seat of the back pressure valve shall be 316 stainless steel or chemical suitable for the chemical pumped. The diaphragm shall be Teflon. The bonnet shall be of cast steel construction. The back pressure valve shall consist of a pressure exerted by an adjustable assembly guided in a cast steel bonnet which puts pressure on a lower guide spring plate to a .375" guide ball, to a piston disc which exerts uniform pressure on the Teflon diaphragm. Sizing of the back pressure valve shall be the responsibility of the manufacturer with the condition that the valve shall not be less than 1/2" diameter. The back pressure valve shall have a flow capacity of not less than 6 gpm pulsating flow from a single-acting simplex metering pump.

e. Pump, Pipe and Fittings: Chemical feed system integrator shall supply the chemical metering pump discharge pipe and fittings including stainless steel fittings, stainless steel quick coupling disconnect fittings, flexible discharge pipe, etc., from the discharge of the pump to the point of connection at the PVC fittings, including stainless steel threaded adapters. This shall also include flexible pipe, quick coupling disconnects and fittings as shown for the calibration chambers.

f. Calibration Standpipe: Chemical metering equipment shall be provided with a calibration standpipe for measuring pump output. The standpipe shall allow convenient observation of the change of fluid level for at least 1/2 minute at full stroke and maximum speed settings, and shall be Schedule 80, clear PVC pipe conforming to ASTM D 1785 with Schedule 80 fittings equipped with a flanged connection to the pump manifold and an end cap fitted with a PVC vacuum breaker and ball valve for air venting. The standpipe shall have a clear, observable length of at least 12 inches and shall be permanently calibrated in gallons and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.2.3 Caustic Feed System

The following shall be provided for caustic soda solution delivery:

a. Concentration: 50 percent.
b. Number of pumps: 2.
c. Type of pump: Mechanically or hydraulically coupled diaphragm.
d. Configuration: Duplex.
e. Controls: Automatic, or semiautomatic rate adjustment.
f. Feed/flow rate: Minimum 0.25 gph; maximum 1.3 gph.
g. Back pressure at point of injection: 60 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 70 psig. Regulators shall be of polyvinyl chloride construction with fluorocarbon resin diaphragms.
h. Suction valve cartridge: Double ball check.
i. Discharge valve cartridge: Double ball check.
j. Materials of construction allowed for wetted parts: PVC

2.2.4 Hypochlorite Feed System

The following shall be provided for hypochlorite solution delivery:

a. Concentration: 12 percent
b. Number of pumps: 2.
c. Type of pump: Mechanically or hydraulically coupled diaphragm.
d. Configuration: Duplex.
e. Controls: Automatic or semiautomatic rate adjustment.
f. Feed/flow rate: Minimum 0.25 gph; maximum 1.6 gph.
e. Back pressure at point of injection: 60 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 70 psig. Regulators shall be of polyvinyl chloride construction with fluorocarbon resin diaphragms.
f. Suction valve cartridge: Double ball check.
g. Discharge valve cartridge: Double ball check.
h. Materials of construction allowed for wetted parts: PVC

2.2.5 Phosphate Feed System

The following shall be provided for sodium polyphosphate solution delivery:

a. Weight: 7 lbs. per gallon.
b. Number of pumps: 2.
c. Type of pump: Mechanically or hydraulically coupled diaphragm.
d. Configuration: Duplex.
e. Controls: Automatic or semiautomatic rate adjustment.
f. Feed/flow rate: Minimum 0.07 gph; maximum 0.22 gph.
e. Back pressure at point of injection: 60 psig. Back pressure regulating valve shall be installed on the pump discharge and shall be factory adjusted to crack open at 65 psig. Regulators shall be of polyvinyl chloride construction with fluorocarbon resin diaphragms.
f. Suction valve cartridge: Double ball check.
g. Discharge valve cartridge: Double ball check.
h. Materials of construction allowed for wetted parts: PVC

2.3 DRIVES FOR LIQUID CHEMICAL FEED PUMPS

The metering pumps shall be supplied with and driven by direct current electric motor drives.

2.3.1 Electric Motor Drive

Electric motor shall be of sufficient capacity to operate the chemical metering equipment under all operating conditions without exceeding their rated nameplate current or power, or their specified temperature limits. The motors shall have starting characteristics and ruggedness necessary under the actual conditions of operations or clean-up procedures used in the areas where they will be located. Alternating current motors with power rating of 1/3 hp or less shall be 115 volts, single-phase, 60-Hz service; motors with power rating in excess of 1/3 hp shall be

460 volts, three-phase, 60-Hz service. Electrical features of direct current motors, including the ratings of the motors, shall be compatible with the capabilities and ratings of the rectifier controllers with which they are used.

2.4 SOLUTION TANKS

Tanks shall be fully resistant to the effects of the full-strength and fully diluted solution concentrations. Tanks shall be pressure rated for 1.5 times the weight of solution at full capacity. Each tank shall have the capacity listed and shall be equipped with a fill nozzle, vent, discharge, level instrument, drain, and two spare connections. Tanks shall be reinforced to withstand all forces when full of solution. Tanks shall be completely shop fabricated with no field assembly permitted. Drain connections shall provide complete drainage of the tank. All gaskets shall be fluorocarbon elastomer; nuts and bolts shall be Type 316 stainless steel; and steel supports shall be either stainless or epoxy coated. Each tank shall be furnished with a calibrated side wall strip to indicate volume. A permanent plastic sign indicating the tank contents shall be attached to the front of each tank. Tanks smaller than 36 inches in diameter shall be fitted with removable lids. Tanks larger than 36 inches in diameter shall be fitted with 24 inch manways. Polyethylene tanks shall be manufactured in accordance with ASTM D 1998. Fiberglass tanks shall be manufactured in accordance with ASTM D 3299 with flanged openings in accordance with ASTM D 5421. Tanks designated to be double walled. Dissolving baskets and tank mixers shall be provided as indicated and shall be sized to provide initial mixing and to maintain suspensions. Floating seals shall be provided as indicated. Tanks shall set atop steel stands as indicated by the drawings.

