

## **SECTION 01025 MEASUREMENT AND PAYMENT**

### **GENERAL**

1.1

### **1.2 SCOPE OF WORK**

This Section describes the methods by which measurement will be made of the quantities for which payment will be made for the Project.

The project is to be bid as one contract.

Defect assessment and non-payment for rejected work.

### **1.3 MEASUREMENT OF WORK**

Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of this section shall govern.

Work shall be measured by the Engineer or his representative with assistance from the Contractor prior to preparation of a payment request by the Contractor.

Unit quantities that are measured in place shall be measured monthly. The Contractor shall give the Engineer a minimum of two days notice for making all required measurements.

Materials that must be measured as delivered shall be measured at the time of delivery by the Engineer or his representative; the Contractor shall provide sufficient advance notice so that such measurements can be made.

Work completed shall be measured for completion against the schedule of values provided by the Contractor in accordance with the General Conditions. Related work necessary for a complete and operational job, such as relocation of mail boxes, relocation of driveway pipe, removal of trees, relocation of utilities, graveling / maintaining driveways, field engineering, clearing and grubbing, traffic control, etc., not specifically identified as a pay item shall be included in the unit price bid for which the work pertains. No additional payments will be made for such activities.

### **1.4 ESTIMATED QUANTITIES**

All estimated quantities for unit price items, stipulated in the BID FORM, or other Contract Documents, are approximate and are to be used as a basis for comparing the bids submitted for the Project. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The

basis of payment for work and materials will be the actual amount of work done and materials furnished. The Contractor agrees to make no claim for damages, anticipated profits or otherwise on account of any difference between the amounts of work actually furnished and the estimated amounts included in the BID FORM. The Contractor will not be paid for any work which exceeds the quantity set forth in the BID FORM without a change order issued before the work is performed unless specifically ordered in writing by the Engineer. The Contractor will provide assistance to the Engineer to check quantities and elevations when so requested.

## **1.5 MEASUREMENT OF QUANTITIES**

Measurement by Weight – Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

Measurement by Volume – Measured by cubic dimension using mean length, width and height or thickness.

Measurement by Area – Measured by square dimension using mean length and width or radius.

Linear Measurement – Measured by linear dimension, at the item centerline or mean chord.

Stipulated Sum/Price Measurement – Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

## **1.6 PROGRESS PAYMENTS**

Progress payments shall be based on the quantity of units installed.

All items of Work not specifically listed in the Bid Schedule shall be considered incidental to the construction, and the cost of all such work and material shall be included in the prices bid for various items listed.

All items listed for measurement and payment shall include all machinery, plant, materials and labor, etc., to successfully and satisfactorily complete Work specified.

Payment – The Contractor will receive payment only for the items listed in the Bid Schedule of his contract, and no separate payments will be made for the work under any section of the Contract Documents except as provided for in the Bid Form. Where measurements are required to be made by the Engineer, for the payment of a pay item, the failure of the Contractor to give the adequate notification or failure of the Contractor to give the engineer assistance for the measurement shall result in the forfeiture of payment for the work or item which was not measured.

Work to be paid for as a "Lump Sum" shall be measured for completion against the "Schedule of Values" provided by the Contractor. The "Schedule of Values" shall be submitted at the Preconstruction conference and shall include quantities and prices of items aggregating the total "Lump Sum" and will subdivide the work into component parts in sufficient detail to serve as the basis for progress payments during construction.

## **PRODUCTS**

### **1.7 STORED MATERIALS**

Partial payment shall be made for approved materials stored at the project site, provided invoices for said materials are furnished in accordance with payment request submittal and shop drawings for said materials have been approved. All costs associated with covering and protecting equipment and materials shall be bore by the contractor.

## **NON-PAY ITEMS**

### **1.8 SITE CLEARING**

No separate measurement or payment will be made for site clearing along the proposed utility route. Payment for all such site clearing shall be included in unit prices bid per linear foot of the various sizes and type of pipe laid as provided for in Bid Schedule.

### **1.9 EXCAVATING, TRENCHING, AND BACKFILL FOR UTILITY SYSTEMS (SECTION 02221)**

No separate measurement or payment will be made for trench earth excavation for water lines, sewers, storm pipe, or other pipes, nor for any other appurtenant facilities such as manholes, valves, fire hydrants, piers, and pipe protection of encasement. Payment for all such excavation shall be included in the unit prices bid per linear foot of the various sizes and type of pipe laid as provided for in the contract Bid Schedule. Where special bedding or cradles are shown on Drawings, or required by engineer, no allowance shall be made for extending earth excavation in trenches to the bottom of such bedding or cradles.

## **BID ITEMS**

## **GENERAL**

### **ITEM 1(1) – Mobilization**

Measurement

Mobilization will not be measured separately for payment.

Payment

Payment for this item, completed and accepted will be at the lump sum price bid, which payment shall be full compensation for all work specified in the plans and specifications. Payment shall include any transportation of equipment necessary to commence the project.

### **ITEM 1(2) – Traffic Control**

Measurement

Traffic Control will not be measured separately for payment.

Payment

Payment for this item, completed and accepted will be at the lump sum price bid, which payment shall be full compensation for all work specified in the plans and specifications. Payment shall include flagmen, flags, traffic barrels, barricades, temporary signs, pilot vehicles and other items necessary to control traffic.

### **ITEM 1(3) – Bonding, Misc.**

Measurement

Bonding will not be measured separately for payment.

Payment

Payment for this item, completed and accepted will be at the lump sum price bid, which payment shall be full compensation for all work specified in the plans and specifications. Payment shall include compensation for all necessary requirements per the plans and specifications for adequate bonding.

#### **ITEM 1(4)– NPDES**

##### **Measurement & Payment**

Under this item the Contractor shall complete all requirements for the NPDES GAR 1000002 permit including sampling stormwater, testing stormwater, inspections and record keeping. Payment for NPDES permitting will be made at the Contract Lump Sum Price in the Bid Form.

#### **ITEM 1(5) – GRADING COMPLETE**

##### **Measurement**

Grading will be measured as a lump sum for payment. The area will be considered as the full right-of-way width for the length of the project including all slope and construction easement areas shown on Plans.

##### **Payment**

Payment for this item, completed and accepted will be at the lump sum price bid, which payment shall be full compensation for all work specified in the plans and specifications. Under this item the Contractor shall furnish all labor, materials, and equipment required for a complete grading and restoration job. This work, which covers both water and sewer construction, shall include but not be limited to: borrow material required to grade site to proposed contours, traffic control, and any demolition of fences, manholes, clay pipes, buildings, shelters etc. This pay item includes the purchase of borrow, hauling borrow, placing borrow and compacting borrow. It further includes restoring and dressing of disturbed areas.

#### **ITEM 1(6-7) – Remove and Replace Concrete/Pavement/misc. items**

##### **Measurement**

Measurement of remove and replace pavement shall be made on the basis of square yards.

##### **Payment**

Payment for remove and replace pavement under these specifications shall be made for the quantities determined in the manner specified above on the basis of the unit price shown in the Bid Form. This amount, so paid, shall be compensation in full for furnishing all labor, tools, equipment, services, and other work in connection with or incidental to the construction. Payment shall be for the cutting, removal and disposal of the existing pavement. Payment shall also include the materials and labor associated with the placement of concrete and asphalt to cover the patch. Payment

shall also include disposal of old materials.

#### **ITEM 1(8) – 4" GRADED AGGREGATE BASE**

##### **Measurement**

Measurement for constructing the graded aggregate base shall be in square yards.

##### **Payment**

The graded aggregate base will be paid for at the contract unit price as provided in the Bid Form. Payment shall include materials, labor, shipping, hauling, spreading, shaping, watering, compacting, and maintaining and for all incidentals to complete the work.

#### **ITEM 1(9) – Testing**

##### **Measurement**

Testing will not be measured separately for payment.

##### **Payment**

Payment for this item, completed and accepted will be made by lump sum. The Contractor shall provide coordination and labor to assist the testing company with taking their testing samples on the jobsite. Contractor shall present invoices from the testing agency prior to receiving payment.

#### **ITEM 1(10) – Coordination w/ Natural Gas Company**

##### **Measurement**

Coordination w/ natural gas company will not be measured separately for payment.

##### **Payment**

Payment will be made in terms of lump sum in the bid form and shall include all work required including labor and materials. Payment shall include any pipe, fittings, restraints, threaded rod or blocks required to lower, raise or shift an existing gas main.

### **ITEM 1(11) – Underground Telephone Line Conflicts**

#### **Measurement**

Underground telephone line conflicts will not be measured separately for payment.

#### **Payment**

Payment will be made in terms of the unit price shown in the bid form and shall include all work required including labor and materials. Payment shall include any pipe, fittings, restraints, threaded rod or blocks required to lower, raise or shift an existing telephone line.

### **EROSION CONTROL**

#### **ITEM 2(1-2)– SILT FENCING**

##### **Measurement**

Quantities for silt fence shall be expressed in linear feet in accordance with the plans and specifications. Silt fence used in sediment traps shall be measured and paid for under this item. Dimensions shall be measured and the quantity shall be calculated from such measured dimensions.

##### **Payment**

Payment for silt fence installed under these specifications shall be made on the basis of the unit price shown in the Bid Form. This amount, so paid, shall be compensation in full for furnishing all labor, materials, tools, equipment, services and other work in connection with or incidental to the construction of this bid item. Specifically, this bid item shall also include the costs of removing the accumulated silt to maintain effective filtration and removal of the silt fence itself after soil stabilization is achieved to the satisfaction of the Owner.

#### **ITEM 2(3) – CONSTRUCTION EXIT**

##### **Measurement**

Measurement of construction exits shall be made on the basis of each installed in accordance with the plans, specifications, and details.

##### **Payment**

Payment for construction exits will be made in terms of the unit price shown in the Bid Form and shall include all materials and labor necessary for a complete installation. Payment shall include all rock and filter fabric. Payment shall also

include any grading required for installation as well as removal, disposal and dressing up at the completion of the job.

**ITEM 2(4) – TEMPORARY GRASSING AND PERMANENT GRASSING/DUST CONTROL**

**Measurement**

Temporary and permanent grassing will be measured as a lump sum payment.

**Payment**

Payment for this item, completed and accepted will be at the lump sum price bid, which payment shall be full compensation for all work specified in the plans and specifications. Under this item the Contractor shall furnish all labor, materials, equipment required for a complete grassing job. Payment shall also include any areas that must be planted again due to erosion or failure to achieve a satisfactory stand. This pay item includes permanent, temporary grassing, lime, dust control, fertilization and mulching.

**NEW WATER**

**ITEM 3(1), 3(4), (4b) -- WATER MAIN (AND LATERALS)**

**Measurement**

Measurement of the non-restrained water main will be made on the basis of length in feet of pipe installed in accordance with the plans and specifications.

**Payment**

Payment for installing water mains will be made in terms of the unit price shown in the Bid Form and shall include all work required for excavation, shoring, bedding, haunching, dewatering, backfilling, capping, tracing wire, detection tape and all other labor and incidentals necessary for a complete and operating water main.

**ITEM 3(2), 3a – Directional Bore/Drill**

**Measurement**

Measurement of directional bore shall be made on the basis of length in feet of pipe installed in accordance with the plans and specifications.



### **Payment**

Payment for directional bore/drill of fusible PVC be on the basis of the unit price as provided in the Bid Form. Payment shall include all materials, labor and necessary extras to bore the fusible PVC pipe.

### **ITEM 3(3) – JACK AND BORE**

#### **Measurement**

Measurement of jack and bore shall be on the basis of linear footage steel casing jacked and bored and carrier pipe it contains.

#### **Payment**

Payment for jack and bore of steel casing shall be on the basis of the unit price as provided in the Bid Form. Payment shall include all materials, labor and necessary extras to jack and bore the required size steel casing and carrier pipe. Payment for installing the carrier pipe and spacers shall also be included herein. Payment also includes any excavation, dewatering, shoring, and all labor, equipment and incidentals necessary for a complete installation.

### **ITEM 3(5) -- RESTRAINED JOINT (RJ) WATER MAIN**

#### **Measurement**

Measurement of the restrained water main will be made on the basis of length in feet of pipe installed in accordance with the plans and specifications. Pipe between two restrained fittings shall not be considered "restrained" for the purposes of measurement and payment.

#### **Payment**

Payment for installing restrained joint water mains will be made in terms of the unit price shown in the Bid Form and shall include all work required for excavation, restraints, dewatering, shoring, bedding, haunching, backfilling, capping, tracing wire, detection tape and all other labor and incidentals necessary for a complete and operating water main.

### **ITEM 3(6) – VALVES**

#### **Measurement**

Measurement of valves shall be made on the basis of each installed in accordance with the plans, specifications and details provided.

### **Payment**

Payment for installing valves shall be made on the basis of the unit price shown in the Bid Form in accordance with the plans, specifications and details. The Bid Form unit price shall include all restraints, excavation, dewatering, backfilling, valve boxes, thrust blocking and all labor, equipment and incidentals necessary for a complete installation.

### **ITEM 3(7) – CONNECT TO EXISTING SYSTEM**

#### **Measurement**

Measurement of the connection of the new water main to existing water mains will be made on the basis of each connection made in accordance with the plans, specifications and details provided.

#### **Payment**

Payment for connecting to the existing system shall be made on the basis of the unit price shown in the Bid Form in accordance with the plans, specifications and details. The Bid Form unit price shall include removing the existing elbow and installing a new tee and any sleeves necessary for connection. It shall also include all dewatering, backfilling and all labor, equipment and incidentals necessary for a complete installation.