2.4.1 Caustic Tank

Tanks shall be sodium hydroxide (caustic soda) solution resistant.

a. Number of tanks: As indicated by plans.
b. Day Tank Capacity: As indicated by plans.
c. Sign shall read: "DANGER - ALKALI (SODIUM HYDROXIDE) SOLUTION."
d. Containment: Secondary containment.

2.4.2 Hypochlorite Tank

Tank shall be hypochlorite solution resistant.

a. Day Tank Capacity: As indicated by plans.
b. Sign shall read: "DANGER - CHLORINE"
c. Containment: secondary containment.

2.4.3 Phosphate Tank

Tank shall be sodium polyphosphate solution resistant.

a. Number of tanks: 1 – Day Tank.
b. Minimum tank capacity: 100 gallons
c. Sign shall read: "CAUTION – SODIUM PHOSPATE SOLUTION - SLIP HAZARD."
d. Containment: Secondary containment.

2.5 INJECTORS

Injectors for chemical solution shall be introduced into the pipeline mains by means of a hard rubber or plastic injection nozzle, or by means of a suitable diffuser tube inserted through a corporation cock. The device for introducing the solution into a pressure main shall be constructed in such a way that accidental breakage of discharge hose or tubing will not cause water to escape from the pipeline, and will allow disassembling of the unit without leakage.

2.6 PIPING

2.6.1 Backflow Preventer

Backflow prevention devices or air gaps shall be provided on tank fill lines in accordance with NAPHCC Plumbing Code.

2.6.2 Chemical Solution Piping

Provisions shall be incorporated to allow solution piping to be conveniently and safely bled of trapped air and minimize infiltration of air bubbles. Chemical solution piping shall be as indicated.

2.7 ELECTRICAL WORK

Electric motor-driven equipment shall be provided complete with motor, motor starter, and controls. Electrical equipment and wiring shall be in accordance with Section 8, Electrical. Hazard classifications indicated on the drawings shall be implemented in accordance with NFPA 70.

2.7.1 Motor Starters

Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified.

2.7.2 Control and Protective Devices

Manual or automatic control and protective or signal devices required for the operation and any control wiring required for controls and devices shall be provided. Motor controls shall conform to NEMA ICS 1 or NEMA ICS 2. Equipment shall be prewired to the maximum

practicable extent. Control cabinets shall conform to the requirements of UL 50, NEMA 250, Type 4, Type 7, or Type 12.

2.7.3 Metering Pump Panels

Each system of chemical feed pumps shall be supplied with a panel to contain the control components to drive the pump, control the output of the pump (manually and automatically) indicate the pumps status, output and input to the computer system, accept 4 to 20 ma signals, supply surge protection for 110 volts and 4 to 20 ma signals. For a single pump panel, the minimum dimensions shall be 24" high, 16" wide and 10" deep. The dual pump panel shall have minimum dimensions of 24" high, 28" wide, and 10" deep. The three pump panel shall have dimensions of 36" wide, 24" high and 10" deep. The four pump panel shall be 42" wide, 24" high and 10" deep. The panel construction shall be 316 stainless steel and polished after fabrication. No darkened spots on the panel, unground cuts or welding or unfinished fabrication of any type will be allowed. Chemical feed panels are not required with the Pulsafeeder Pulsar, Model 340 or Pulsatron pumps. Each panel shall carry a U.L. label after the complete panel is fabricated and wired with all components. Each panel shall carry a power on light, speed indicator for each pump, speed pot for each pump, glove type hand-off automatic switch for each pump and mixer motor, and name plates with a minimum of 1/4" lettering for each function on each panel. Internal to each panel shall be a steel subplate covering the entire back of each panel, 20 amp circuit breaker minimum for each panel, duplex receptacle, internal light, light switch, reliance DC drive (or prior approved equal) for each pump, 10 amp circuit breaker for each pump drive and mixer motor, ground buss for each panel for each component to be grounded, 10 spare terminal blocks over and above those needed for the initial operation, surge protection cards for all 4-20 ma signals into and out of each panel (one protection card per each signal line, and control relays for the appropriate outputs to start and stop field devices). Signal line protectors shall consist of cards especially fabricated for the application of track mounted 4 to 20 ma surge protection. Each card shall contain varistors (metal oxide varistors) line to line and line to ground inductors, zener diodes, gas tube arresters and fuses on a PC board which mounts in snap track. Each card with all the previous components shall be completely labeled with necessary information as a standard component so as not to need a special table or chart to show proper terminal connections. If the meter pump supplier uses the pulsar meter pump with the DLC controller and internal SCR drive, a meter pump panel is not required. The chemical metering pump supplier shall supply with each pump system all solenoids, needle valves, check valves and rotameters associated with dilution water if shown on the plans. Chemical feed panels are not required with Pulsatron pumps.

2.8 EQUIPMENT APPURTENANCES

Bolts, nuts, anchors, washers and all other types of supports necessary for the installation of the equipment shall be galvanized steel, cadmium plated or Type 316 stainless steel.

2.9 FACTORY PAINTING

Factory painting shall conform to manufacturer's standard factory finish, provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Coating shall be not less than 1.75 mils thick.

2.10 FACTORY TEST REPORT

Factory examination of fiberglass tanks shall be in accordance with ASTM E 1067 prior to shipping. A copy of the corresponding test report shall be furnished with each tank.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Chemical Feeding Equipment

Controlled volume pumps, equipment, and appurtenances shall be installed to provide a complete and integrated system in accordance with the instruction of the manufacturer and under the direct supervision of the manufacturer's representative.

3.1.2 Pipe, Tubing, Hangers and Supports

All chemical feed piping shall be Sch. 80 PVC unless otherwise noted on the contract drawings. The piping shall be securely mounted utilizing pipe hangers, unistrut, or an approved mounting system in areas readily accessible to the Owner. The piping shall be color coded and labeled with colored tape exhibiting the chemical name or sample point. The tape shall be applied at strategic points not to exceed 20' on center within all areas where pipe is visible. In exterior locations the pipe shall be insulated and wrapped with aluminum sheathing.

3.2 FIELD PAINTING

Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and top-coated with the manufacturer's standard factory finish provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Equipment, which did not receive a factory finish, shall be painted as specified in Section 09900 PAINTING, GENERAL. Coating shall be not less than 1.75 mils thick.

3.3 FIELD TESTING

After installation of each controlled volume pump, operating tests shall be carried out to assure that the chemical metering installation operates properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted. Reports of all tests shall be submitted prior to final acceptance of the installation.

3.3.1 Tanks

Tanks shall be cleaned of loose debris and dried prior to testing. Tanks shall be field tested for leaks or damage in shipment. The tanks shall be hydrostatically tested to or 1.5 times the system operating pressure, whichever is greater, to detect large leaks and then with the specified chemical to detect small leaks. Tanks shall be tested with each solution for a period of 24 hours at which time no visible leakage shall be evident. All pipes, hoses, pumps, water, power and other equipment required to convey the test liquids and to carry out the tests shall be supplied by the Contractor. Damage or leaks in tanks shall be repaired or tanks shall be replaced. Damaged ceramic tanks shall be replaced.

3.3.2 Metering Pumps

Pumps shall be tested to demonstrate that the pumps are capable of operating without vibration or leakage. Testing shall be performed at the maximum design flow rate and at half the design flow rate. Testing shall be demonstrated while controlled and operated in all feasible modes with the pumps operated singly and in unison. The response of each pump shall be plotted on curves for the various operating pressures encountered and the results shall be compared to the curves shown on the manufacturer's published pump data. If control characteristic curves are not available at the time of testing, the pump manufacturer's service engineer shall generate such curves for each pump. Pump curves shall graphically depict the pump displacement at 25, 50, 75, and 100 percent of motor speed for SCR equipped pumps, and at 25, 50, 75, and 100 percent of maximum stroke position for all pumps. Curves shall be generated only for the specified back pressure.

3.3.3 Time, Volume and Pumping Pressure

Pumps shall be tested by filling the standpipe with chemical and measuring the outage, with all other equipment valved off. The time, volume and pumping pressures shall be recorded.

3.3.4 Test Pressure

Tests shall be carried out at 50 and 60 psig. Back pressure valves shall be manually controlled for this testing, and shall be reset as necessary after testing. The time to deliver a given quantity of chemical at a given stroke and speed setting shall be the same at all pressures.

3.3.5 Flow

Pumps shall be tested to demonstrate zero gallons per minute flow at a zero stroke or speed setting. Failure to meet this test shall be cause for rejection.

3.3.6 Synchronization

The pumps shall be operated for a period of 4 hours to demonstrate that the double diaphragm systems do not lose their synchronization. Loss of synchronization shall also be cause for rejection and the pump shall be repaired or replaced as necessary. Repaired or replaced equipment shall be fully retested.

3.3.7 Chemical Waste

Chemicals wasted during testing procedures shall be neutralized to achieve a pH value between 6.5 and 9.5 and a chlorine concentration of not more than 1 percent (10,000 mg/L). All chemicals wasted during testing procedures shall be [routed to the sanitary sewer] [routed through the treatment process] at a rate that the process can assimilate without upset.

3.4 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams shall be posted where directed. Condensed operating instructions shall be posted as specified above.

3.5 FIELD TRAINING

The Contractor shall conduct a field training course for designated operating, maintenance and supervisory staff members. Training shall be provided for a total period of 4 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance instructions.

PART 4 PAYMENT PROCEDURES

See Section 3 of the General Requirements for Payment Procedure requirements.

PART 5 WARRANTY

The Contractor shall guarantee the work provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. All guarantees for materials, equipment and accessories provided under this section shall be obtained by the Contractor and submitted.

-- End of Section --

DETAILED SPECIFICATIONS

SECTION 3: WELL HOUSE ELECTRICAL AND MECHANICAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(2005) Standard for Electrical Steel Rigid Steel Conduit

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A36	(2008) Standard Specification for Carbon Structural Steel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

STD. 837	(1989) Standard for Qualifying Permanent Connections Used in Substation Grounding

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 3	(2004) PVC Fittings for Use with PVC Conduit and Tubing

UNITED LABORATORIES (UL)

UL 6	(2006) Electric Rigid Metal Conduit – Steel
UL 508	(2010) Industrial Control Equipment
UL 514	(2010) Metallic Outlet Boxes
UL 651	(2010) Sch. 40 and 80 Rigid PVC Conduit and Fittings
UL 1242	(2006) Electrical Intermediate Metal Conduit -Steel

1.2 DESCRIPTION

This section of the specifications includes the furnishing and installation of all labor, materials, tools, equipment, and operations necessary for the proper execution and completion of all electrical work indicated on the drawings and specified herein for the proposed well enclosures and chemical feed buildings. The new production well construction is complete for Well #24 including installation of 7.5 HP, 230V, 3-phase submersible pump. Well #8 is an existing production well that is equipped with a 3.0 HP, 200V, 3-phase submersible pump.

The Contractor shall furnish and install all conduit, cable, systems for power, and shall furnish and install raceways for special systems as specified herein and as indicated on the electrical drawings, complete and ready to operate in every respect, including connection of Owner furnished equipment, if applicable.