### **ITEM 3(8) – FIRE HYDRANT ASSEMBLY**

#### **Measurement**

Measurement of installing new 6" fire hydrant assemblies will be made on the basis of each installed in accordance with the plans, specifications, and details provided.

#### **Payment**

Payment for installing 6" fire hydrant assemblies will be made in terms of the unit price shown in the Bid Form in accordance with the plans, specifications and details. Payment shall include all labor and materials required for excavation, shoring, bedding, haunching and backfilling. It shall also include the labor and materials for the tee, pipe, blocking, restraints and valve associated with hydrant.

### **ITEM 3(9) – WATER MAIN MARKERS**

#### **Measurement**

Measurement of water main markers shall be made on the basis of each installed in accordance with the plans, specifications and details provided.

#### **Payment**

Payment for installing water main markers shall be made on the basis of the unit price shown in the Bid Form in accordance with the plans, specifications and details. The Bid Form unit price shall include all materials and all labor, equipment and incidentals necessary for a complete installation.

SECTION 02210  
EROSION AND SEDIMENT CONTROL

1. GENERAL:

a. RELATED LAND DISTURBING DOCUMENTS:

1. Land Disturbing Activity Permit (LDA) is required for each project over 1.1 acres and is part of the Work associated with the project. The Contractor is required to comply with the best management practices for the control of erosion and sediment from the work site.

2. NPDES Phase 2 General Permit Nos. GAR 100001, GAR 100002, GAR 100003 for the discharge of storm water associated with construction activity for projects one (1) acre and larger is required and is a part of the work associated with this project. Both the Owner and the Contractor are primary permittees (any entity that has submitted a Notice of Intent) of the Erosion, Sedimentation and Pollution Control Plan (ES&PCP). The Owner provides the ES&PCP to the Contractor. A copy of this permit will be provided to the Contractor and the Contractor shall comply with its provisions until the work is completed and accepted by the Owner.

*The Contractor cannot start work until seven (7) days after the Owner has filed the Notice of Intent (NOI).*

The ES&PCP and Comprehensive Monitoring Plan (CMP) will indicate when, where and how often the site inspection and water testing should be conducted. Inspections will be made by Effingham County.

3. NPDES Phase 2 Stormwater Discharge Permit Fees as required by Rules & Regulations for Water Quality Control Chapter 391-3-6, revised October 2003 is part of the permit requirement. These fees shall be paid prior to the commencement of any land disturbing activity.

b. DESCRIPTION OF WORK:

Under this section shall be included all measures both temporary and permanent to control erosion and sedimentation, and protect all surface waters and property both on and off site. This shall include all labor, materials and equipment necessary to meet the requirements of this Section. The Contractor shall not begin work until he is in full compliance with the LDA Permit that has been approved for the work associated with this project. Failure to install and maintain erosion control and sedimentation on the site shall constitute a violation of this permit for each day on which such failure occurs.

c. EROSION AND SEDIMENTATION ACT - DEFINED:

It is the intent of this Specification that the Project and the Contractor comply with all applicable requirements of the State of Georgia Erosion and Sedimentation Control Act of 1975 as amended and any County or Municipal Soil Erosion Ordinance.

The Manual for Erosion and Sediment Control in Georgia further defines practices and requirements. All erosion and sedimentation control measures must be designed for a 25-year, 24-hour rain event. The Contractor is responsible for maintaining all sediment and erosion control measures on the project site during construction. The Contractor is responsible for any damage caused due to failure to implement these requirements. A Soil Erosion and Sedimentation Control Permit has been obtained by the Owner so that periodic inspections may be made by Effingham County. The Contractor is to cooperate with the person performing these inspections.

d. COORDINATION WITH CONTRACT DRAWINGS:

A Soil Erosion and Sedimentation Control Plan will be provided to the Contractor and is to be implemented as a part of the procedures necessary to implement requirements of the Act and Ordinance.

2 PRODUCTS:

Not applicable to this specification section.

3. EXECUTION:

a. IMPLEMENTATION:

Implementation of the requirements of the Act is based on the following principles:

1. The disturbed area and the duration of exposure to erosion elements should be minimized.
2. Stabilize disturbed areas immediately.
3. Retain or accumulate runoff.
4. Retain sediment.
5. Do not encroach upon watercourses.

4. SYMBOLS:

The Soil Erosion and Sedimentation Control Plan contains standard symbols for the different types of measures for implementing the Act. These symbols are defined for conditions, design criteria and construction specifications in Chapter 6 of the Manual and on the Drawings.

5. SPECIFIC REQUIREMENTS:

- a. All erosion and control measures must be installed prior to initiation of construction activity.
- b. A temporary construction egress pad shall be installed and maintained at any point where construction vehicles enter a paved road, street or parking area. The pad shall be used to prevent mud from leaving the construction area. The pad shall be constructed as shown in the Manual for Erosion and Sediment Control.
- c. All disturbed areas shall be grassed by sodding or seeding, fertilizing, mulching and watering to obtain a ground cover which prevents soil erosion.
- d. All measures installed for sediment control shall be checked at the beginning and end of each day when construction is occurring to ascertain that the measures are in place and functioning properly.
- e. Erosion control measures shall be inspected by the Contractor after each rainfall event and at least daily during prolonged periods of continuous rainfall. Contractor shall make repairs and adjustments as necessary to maintain the effectiveness of all sediment and erosion control measures.
- f. The contractor shall remove all silt fencing after permanent grassing is established and accepted by the Owner.

END OF SECTION 02210

SECTION 02221  
EXCAVATION, TRENCHING AND BACKFILL FOR UTILITY SYSTEMS

1. SCOPE:

Under this heading shall be included the excavation, trenching and backfilling required for all underground utility systems.

Utility systems include sanitary sewers, storm sewers, water piping and force mains.

2. GENERAL:

Underground piping and utility systems which are to be installed in trenches whose lowest point of excavation is below the existing ground level, and are unaffected by an excavation for structures, may be installed at any time during the course of the work. Piping and systems to be installed in or over fill, backfill or new embankments shall not be installed until all earthwork has been completed to rough grade, nor until settlement of the fill or embankment has taken place.

Braced and sheeted trenches and open trenches shall comply with all state laws and regulations, and local ordinances relating to safety, life, health and property. Also, this shall conform to the Occupational Safety and Health Standards for Excavations, Final Rule (29 CFR Part 1926) as printed in the October 31, 1989 issue of the Federal Register.

The sides and bottoms of the trenches shall be protected against any instability which may interfere with the proper laying of the pipe and as necessary for the safety of the workmen and others and as may be necessary to protect adjacent structures. Protective systems for trenches shall be utilized by the Contractor and shall conform with Section 1926.652, 29 CFR Part 1926, Final Rule.