1.3 CODES AND ORDINANCES

All electrical work and materials shall comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), American Society for Testing and Material (ASTM), Insulated Cable Engineers Association (ICEA), National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), Underwriters' Laboratories (UL) and applicable local codes and regulations.

All electrical equipment shall be UL listed.

If discrepancies occur between laws, codes, ordinances, rules and regulations, and the specifications or drawings, each discrepancy shall be called to the attention of the Engineer in writing before the bids are submitted. That work which is shown or specified in violation of these rules and regulations shall be done in compliance with the regulations, and no claim for additional cost required to make implied systems complete will be accepted.

1.4 UTILITY COORDINATION, PERMITS AND FEES

The Contractor shall coordinate power service modifications with the local power utility and provide equipment in full conformance with their requirements.

The Contractor shall obtain all permits and inspections required for the completion of this contract.

1.5 WORKMANSHIP

Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved. Experienced and skilled electricians and mechanics under the supervision of a competent foreman shall perform work. Substandard workmanship will be cause for rejection of work and replacement by Contractor.

1.6 DRAWINGS AND SPECIFICATIONS

The drawings show the location and arrangement of conduits, ducts, and equipment, together with details of connections of certain principal items. The layout shown shall be followed as closely as circumstances will permit, but the Contractor shall lay out his work so as to avoid conflict with other contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members. The Contractor shall install at the proper time all necessary sleeves, hangers and inserts that will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of the above items.

The Contractor shall refer to the general drawings and cooperate fully with other contractors and trades while installing electrical equipment because of close space limits. In case of conflict, the Engineer shall be notified before proceeding with installation.

The drawings and specifications complement each other and together are intended to give a complete description of the work. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown on plans, shall be furnished the same as if mentioned or shown in both places. If conflicts exist, then the most stringent method shown or described should apply.

Any discrepancy, omission, or conflict found in plans or specifications shall be called to the immediate attention of the Engineer, prior to receipt of bids.

The drawings are not intended to show complete details. It is the Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement. The Contractor shall take all field measurements and be responsible therefore. Exact locations are to be defined in the field.

1.7 CUTTING AND PATCHING

The Contractor shall do any cutting of walls or structures required for the installation of work under this section. Holes through walls for passage of conduits shall be properly and neatly sleeved and grouted. Sleeves through exterior walls shall be effectively sealed against passage of water. All disturbed areas shall be refinished and left in a finished and matching condition and shall meet the approval of the Engineer.

1.8 ALLOWANCE FOR ADDITIONAL WORK

Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall be submitted and approved in writing. No claim for addition to the contract will be valid unless so ordered and approved by the Owner and Engineer.

1.9 AS INSTALLED PRINTS

The Contractor shall maintain a set of prints, showing exact location of all relocated equipment, concealed equipment, service accesses, hand holes, underground duct banks, and all other changes to the plans. This set of prints shall be kept current and turned over to the Engineer upon completion of the job. Dimensions shall be shown to locate all underground conduit duct banks from permanent reference points.

1.10 INCIDENTAL CONSTRUCTION WORK

The Contractor shall provide all openings as required for the electrical work. The Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications. He shall properly complete and finish up his work after other contractors have finished as the Engineer may direct. All excavating required for the installation of the system shall be done by the Contractor. Backfill shall be accomplished as specified in the appropriate section of the specifications.

1.11 CLEANING AND PAINTING

The Contractor shall at all times keep the Owner's premises, adjoining driveways and streets clean of rubbish caused by the Contractor's operations and at the completion of the work shall remove all the rubbish from and about the premises, all his tools, equipment, temporary work, surplus material and shall leave the area clean and ready for use.

The Contractor shall be required to perform touch-up painting on factory-finished equipment installed under this contract where necessary to repair damaged areas. All metal exposed to weather shall be properly painted. Any equipment installed where exposed to weather shall have all damaged areas cleaned, primed, and painted by the Contractor.

1.12 IDENTIFICATION

All equipment shall be identified and properly marked. All marking must meet the Engineer's approval. All markers shall be of appropriate size. Each panel, transformer, contactor, starter, and other piece of electrical equipment shall be identified as to their service.

All disconnect switches, junction boxes, motor controllers, and other equipment requiring electrical owner connection shall be marked with voltage present, as appropriate to designate 120, 208, 240, 277, or 480 volts and single or three-phase, as applicable.

1.13 MAINTENANCE AND OPERATING INSTRUCTIONS

The Contractor shall furnish to the Engineer five (5) complete sets of applicable drawings, instructions and parts lists on all equipment furnished, providing names and addresses of manufacturers or subcontractors and suppliers. Two (2) copies of manufacturer's warranties on all equipment shall be provided to the Owner and one (1) copy to the Engineer.

The one-year warranty period on all equipment and systems installed by this Contractor shall start upon final approval and acceptance following the installation and commissioning of the equipment.

1.14 SHOP DRAWINGS

Submit six (6) copies of the following in accordance with the requirements as set forth in Section 4 of the General Requirements.

1.15 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

The Contractor shall be responsible for furnishing suitable shelter and protection for all materials and equipment stored on the job. Equipment shall be protected from damage from any source both during storage and after installation until completion of the job. No damaged equipment will be accepted. Existing equipment removed from service shall be protected from damage and loss of parts until turned over to the owner.

PART 2 MATERIALS

2.1 ELECTRICAL MATERIALS AND METHODS

Materials and workmanship on all work installed under this contract shall be new and of the best quality and shall conform to the best practice for such work and be installed in accordance with manufacturer's recommendations and instructions, including all hardware and accessories recommended or appropriate. Any work or materials not specifically mentioned in these plans and specifications, but required to make this job a complete and workable system shall be furnished and installed by the Contractor.

Substitution for equipment specified must be equal in every respect and the Contractor shall base his proposal on the quality of materials and equipment covered in these specifications and shown on the drawings.