3. LOCATION AND PROTECTION OF UTILITIES AND STRUCTURES:

It shall be the responsibility of the Contractor to acquaint himself with the location of all utilities and structures both present and proposed, also all existing surface structures which may be affected by work under the Contract. The location of any underground structures furnished, shown on the Drawings or given on the site are based upon the available records but are not guaranteed to be complete or correct, and are given only to assist the Contractor in making a determination of the existence of underground structures.

Overhead utilities, poles, etc., shall be protected against damage by the Contractor, and if damaged by the Contractor, shall be replaced by him. The Contractor shall notify those who maintain utilities sufficiently in advance of the proposed construction so that they may locate, uncover and disclose such work.

The Contractor shall provide for the continuance of the flow of any sewers, drains, water pipes, and water courses, and the like. Where such facilities, water courses, or electric overhead

wires or conduits are interfered with by the work of the Contractor, the interruption shall be a minimum and shall be scheduled in advance with the Engineer and the utility owner.

The Contractor shall restore all facilities interfered with to their original condition or acceptable equivalent. The cost of such restoration or damage caused directly by his work shall be paid for by the Contractor and shall be included in the prices bid for the items to which it pertains.

4. EXCAVATION AND TRENCHING:

a) Excavation.

Excavate all materials encountered.

b) Caution in Excavation.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures in the trench zone may be determined before being damaged. He shall be held responsible for the repair or replacement of such structures when broken or otherwise damaged because of his operations.

c) Subsurface Explorations:

The Contractor shall make explorations and excavations at no additional charge to the Owner to determine the location of existing underground structures.

d) Depth of Trench.

Utilities and other piping shall be laid in open trenches as shown and specified. Trenches shall be excavated to the designated lines and grades, beginning at the outlet end and progressing toward the upper end in each case.

e) Minimum Width of Trench.

Trenches shall be of minimum width to provide ample working space for making joints and tamping backfill. Sides of trenches shall be closely vertical to top of pipe and shall be sheet piled and braced where soil is of unstable nature. Above the top of the pipe, trenches may be sloped. The width of the trench above this level may be wider for sheeting and bracing and the performance of the work. Minimum width shall comply with ASTM D2321. Minimum width shall not be less than the greater of either the pipe outside diameter plus 16-inches or the pipe outside diameter times 1.25, plus 12-inches.

f) Alignment and Grade.

Trenches shall be excavated on the alignments shown on the Drawings, and to the depth and grade necessary to accommodate the pipes at the elevations shown. Where elevations of the invert or centerline of a pipe are shown at the ends of a pipe, the pipe shall be installed at a continuous grade between the two elevations.



g) Over Excavation.

Excavation in excess of the depth required for proper shaping shall be corrected by bringing to grade the invert of the ditch with compacted coarse, granular material at no additional expense to the Owner. Bell holes shall be excavated to relieve bells of all load, but small enough to insure that support is provided throughout the length of the pipe barrel.

Excavation in excess of the depths required for manholes and other structures shall be corrected by placing a sub-foundation of 1500 psi concrete, at no additional expense to the Owner.

If trenches are excavated to widths in excess of those specified, or if the trench walls collapse, the pipe shall be laid in accordance with the next better class of bedding at the expense of the Contractor.

h) Rock Excavation:

Stones found in trench shall be removed for a depth of at least six (6) inches below the bottom of the pipe.

5. TRENCHES:

Trenches shall be maintained in a safe condition to prevent hazardous conditions to persons working in or around the trench.

Braced and sheeted trenches and open trenches shall comply with all State and Federal Laws and Regulations, and local ordinances relating to safety, life, health and property.

The top portion of the trench may be excavated with sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, utilities, etc. The bottom of the trenches shall be graded to provide uniform bearing and support each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections excavated for bell holes and for the sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and in order that the pipe rests upon the trench bottom for its full length and shall be only of such length, depth and width for making the particular type of joints. The bottom of the trench shall be rounded so that at least the bottom one-third of the pipe shall rest on undisturbed earth for the full length of the barrel as jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by workmen skilled in this type of work.

The sides of all trenches and excavation for structures shall be held by stay bracing, or by skeleton or solid sheeting and bracing according to conditions encountered, to protect the excavation, adjoining property and for the safety of personnel. Bracing and shoring may be removed when the level of the backfilling has reached the elevation to protect the pipe work and adjacent property. When sheeting or shoring above this level cannot be safely removed, it may be left in place. Timber left in place shall be cut off at least 2 feet below the surface.

6. DEWATERING AND PROTECTION AGAINST WATER:

The Contractor shall remove water from the site and shall lower the ground water level as necessary to complete the excavations to the required depths and so that all required work can be accomplished in the dry. The Contractor shall do such well construction, well pointing, sheeting, ditching, and pumping, and shall construct necessary drains, channels and sumps to keep his excavations and new structures clear of ground water, storm water or sewage and to keep his construction areas dry during the progress of the Work.

Adequate measures and protection shall be provided by the Contractor to protect his work from damage from uplift due to ground water, storm water, or flood water. Any damages which may result shall be the Contractor's responsibility.

The Contractor shall accept all responsibility for damage to the work of this Contract because of floods and water pressures and other water damages and shall accept all risks of floods and other events which may occur.

All water discharged by pumping operations shall be discharged so as not to interfere with work under this Contract or with existing structures and operations. Water from dewatering operations shall be conveyed to the existing drainage features, using piping and pumping facilities provided by the Contractor.

Route of dewatering pipe shall be subject to the Engineer's review. Discharge facilities and water quality shall comply with applicable regulations of State and Federal agencies.

Dewatering operations shall be uninterrupted and continuous during the course of the work so as not to endanger any construction in place or to present a hazard to workmen in and around the site. The Contractor shall take all measures necessary including, but not limited to, standby equipment and constant attendance to ensure that the dewatering system remains operational and effective throughout the period of time that it is required.

No water shall be allowed to run over any uncompleted portions of the work. No units of the work shall be constructed under water. The cost of dewatering shall be included in the price bid for the item of work for which it is required.

7. PILING EXCAVATED MATERIALS:

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing roadways.

8. LIMIT TO LENGTH OF OPEN TRENCH:

Backfill or properly secure all open trenches at the end of work day.

9. REMOVAL OF UNSUITABLE MATERIAL:

Removal of unsuitable material will be based on the following requirements:

- a) Unsuitable materials for bedding and backfilling are those classified as MH, CH, OL, OH and PT in accordance with the Unified Soil Classification System. Excavated soils that are too wet to compact shall not be classified unsuitable due to high moisture content alone. Where, in the opinion of the Engineer, the subgrade of the pipe trench is unsuitable material, the Contractor shall remove the unsuitable material 6" deep and furnish and place stone backfill in the trench to stabilize the subgrade. Attention is invited to the fact that the presence of water does not necessarily mean that stone backfill is required. If well points or other types of dewatering will remove the water, the Contractor shall be required to completely dewater the trench in lieu of stone backfill. Stone backfill will be limited to areas where well pointing and other conventional methods of dewatering will not produce a dry bottom. Stone shall be placed 6" deep and the width of the trench. The pipe shall be carefully bedded in the stone as specified or in accordance with the manufacturer's recommendations.
- b) When the trench is excavated to the plan depth or as required by these Specifications, and soft or other material not suitable for bedding purposes is encountered in the trench, the Contractor shall immediately notify the Engineer for inspection and measurement of the unsuitable material to be removed.
- c) No overdepth excavation or backfilling of the overdepth excavated trench shall start until proper measurements of the trench have been taken by the Engineer for the determination of the quantity in cubic yards of unsuitable material excavated. Backfill material and backfilling shall conform to the requirements specified in Article 12 below.
- d) No payment will be made for any overdepth excavation of soft unstable material due to the failure of the Contractor to provide adequate means to keep the trench dry.
- e) No payment will be made for any overdepth excavation of the unsuitable material and replacement not inspected and measured by the Engineer prior to excavation.

10. BEDDING OF DUCTILE IRON PIPE:

Pipe shall be laid on foundations prepared in accordance with ASTM C12 as modified herein, and in accordance with the various classes of bedding required by the trench width and trench depth for the size of pipe to be laid.

a) Class "A" Bedding.

Class "A" Bedding shall be achieved by either of the following two construction methods:

1. Concrete Cradle.

The pipe shall be bedded in a monolithic cradle of plain or reinforced concrete having a minimum thickness under the pipe barrel of one-fourth the inside diameter of the pipe but in no case less than 4 inches and extending up the sides to a height of at least one-fourth of the pipe outside diameter. The cradle shall have a width equal to the full width of the trench as excavated. The pipe shall be laid to line and grade on concrete blocking after which the concrete shall be placed to the limits described. Concrete shall be 3,000 psi concrete.

2. Concrete Arch.

The pipe shall be bedded in crushed stone or rounded gravel bedding material having a minimum thickness under the pipe barrel of one-fourth the outside diameter of the pipe but in no case less than 4 inches and shall extend up the sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain or reinforced concrete arch having a thickness of one-fourth the inside diameter of the pipe but in no case less than 4 inches at the crown of the pipe. The arch shall have a width equal to the full width of the trench as excavated.

b) Class "B" Bedding.

Class "B" Bedding shall be achieved by either of two construction methods:

1. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least 2 inches greater than the radius of the outside of pipe with a width sufficient to allow 6/10 of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation. Carefully compacted backfill shall be placed at the sides of the pipe to a thickness of at least 12 inches above the top of the pipe.

2. The pipe may be bedded in compacted crushed stone, placed on a flat trench bottom. The crushed stone bedding shall have a minimum thickness of 3 the outside pipe diameter and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 inches over the top of the pipe shall be filled with carefully compacted material.

c) Class "C" Bedding.

Class "C" Bedding shall be achieved by either of two construction methods:

1. The pipe shall be bedded in an earth foundation formed in the trench bottom by a shaped excavation which will fit the pipe barrel with reasonable closeness for a width of at least 50 percent of the outside pipe diameter. The side fills and area over the pipe to a minimum of 12 inches above the top of the pipe and shall be filled with compacted fill.

2. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of 4 inches under the barrel and shall extend 1/6 of the outside diameter up the pipe barrel at the sides. The remainder of the side fills and area to a minimum depth of 12 inches over the top of the pipe shall be filled with compacted backfill. Class "C" Bedding shall be used except where the use of Class "A" or Class "B" bedding is shown on the Drawings.

d) Class "D" Bedding.

Class "D" Bedding is achieved by shaping bell holes only on a flat trench and no care is taken to secure compaction at the sides and immediately over the pipe. This type bedding is not permitted.

e) Bell Holes.

Bell holes shall be provided in all classes of bedding to relieve pipe bells of all load, but small enough to insure that support is provided throughout the length of the pipe barrel.

f) Coarse Granular Bedding.

Coarse Granular Bedding material shall consist of crushed stone or pea gravel, clean and graded, 95 to 100 percent of which shall pass a 3/4-inch sieve with 95 to 100 percent retained on a No. 4 sieve. Bedding material shall be placed on a flat bottom trench and thoroughly compacted by tamping or slicing with a flat blade shovel. Compacted bedding material shall be extended up the sides of the pipe to midpoint.

g) Overwidth Excavation.

If trenches are excavated to widths in excess of those specified below, or if trench walls collapse, pipe shall be laid in accordance with the requirements for at least the next better class of bedding at the expense of the Contractor.

h) Borrow Backfill.

Borrow backfill will be required if there is not sufficient suitable material available from other parts of the work to backfill the trenches. Borrow backfill from approved borrow pits shall be used. Only those soils in the borrow pits that meet the specified requirements for suitable material shall be used.

i) Trench Widths.

Trench widths at the top of the pipe and depths for ductile iron pipes using the various bedding classes, shall not exceed those shown below:

<u>Pipe Size</u>	<u>MAXIMUM TRENCH DEPTH</u>			
	<u>Class D Bedding</u>	<u>Class C Bedding</u>	<u>Class B Bedding</u>	<u>Class A Bedding</u>
6"	0	14'	20'	30'
8"	0	14'	20'	30'
10"	0	14'	22'	30'
12"	0	14'	22'	30'
15"	0	14'	22'	30'
21"	0	14'	22'	30'
24"	0	14'	22'	30'

11. BEDDING OF PVC PIPE:

a) Pipe shall be bedded true to line and grade with uniform and continuous support from a firm base in accordance with ASTM D2321 as modified herein. Blocking shall not be used to bring the pipe to grade.

b) Embedment materials listed here include a number of processed materials plus the soil types defined by the USCS Soil Classification Systems in ASTM D2487. These materials are grouped into categories according to their suitability for this application:

1. Class I.

Angular 6 to 40 mm (3 to 12 inches), graded stone including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

2. Class II.

Coarse sands and gravels with maximum particle size of 40 mm (12 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.

3. Class III.

Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

4. Class IV.

Silt, silty clays and clays including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not to be used for bedding, haunching or initial backfill.