Where substitutions alter the design or space requirements indicated on the plans, the Contractor shall include all items of cost for the revised design and construction, including the cost of any changes or modifications in structural or mechanical details and electric service resulting from substitution of electrical equipment, and the cost of all allied trades involved.

All manufactured and fabricated assemblies of electrically operated equipment furnished under this contract shall have Underwriter's Laboratories approval or UL Re-examination listing in every case where such approval has been established for the particular type of materials or devices in question.

2.2 CONDUITS AND RACEWAYS

All wiring shall be in conduit or other approved raceways except as shown on the drawings or otherwise specified, and shall be concealed unless otherwise noted. Conduit shall be one of the types listed below.

2.2.1 Conduit Types

- PVC-Coated Rigid Steel Conduit. The conduit shall be rigid steel, hot-dip galvanized, with a 40 mil thick PVC coating on the pipe outer diameter and a 2-mil thick PVC coating on the pipe inner diameter. PVC coated rigid steel conduit shall be as manufactured by Ocal, Perma-Cote, or Robroy Industries.

- Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, and shall conform to ANSI C80.1, and UL 6.

- Intermediate Metal Conduit (IMC). IMC shall be hot-dip galvanized and shall conform to Fed Spec WW-C-581 and UL 1242.

- Rigid PVC Conduit. The conduit shall be Schedule 40 PVC, 90 deg C rated conforming to NEMA TC-3 and UL514, 651. Conduit shall be as manufactured by Carlon, Indian head, Robroy, Ocal or equal. Schedule 80 shall be provided if required by Code and conduit size adjusted accordingly.

- Liquid Tight Flexible Metal Conduit. Liquid tight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moisture proof polyvinyl chloride jacket, and shall be UL labeled.

2.2.2 Conduit Installation

- Intermediate metal conduit shall be installed in exposed indoor applications unless otherwise noted.

- Rigid steel conduit shall be installed in masonry walls, concrete slabs, and cast-in-place walls.

- Intermediate and rigid steel conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts. Terminations and connections

shall be taper threaded. Conduits shall be reamed, free of burrs, and terminated with conduit bushings.

- PVC-coated rigid steel conduit shall be installed in all exposed outdoor locations and where indicated on the drawings. PVC-coated mounting hardware and framing materials shall rigidly support conduit. Nuts and bolts shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer. Threading tools used for steel conduit shall not be used to thread PVC-coated rigid steel conduit.

- Liquid tight flexible metal conduit with watertight connectors shall be installed for final connections to dry type transformers, motors, equipment with moving parts, and where indicated on the drawings. Conduit shall be installed without sharp bends and in minimum lengths required for the application but not longer than 4'-0", unless acceptable to the Engineer.

- Unless otherwise noted, direct buried underground conduit shall be PVC schedule 80. Turn-ups outdoors shall be PVC coated rigid steel. Turn-ups indoors shall be rigid steel.

- Underground conduits shall be concrete encased under roadways and where indicated on the drawings.

- Locknuts inside and outside shall securely fasten conduit connections to sheet metal enclosures. Conduits shall be installed between the reinforcing steel in walls or slabs that have reinforcement in both faces. In slabs that have only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduit shall be neatly grouted into any openings cut into concrete and masonry structures. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.

- All conduits that enter enclosures shall be terminated by fittings that ensure that the NEMA rating of the enclosure is not affected or changed. A corrosion-resistant coating shall be applied to all conduits that turn out of concrete, masonry, or earth indoors. The coating shall consist of a heavy coat of thixotropic coal tar paint extending six inches on each side of the point of turnout.

- Concrete encased conduit shall have minimum concrete thickness of 2 inches between conduits, six inches above and below conduits. Underground conduit bend radius shall be not less than 2 feet at vertical risers or less than 3 feet elsewhere. Underground conduits and conduit banks shall have 2-feet minimum earth cover except where indicated otherwise. Underground conduits shall be sloped to drain to the handholes.

- After cable has been installed and connected, conduit ends shall be sealed by non-hardening duct sealing compound forced into conduits to a minimum depth equal to the conduit diameter. This shall apply for all conduits at handholes and building entrance junction boxes, and for all conduit connections to equipment.

- All exposed conduit runs shall be so located that pull or junction boxes will not be made inaccessible due to inadequate clearance with piping or equipment.

- All conduits used for service entrance feeders from supply point to first overcurrent device shall be bonded with suitable bonding locknuts and/or bonding insulating bushings, or by separate copper bonding conductor.

2.3 CONDUCTORS

2.3.1 General

The Contractor shall furnish and install all wire and cable necessary to complete the work herein outlined and as shown on drawings, except such items as are specifically noted as being furnished by others. All wiring in the entire system must be color-coded and all conductors shall have their size, voltage, manufacturer, and type clearly marked on the outer covering. All wire and cable shall be as herein specified or as shown on the drawings. Wire and cable shall be as manufactured by Okonite, Belden, Anaconda, Rome, General Cable, or equal.

2.3.2 Conductors

Conductors shall consist of annealed copper wire of size indicated on drawings or as may be specified herein. No conductors smaller than #12 AWG copper shall be used unless otherwise indicated on the drawings. All conductors #12 AWG and larger shall be of Class B concentric stranded construction, unless specified otherwise herein or on drawings.

2.3.3 Wire Insulation

All wire and cable unless otherwise specified shall be single conductor type THWN or THHN 600-volt insulation. Service entrance conductors shall be RHH/RHW-USE type insulation.

Conductors shall be color coded as follows:

black, blue, red, white, and green on 120/208 volt wye systems
black, orange, red, white, and green on 120/240 volt delta systems
brown, orange, yellow, gray, and green on 277/480 volt wye systems.

2.3.4 Installation

The Engineer reserves the right to inspect any and all joints in wiring. If the joint is already taped, the Contractor shall properly re-tape after inspection. Conductors shall be continuous without joints or splices in runs between outlet boxes. All splices shall be made at boxes only.

2.3.5 Splices And Terminations

Splices shall be made by use of mechanical connectors of the following manufacturers' types, T & B Sta-Kon, Burndy Crimpit, Minnesota Mining and Manufacturing Company Scotchlock, and Ideal Wire-Nut. Conductors size #8 AWG and larger shall be spliced and connected with suitable, solderless, mechanical lugs and connectors. All splices, taps, and connections shall be insulated with Scotch electrical tape as made by Minnesota Mining & Manufacturing Company as applicable to installation.

2.4 SUPPORTING DEVICES

2.4.1 General

All secondary electrical devices such as outlet boxes, poles, bases, switches, and receptacles shall be located generally as shown on the drawings. No device utilized by the handicapped shall be located higher than 4'-0" from the finished floor level to the top of the device.

2.4.2 Outlet and Switch Boxes

Boxes exposed, in masonry walls and cast-in-place walls shall be cast metal with conduit hubs, Crouse Hinds Type FS or equal. Intermediate oversize type cover plates shall be used where standard cover plates will not cover opening. All adjacent plates shall match in material, size, design, and color. All exterior mounted boxes shall have approved weather-proof plates and/or covers.

2.4.3 Outlet Locations

All outlets for receptacles or switches shall be installed in the location indicated on the drawings. When necessary, the Contractor shall relocate outlets to coordinate with other equipment.

2.4.4 Dimensions

Unless otherwise indicated on the drawings, electrical devices shall be placed at the following distances from finished floors:

- Light Switches – center of switch 45” above finished floor (45” AFF).
- Duplex receptacles – center of receptacle 18” above finished floor (18” AFF).

- Power Panelboards - top of cabinet 6'-6" above finished floor.
- Safety switches and/or circuit breakers - handle not over 6'-6" above finished floor.

2.4.5 Location

The Electrical Contractor is cautioned to review general drawings to confirm location of equipment and to adjust the exact installed location of receptacles and devices accordingly to avoid interference between electrical devices and equipment. Responsibility for locating devices in the field is the Contractor's. The Engineer should be contacted for clarification before installation.

2.4.6 Structural Steel

The Contractor shall provide miscellaneous structural steel necessary to mount electrical equipment to walls, beams and joists. All structural steel furnished shall be standard shapes and sizes and shall be stainless steel. All interior steel shall be firmly and rigidly welded or bolted in place. All structural steel shall be structural quality conforming to ASTM A36.

2.4.7 Tap and Pull Boxes

Boxes shall be of code gauge galvanized sheet steel but not less than 14 gauge metal. Holes for raceways shall be drilled on the job. Where necessary for boxes to be supported away from the ceiling or beams, strap iron or threaded rod shall be used for supports. Outdoor boxes shall be Nema 4X stainless steel unless otherwise noted. Boxes shall have covers fastened on with screws. Sizes of boxes shall be determined by NEC requirements.

2.4.8 Secondary Systems

The Contractor shall furnish and install all conduit, junction boxes, outlet boxes, and plates for conduit systems as indicated on the drawings.

2.5 GROUNDING

All electrical systems and equipment connected under this contract shall be grounded in strict accordance with the National Electrical Code and state and local regulations. Provide a green insulated equipment grounding conductor in all conduits. It is intended that equipment grounding is not dependent on conduit connections.

Metal raceways, metal enclosures or electrical devices, switchgear enclosures, transformer frames, and other equipment shall be completely grounded in an approved manner prescribed by the NEC. All necessary conduit, conductors, clamps and connectors for the grounding system shall be furnished, installed and connected by the Electrical Contractor. The service shall be grounded as indicated on the drawings and as required by the NEC. Ground connections to water pipes shall consist of a ground fitting that bonds both conduit and conductor to the pipe.

All grounding conductors shall be bare or green insulated in accordance with the National Electrical Code, soft drawn copper cable or bar, not smaller than 12 AWG. Ground cable splices and joints which will be inaccessible upon completion of construction shall meet the requirements of IEEE Standard 837, and shall be Cadweld "Exothermic" or Burndy "Hyground" type. Ground cable near the base of a structure shall be in earth and as far from the structure as the excavation permits but not closer than 6 inches.

Ground connections to equipment and ground buses shall be by copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures or by grounding locknuts or bushings.

Ground rods not described elsewhere shall be 5/8 inch diameter by 8 feet long, with a copper jacket bonded to a steel core.

2.6 DISCONNECT SWITCH (CIRCUIT BREAKER TYPE)

Unless otherwise specified, each circuit breaker type disconnect switch shall be 3 phase, heavy-duty, with a voltage and continuous current rating as indicated on the drawings.

Each disconnect switch shall have an enclosure rating as indicated on the drawings.

Circuit breakers shall be 3 phase, 240 volt, molded-case circuit breakers of not less than 42,000 amperes interrupting rating at 240 volts ac, complete with thermal and instantaneous trip elements. Breakers shall be manually operated with quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration. Circuit breakers shall have "On", "Off", and "Tripped" indication and pad-lockable handles.

Where required, disconnect switches shall be service entrance rated.

Disconnect switches shall have nameplates identifying related equipment, and unit numbers where applicable. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened to the enclosure.

2.7 LIGHTING PANELS (LP)

Unless otherwise specified, each lighting panel shall be dead-front, circuit breaker, 240/120 volt, 3-phase panel board type in accordance with the drawings and the following specifications.

The panel shall have a surface-mounted enclosure with a NEMA type enclosure designation as required by the location where it will be installed. The enclosure shall have a door with latch

and lock. A directory inside the door shall have the panel and all circuit identities neatly typewritten at completion of the contract.