5. Class V.

This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inches) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching and initial backfill.

c) Compaction of foundation, bedding, haunching and initial backfill shall extend to the trench wall.

d) Embedment material in the area around the pipe shall be installed with care. Care shall be used to insure that sufficient material has been worked under the haunch of the pipe to provide adequate side support. Precautions must be taken to prevent movement of the pipe during placing of the material through the pipe haunch. Place initial backfill material in three stages: First, to the center line of the pipe; second, to the top of the pipe; and third, to a point 12 inches above the top of the pipe. Compact each stage of haunching and initial backfill by hand or mechanical tamping to a minimum of 100 percent Standard Proctor Density. Where unstable trench walls exist because of migratory materials such as water-bearing silts or fine sands, care shall be taken to prevent the loss of side support through the migratory action.

e) Avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill and backfill material shall be done in such a way so that compaction equipment will not have a damaging effect on the pipe.

f) Trench depths, using the various bedding classes, shall not exceed those shown below:

## MAXIMUM TRENCH DEPTH

Pipe Size	Class IV Bedding	Class III Bedding	Class I or Class II Bedding
All Sizes	Not To Be Used	16'	30'

Density (**Standard** Proctor) of 100 percent minimum in pipe zone.

g) ASTM D2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe" shall be used in conjunction with the above.

### 12. BACKFILLING:

Backfilling consists of placing suitable materials removed during the excavation into the excavated areas, placing embedment materials and compacting the same to a density equal to or greater than what exists before excavation or as specified herein.

Under backfilling operations is also included removal of excess materials and debris from the site, leveling all depressions caused by operation of equipment and maintaining the backfilled areas until accepted by the Owner.

All backfill material shall be free of stones, concrete and clay lumps larger than  $\frac{1}{3}$  cubic foot. Roots, stumps and rubbish which will decompose will not be permitted in the backfill. Backfill material shall have its moisture content corrected, as may be necessary before being placed in the trench to bring the moisture content to approximately "optimum" for good compaction. Any rock, stone, concrete, clay lumps larger than  $\frac{1}{3}$  cubic foot in volume, rubbish and debris shall be removed from the site and disposed of by the Contractor in a lawful manner.

Backfilling operations in this work are referred to herein as Backfilling at the Pipe Zone, Type "A" and Type "B".

Backfilling in the excavated areas below parts of proposed structures shall be referred to hereinafter as Type "A" Backfilling.

Where trenches cross or extend under structures or into present roadways, known future roadways or parking areas as shown on the Drawings, the backfilling shall be referred to hereinafter as Type "A" Backfilling.

Backfilling in all other areas shall be referred to hereinafter as Type "B" Backfilling.

a) Backfilling at the Pipe Zone.



Throughout the entire construction, backfilling at the pipe zone shall include bedding and shall be as follows: Backfill material shall be placed below, around each side, and over the top of the pipe, in approximately horizontal layers to a height of 12 inches over the top of the pipe. Layers shall be of such thickness to facilitate the required compaction. This backfill shall be well compacted by using mechanical tamping equipment in such manner as not to damage the pipe, pipe joints or shift the pipe alignment. Workmen shall not be permitted to walk over the pipe until at least 12 inches of compacted fill has been placed over the pipe. The Contractor shall not use water to obtain compaction except for adding water to the backfill material before placing in the trench to bring the moisture content to approximately "optimum" for good compaction.

b) Type "A" Backfilling.

Type "A" backfilling consists of placing sand and gravel or other suitable materials excavated from the trench in the trench in 6 inch thick layers from a point 12 inches above the top of the pipe and mechanically tamping or compacting by rolling until the backfill density after compaction is equal to 100 percent of the maximum density obtainable at optimum moisture content as determined by the Standard Proctor Test (ASTM D698). No water shall be used to secure compaction except for adding water to the backfill material before placing in the trench to bring moisture content to approximately "optimum" for good compaction. Each 6 inch thick layer shall be mechanically tamped before additional backfill material is placed in the excavated area.

c) Type "B" Backfilling.

Type "B" Backfilling consists of placing sand and gravel or other suitable material excavated from the trench in the trench in 12 inch thick compacted layers from a point 12 inches above the top of the pipe. Each 12 inch thick layer shall be compacted before additional backfill material is placed in the excavation. Only mechanical tamping, use of roller or small tractor will be allowed. The density of the backfilled material after compaction shall be equal to 95 percent of the maximum density obtainable at optimum moisture content as determined by the Standard Proctor Test (ASTM D698). Except in the upper 12 inches, water shall be added to backfill material only before being placed in the trench in order to bring the moisture content to approximately "optimum" for good compaction.

13. PROTECTION OF WATER SUPPLY PIPES:

a) Parallel Installation:

Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sanitary sewer, storm sewer or sewer manhole. The distance shall be measured edge to edge. When local conditions prevent a horizontal separation of 10 feet, the water main maybe laid closer to a sewer (on a case-by-case basis) provided the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. The sewer materials and joints shall be the equivalent to

water main standards of construction and be pressure tested to assure water-tightness.

b) Crossing:

Water mains crossing sewers, storm sewers or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer. At the crossings, one full length of water pipe shall be located so that both joints will be as far apart as possible. When local conditions prevent a vertical separation of 18 inches, the sewer passing over or under the water mains shall be constructed of materials and with joints that are equivalent to water mains standards of construction and shall be pressure tested to assure water-tightness.

c) Special Conditions:

When water mains cross under sewers, additional measures shall be taken by providing:

1. a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main;
2. that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer; and,
3. both the sewer and the water main shall be constructed of water pipe materials and subjected to hydrostatic test, as prescribed in Section 02700 - Water Distribution System and/or Section 02710 - Sewer Force Mains. Encasement of the water pipe in concrete shall also be considered.

14. UTILITY CONSTRUCTION IN OTHER EXCAVATION:

Where utilities are required to be constructed in areas also requiring excavation and backfill for other work, coordinate the work so that the parts come together properly and the construction of the various parts can be done without damage to other parts. Place bedding which will form bearing for pipes, using suitable material and shaping to the lower  $\frac{1}{3}$  of the pipe to provide uniform and continuous bearing. Compaction of backfill material which will form bearing shall be equal to that specified hereinbefore under Type "A" Backfilling. After the pipe or other utility is placed, backfilling shall proceed as specified hereinbefore following the requirements specified under "Backfilling at the Pipe Zone," "Type 'A' Backfilling", and "Type 'B' Backfilling" as applicable.

15. TESTING:

a) General.

The Contractor shall select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction. Copies of all test results shall be furnished to the Engineer.

a) General.

**The Contractor shall select a qualified independent testing laboratory, acceptable to the Engineer, for the purpose of identifying soils, checking densities, and classifying soils materials during construction. All testing will be paid for by the Contractor. Copies of all test results shall be furnished to the Engineer in accordance with Section 01400.**

b) Moisture-Density Tests.

Testing shall be in accordance with ASTM Methods D698. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity or source of fill material will require the performance of additional tests. Copies of all test results shall be furnished to the Engineer.

c) Field Density Tests.

Tests shall be made in accordance with ASTM Method D1556. Tests shall be made in accordance with the following minimum schedule or as required by the soils technician or as may be directed by the Engineer:

One test for each lift of backfill for each 200 feet of trench or fraction thereof.

d) Submittals.

The soils technicians will submit formal reports of all compaction tests and retests. The reports are to be furnished to the Owner and the Engineer as soon as possible upon completion of the required tests.