Circuit breakers shall be thermal-magnetic, bolt-in, individually front replaceable, and shall indicate "On", "Off", and "Tripped". Breakers indicated, as multiple-pole shall be common trip. Breakers shall have interrupting ratings not less than 10,000 amperes. Handle clips to prevent casual operation of breakers shall be provided for 10 percent (minimum of two) of the breakers and applied to the circuits directed. Breakers and provisions for future breakers shall be provided in the quantities, poles, and ampere ratings indicated on the drawings. Breakers shall be single pole, 20 amperes, unless otherwise indicated.

The panel shall have main and neutral buses insulated from the cabinet, and a ground bus. Buses shall be copper, with ampere ratings and main lugs or main breaker as indicated. The ground bus shall be similar to a neutral bus and shall have a good ground connection to the cabinet, a removable bond to the neutral bus, clamp type lugs for the ground cable in each supply conduit, and connections for a ground cable in each load conduit.

Lighting panels shall be service entrance rated where required.

Lighting panels shall have nameplates identifying the panel, and unit numbers where applicable. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened to the enclosure.

2.8 LUMINARIES

The Contractor shall furnish and install all lighting fixtures as called for on the drawings or as herein specified. All fixtures shall be new, industrial grade, and as specified on the drawings.

Ballasts supplied with fluorescent fixtures shall be electronic, premium grade, approved by Underwriters' Laboratories, and properly applied for each installation.

The neutral conductor of lighting systems must be of the same size as the other conductors or larger. On three wire systems the load shall be divided as evenly as possible on each "outside" or phase conductor. Neutral conductors shall be identified throughout.

The Contractor shall furnish and install all lamps required for all fixtures. All lamps shall be of size and type specified; manufactured by General Electric, Westinghouse, Metlalux, or Sylvania. Fluorescent lamps shall be cool white. All lamps shall be warranted by the Contractor for the published rated life. Four weeks after acceptance of the system, the Contractor shall check all lighting fixtures and replace lamps and/or ballasts that have failed during this period of time.

2.9 SWITCHES

Wall switches specification grade and shall be 20 amperes, 120/277 volts, Arrowhart 1221 through 1224, Hubbell 1221 through 1224, Eagle 1221 through 1224, or equal and shall be mounted 3'-6" AFF unless otherwise indicated on the drawings.

2.10 RECEPTACLES

Receptacles shall be specification grade, duplex, three-wire, grounding, 20 amperes, 125 volts, Arrowhart 5362, Hubbell 5362, Eagle 5362, or equal for 120 volt circuits. Ground fault receptacles shall be duplex, 20 amperes, 125 volts, Arrowhart GF5352, Hubbell GF5352, Eagle GF5352, or equal. Receptacles shall be mounted eighteen inches AFF unless otherwise indicated on the drawings.

2.11 CONTROL STATIONS

Control stations shall be provided as indicated on the one-line diagrams or schematics or as required by the equipment furnished. Pilot devices shall be heavy-duty, oil tight, and shall perform the functions indicated. Indoor control stations shall have NEMA Type 4X enclosures. Control stations outdoors or indicated to be weatherproof shall have NEMA Type 4X stainless steel enclosures with protective caps on the control devices.

Control stations shall have engraved or etched legends ("Start", "Stop", etc.) as described on the drawings. Control stations shall have nameplates identifying related equipment, and unit numbers where applicable. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened to the control station.

Emergency stop control stations shall be mushroom type.

2.12 WELL PUMP CONTROL PANELS, WPCP

The WPCP shall be listed or labeled to UL508 standards for Industrial Control Equipment by an independent testing agency approved by the State of North Carolina.

The control panels shall have a NEMA 4X enclosure with a flange mounted disconnect operator. The door of the enclosure shall be interlocked with the disconnect operator. Operator controls shall be mounted the enclosure door. The back panel shall be secured to the enclosure with collar studs, washers, and nuts.

The WPCP shall be provided with a disconnecting means with short circuit and overcurrent protection and a flange mounted operator mechanism. The disconnecting means shall be a thermal magnetic circuit breaker with a minimum rating of 42KAIC at 240VAC. The flange mounted operator mechanism shall be lockable in the OFF position.

The WPCP shall be provided with Transient Voltage Surge Suppression (TVSS), voltage & phase rotation Power Monitor Relay (PMR), and an adjustable on-delay timer that will inhibit pump operation during the first minute that power is applied to the WPCP. A fault condition detected by the Power Monitor Relay and an inhibit condition by the on-delay timer shall cause the "Power Fault" pilot light to illuminate.

Well Pump shall be controlled by NEMA rated starters with circuit breaker type motor circuit protectors and thermal overload relays with NEMA Class 10 trip times. An overload reset pushbutton shall be mounted on the enclosure door in such a manner as to permit resetting of the overload relay without opening the enclosure.

A "Hand-Off-Auto" mode selector switch shall provide manual run, manual stop, and automatic operation signals for the pump starter. Manual operation (Hand) shall override all shutdown systems, except the motor overload relay. Manual stop (Off) shall inhibit pump operation in all cases. In automatic operation (Auto), the pump will operate based on the Alternator Mode switch, the alternator, and the fault status of the other pump.

Selector Switches (SS) and pushbuttons shall be mounted on the enclosure door.

A seven-digit non-resettable elapsed time meter shall be provided for each pump and mounted on the enclosure door to indicate the total running time of the pump in "hours" and "tenths of hours".

Selector Switches, Push Buttons, and Pilot Lights shall be 30.5mm, heavy-duty, oil-tight, type 4/13, with metal collar & nut. Selector Switches shall be provided with standard knob operators unless otherwise specified. Push Buttons shall be provided with flush operators unless otherwise specified. Pilot Lights shall be 120VAC transformer type with low voltage LED lamps and plastic colored lens. Pilot Lights shall be of the Press-To-Test (PTT) type or wired so a single push button will illuminate all the pilot lights at once for testing. SS, PB, and PL shall be provided with engraved legend plates. Legend plates shall allow for a minimum of two rows with fourteen characters per row. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts ac. Contact configuration shall be as indicated on the drawings or as required for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty.