This report information is to include but not be limited to the following:

1. Date of the test and date submitted.
2. Location of test.
3. Wet weight, moisture content and dry weight of field sample.
4. Description of soil.
5. Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.
6. Ratio of field dry density to maximum lab dry density expressed as a percentage.
7. Comments concerning the field density passing or failing the specified compaction.
8. Comments about re-compaction if required.

e) Compaction Results.

If any compaction test reveals that fill or backfill is not compacted as specified, the Contractor shall scarify and re-compact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. **These additional tests, required due to failure of the original**

**test shall be paid for by the Contractor without reimbursement by the Owner.**

The soils technician is to advise the Engineer and the Contractor's Superintendent immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

16. **CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS:**

a) **Excavation, Trenching and Backfilling Operations.**

Excavation, trenching and backfilling along highways, streets and roadways shall be in accordance with the applicable regulations of the Georgia State Highway Department with reference to construction operations, safety, traffic control, road maintenance and repair.

b) **Protection of Traffic.**

Provide suitable signs, barricades and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All signs removed by reason of construction shall be replaced as soon as condition which necessitated such removal has been cleared. No highway, street or roadway shall be closed without first obtaining permission from the proper authorities.

c) **Construction Operations.**

The Contractor shall construct all work along highways, streets and roadways using the following sequence of construction operations, so as to least interfere with traffic:

1. **Stripping.**

Where the pipe line is laid along road shoulders, sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.

2. **Trenching, Laying and Backfilling.**

Excavate trenches, install pipe line and backfill. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated and excess material removed immediately.

3. **Shaping.**

Immediately after completing backfilling operation, re-shape any damage to cut and fill slopes, side ditch lines, and shall replace top soil, sod and any other materials removed from shoulders.

d) Excavated Material.

Excavated material shall not be placed along highways, streets, and roadways in such manner as to obstruct traffic. Roadways and pavement will be maintained free of earth material and debris.

e) Drainage Structures.

All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.

f) Maintaining Highways, Streets, Roadways and Driveways.

The Contractor shall furnish proper equipment which shall be available for use at all times for maintaining highways, streets and roadways. All such streets, highways and roadways shall be maintained in suitable condition until completion and final acceptance of the work.

The Contractor shall repair all driveways that are cut or damaged and maintain them in suitable condition until completion and final acceptance of the work.

17. REMOVE AND REPLACE PAVEMENT:

Pavement and base course which must be removed for constructing sewers, manholes, forcemains, water lines, and all other appurtenances in streets shall be replaced as specified in Section 02500 or 02510.

a) The top 18 inches of subgrade material immediately under the paving base and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.

b) Where utility lines are constructed on unpaved streets, roads or easements, the top 18 inches of soil shall be stripped and windrowed separate from the excavation from trenches. After the line has been installed and the backfill completed within 18 inches of the original grade, the salvaged surfacing shall be replaced. This work shall be considered as general clean-up along with the removal of surplus excavated materials from the site and the restoring of the surface outside trench limits to its original condition, the cost of which shall be included in the price bid for the utility line.

17. REMOVING AND RESETTING FENCES:

Where existing fences must be removed to permit construction, the Contractor shall remove such fences. As construction progresses, reset the fences in their original location and to their original condition. All costs of removing and resetting fences and such temporary works as may be required shall be included in the prices for the utility line.

18. PROTECTING TREES, SHRUBBERY AND LAWNS:

Trees and shrubbery along trench lines shall not be disturbed unless absolutely necessary. Trees and shrubbery necessary to be removed shall be properly heeled-in and re-planted. Heeling-in and re-planting shall be done under the direction of an experienced nurseryman. Where utility trenches cross established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replaced.

Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials. Removal and replacement of sod shall be done under the direction of an experienced nurseryman.

19. WALKS, DRIVES, CONCRETE CURB AND GUTTER:

Walks and drives removed or damaged during the course of construction shall be replaced with Class "A" Concrete at the same thickness as removed. They will be cut to a neat edge with a masonry saw after backfilling and compacting trench in 6 inch layers to a density not less than 100 Percent Standard (ASTM Test D698) to a depth of 24 inches.

Concrete curb and gutter sections removed or damaged during the course of construction shall be replaced in full sections with concrete having a compressive strength of at least 3,000 psi.

END OF SECTION 02221

SECTION 02310  
JACK AND BORE

1. SCOPE:

Under this heading shall be included the installation of pipeline crossings of roads, highways and railroad tracks as shown. The Owner will obtain the necessary permits for all crossings.

2. MATERIALS:

a) Casing pipe.

Casing Pipe shall be new and unused. Casing pipe shall meet ASTM A139 Grade B (Hydrostatic testing is not required). One end of the pipe shall be beveled to a standard 37 degree bevel.

Casing pipe shall be steel pipe with full circumference welded joints having a minimum yield strength of 35,000 psi. Casing pipe shall be seamless or straight seam. Spiral weld pipe is unacceptable. Length and diameter shall be as shown on the Drawings.

Casing pipe wall thickness shall be as indicated unless shown otherwise on the Drawings. Thickness shall be as indicated below for minimum depth of 4'-6" ground cover, for pipe not coated or cathodically protected.:

Nominal Size <u>Inches</u>	Railroad Crossing <u>Inches</u>	Highway Crossing <u>Inches</u>
8	0.250	0.250
10	0.250	0.250
12	0.250	0.250
14	0.250	0.250
16	0.281	0.250
18	0.312	0.250
20	0.344	0.312
24	0.375	0.312
30	0.469	0.375
36	0.531	0.500
42	0.625	0.500
48	0.688	0.625
54	0.781	0.625
60	0.844	0.625
66	0.938	0.625
72	1.000	0.750

## b) Carrier Pipe.

Carrier pipe shall be mechanical joint ductile iron pipe and shall conform with the requirements for pipe as specified in appropriate Section of these Specifications.

<u>Casing Pipe</u>			
Carrier Pipe	Pressure System	<u>Gravity System</u>	
I.D. (Nom.)	I.D. (Nom.)	Under 100'	Over 100'
<u>inches</u>	<u>inches</u>	<u>inches</u>	<u>inches</u>
4	16	18	20
6	18	20	24
8	20	24	30
10	24	24	30
12	24	30	36
24	36	48	54
30	48	54	60
36	54	60	66
42	60	66	72
48	66	72	

3. INSTALLATION:a) Casing pipe.

Installation of casing pipe, where indicated on the Drawings, shall be by boring and jacking as specified herein.

Suitable pits or trenches shall be excavated for the equipment and its operation. Where necessary, pits and trenches shall be securely sheeted and braced to prevent caving.

Construction shall be done in a manner that will not interfere with the operation of the facility, and shall not weaken the roadbed or structure.