One set of Form C relay contacts shall be provided for remote monitoring of each of the conditions indicated by the pilot lights and the general alarm. The relay contacts shall be wired to properly labeled terminals for remote monitoring.

The well pump control panel shall delay starting of the well pump for 1 min (adjustable 0 – 2 min) after power failure.

2.12.1 MOTORS

The Contractor shall furnish power wiring and disconnect switches for all equipment furnished and shall install disconnect switches where indicated or required. All contacts shall be inspected and cleaned, if required, in control panels, starters, and miscellaneous control devices and all necessary adjustments and wiring changes as may be required for proper adjustments shall be made.

Running tests shall be made on all equipment connected by the Contractor to check proper operation of equipment and verify installation of properly sized overcurrent relays. Such tests shall not be made; however, without the permission of a responsible party designated by the Owner and equipment supplier. The Contractor shall connect and test all other equipment and shall provide cords and mating caps for receptacles where equipment is cord connected.

2.13 ELECTRIC UNIT HEATERS

Electric unit heaters shall be heavy duty and shall include fan and motor assembly, built-in contactor, built-in thermostat, disconnect switch, control transformer as required. Unit heater shall be suitable for use with power supply indicated on the drawings. Heater elements shall be steel plate, fin type with elements brazed to common fins for maximum strength and heat transfer. Each unit heater fan motor shall be provided with automatic reset thermal overload protection. Unit heater shall be provided with suitable mounting hardware.

Each unit heater shall have a capacity as indicated on the drawings. Electric unit heaters shall be as manufactured by Markel, Chromalux, Brasch or equal.

2.14 THERMOSTATS

Thermostats for exhaust fans and ventilators shall be provided as indicated on the drawings and specified herein. Wall-mounted thermostat shall be mounted 5'-6" above finished floors. Insulating spacers for thermostats mounted on exterior building walls shall be provided. Thermostats shall be two-position line voltage thermostats. The thermostats shall have a dpdt switch rated for 1 HP at 120 VAC. The thermostats shall have a range of 35 F to 100 F with a non-adjustable differential of 2 degrees F, and shall be Honeywell, Penn Controls, Greenheck or equal.

2.15 EXHAUST FANS

Exhaust shall be provided as indicated on the drawings and specified herein. Fans shall be rated in accordance with AMCA standards, or shall bear the AMCA Certified Rating Label, and shall be UL listed.

Fan noise level tests and ratings shall be made and published in accordance with AMCA Standards 300 and 301. Fan sound ratings and sound test verifications shall be furnished with each fan submittal.

Exhaust shall include accessories shall include gravity damper with louver, personnel safety guard, and insect screen. The propeller fans shall have steel aluminum blades, shall be statically and dynamically balanced to ensure quiet, vibration-free operation, and shall be suitable for mounting as indicated. Fan motors shall be open dripproof, with permanently lubricated, double-sealed ball bearings.

Fans shall include back draft damper with linked blades and fan guard. Provide each fan motor and drive shall be isolated from fan enclosure by rubber-in-shear or spring type isolators standard with manufacturer.

Exhaust Fans shall be mounted 72" A.F.F. Well House Exhaust Fan shall be 16" and capacity shall be 2675 cfm @ 0.050 in. S.P. Exhaust Fans shall be Greenheck, Penn Ventilator, ILG or equal.

2.15.1 Aluminum Intake Louvers

Aluminum intake louvers shall be located as indicated on the drawings. The contractor shall provide necessary wiring, actuators and controls to coordinate louver operation with well house exhaust fans. Louvers shall be fabricated of minimum 0.081 inches thick, extruded aluminum, allow 6063 T5, for exterior. Four inches thick weatherproof units profile 638A or equivalent. Bird screens shall be ½" square mesh, 16 gauge aluminum, installed in standard folded frame, attached to louver and mounted on inside unless otherwise indicated on drawings. The Contractor shall provide anchors, fastenings, reinforcing, and required ancillary items fabricated of compatible material. Aluminum louvers shall have baked enamel finish, color as selected by Owner. The Contractor shall install louvers in accordance with manufacturer's recommendations, furnishing anchoring and bracing accessories as required.

2.16 DEHUMIDIFIER

The Contractor will provide two (2) Dehumidifiers to MCPW for inclusion in the chemical feed houses. The Dehumidifier capacity shall be 50 pints per 24 hours. The compressor shall be rated 115 volts, 60 Hz, 6.0 operating amps. Fan shall be 2 speed and 194 cfm at high speed. Humidity range shall be 35% to 85%. Refrigerant shall be Type R134a. Power cord shall be 6' long. Plug shall be 5-15P Type. Filter shall be washable. Dehumidifier Unit shall be UL listed. MCPW will plumb unit.

2.16 INSTRUMENTATION

2.16.1 Ultrasonic Liquid Level Transmitter and Controller

The Contractor will supply and install an ultrasonic liquid level transmitter and controller as indicated by the project drawings. The transmitter output shall be Analog 4-20 mA, HART. The controller shall have a NEMA 4X-rated wall mounted enclosure. The transmitter shall be Rosemount Model 3102 or equal. The controller shall be Rosemount Model 3491 or equal.

PART 3 PAYMENT PROCEDURES

See Section 3 of the General Requirements for Payment Procedure requirements.

PART 4 WARRANTY

The Contractor shall guarantee the work provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. All guarantees for materials, equipment and accessories provided under this section shall be obtained by the Contractor and submitted.

-- END OF SECTION --