Jacks for forcing the pipe through the roadbed shall have a jacking head constructed in such a manner as to apply uniform pressure around the ring of the pipe. The pipe to be jacked shall be set on guides, braced together, properly supported and directed to the proper line and grade. In general roadbed material shall be excavated just ahead of the pipe using the boring auger, the excavated material removed through the pipe, and the pipe forced through the roadbed into the excavated space.

The diameter of the excavation shall conform to the outside diameter and circumference of the pipe as closely as practical. Any voids which develop during the installation operation shall be pressure grouted with an approved mix.

Variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of 2 percent in lateral alignment, and 1 percent in vertical grade.



When boring and jacking of pipe is once begun the operation shall be carried on without interruption insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in boring and jacking operations shall be removed and replaced by the Contractor at his expense.

The pits or trenches excavated to facilitate boring and jacking operations shall be backfilled immediately after the operation has been completed. Wet boring and jacking shall not be permitted.

b) Carrier Pipe.

Carrier pipe joints shall be assembled and pushed through casing pipe on casing spacers. After installation of carrier pipe, the ends of the casing pipe shall be closed.

c) Casing Spacers:

Casing spacer shall be installed in accordance with the manufacturers recommendations. Casing spacers shall be stainless steel with plastic or nylon runners and stainless steel hardware by Cascade, or equal.

END OF SECTION 02310

SECTION 02700  
WATER DISTRIBUTION SYSTEM

1. SCOPE:

Under this heading shall be included installation of the water distribution system as shown and as specified herein.

The Contractor shall comply with all local codes and regulations of local utilities. He shall coordinate work necessary for the completion of utilities with local utility companies and cooperate with the companies as required.

2. EXCAVATION AND BACKFILL:

Excavation and backfill shall be as specified in Section 02221, Excavation, Trenching and Backfilling for Utility Systems. A minimum cover over the top of the pipe of 36-inches from the proposed paving subgrade, shoulder or finish grade shall be provided.

3. MATERIALS:

All pipe material, solder and flux shall be lead free (less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings). All materials shall be certified for conformance with American National Standards Institute / National Sanitation Foundation Standard 61 (ANSI/NSF61).

a) Metal Pipe.

1) Ductile Iron Pipe.

Ductile iron pipe shall be manufactured in accordance with ANSI /AWWA C151/A21.51, latest revision.

Ductile iron pipe shall be of the thickness according to ANSI/AWWA C150/A21.50, latest revision, for Laying Condition Type 2, at a minimum.

Flange Pipe or Victaulic grooved pipe shall be Pressure Class 350.

2) Fittings.

Fittings shall conform to ANSI/AWWA C111 A21.11, latest revision, and shall be push-on-type unless otherwise shown.

Flanged Fittings shall conform to ANSI/AWWA C110/A21.10, latest revision. The AWWA C110 fitting flanges shall have facing and drilling which match AWWA C115 threaded-on flanges which also match ANSI B16.1 Class 125 flanges except where Class 250 are specifically noted.

Mechanical Fittings shall conform to ANSI/AWWA C153/A21.53, latest revision. Bolts shall conform to ANSI B18.2.1, latest revision. Nuts

shall conform to ANSI B-18.2.2, latest revision. Bolts and nuts shall conform to ANSI B1.1

3) Joints.

Push-on Joints shall conform to ANSI/AWWA C111/A21.11, latest revision.

Flanged Joints shall conform to ANSI/AWWA C115/ A21.15, latest revision.

Mechanical Joints shall conform to ANSI/AWWA C111/A21.11, latest revision. Bolts shall conform to ANSI B18.2.1, latest revision. Nuts shall conform to ANSI B-18.2.2, latest revision. Bolts and nuts shall conform to ANSI B1.1

4) Lining.

Lining for ductile iron pipe and fittings shall be a cement mortar lining meeting the ANSI/AWWA C104/ A21.4, latest revision, for standard thickness lining. After cement lining, the interior of the pipe shall be given a seal coat of approved bituminous material in accordance with ANSI/AWWA C104/A21.4, latest revision.

5) Exterior Coating.

Exterior coating shall be an approved bituminous coating one mil thick in accordance with ANSI/AWWA C151/ A21.51, latest revision.

6) Conductive Joints

Where conductive joints are indicated on ferrous pipe that are subject to electrical thawing service, metal contact strips molded into the gasket are acceptable. Conductive gasket shall be capable of carrying 600 amps. These gaskets are not to be used where corrosion monitoring and cathodic protection are a requirement.

7) Bonded Joints

Where indicated on ferrous pipe, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of non-ferrous-metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

b) PVC Pipe.

PVC pipe shall be Underwriters' Laboratories approved and listed and must meet all requirements of ASTM D2241 and bear the seal of conformance to NSF61.

PVC pipe used for water mains shall be blue in color only. It shall meet or exceed AWWA C900 with the following supplemental specifications:

- 1) Pressure Pipe.  
Pipe less than 4 inches shall be Polyethylene Pipe , 200 psi, SDR-7CTS.  
Pipe 4 inches to 12 inches shall be Class 150 with Dimension Ratio 18 or lower (thicker).  
  
Pipe 14" and larger shall be Class 235 C905 DR 18.
- 2) Routine Hydrostatic Proof Test Requirements.  
Each piece of pipe shall be tested at four (4) times rated pressure class.
- 3) Outside Diameter.  
Pipe shall have cast iron pipe outside diameter.
- 4) Joints.  
Pipe shall have elastomeric-gasket integral bell end. Bell section shall have a thickened wall. Gasket groove Wall thickness shall meet or exceed the thickness of the pipe barrel.
- 5) Fittings.  
Ductile iron shall be mechanical-joint type conforming to ANSI /AWWA C153/A21.53, latest revision, with cement mortar lining and seal coat in accordance with ANSI/AWWA C104/A21.4, latest revision, and one mil thick petroleum exterior coating in accordance with ANSI/AWWA C104/ A21.4, latest revision, unless otherwise shown.
- 6) Affidavit of Compliance.  
The manufacturer shall furnish an affidavit that all materials delivered comply with the requirements of this standard and supplemental specifications.
- 7) Couplings and Fittings.  
Couplings and fittings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are to be used. They shall have the same minimum pressure rating as the pipe. Coupling method shall allow for expansion or contraction of each pipe section to be taken up at each end of the pipe. Couplings shall permit five (5) degree deflection (2 2 degrees on each side) of the pipe with any evidence of infiltration, exfiltration or breaking.
- 8) Gaskets:  
PVC pipe joint gaskets shall meet the requirements of ASTM F477.

c) Gate Valves.

Gate valves shall be as shown on the Drawings and shall conform to the following Specifications:

1) Resilient-Seated Gate Valves (3 Inches to 12 Inches).

Resilient-seated gate valves 3 inches to 12 inches shall conform to AWWA C509 with non-rising stem.

Unless otherwise indicated or specified, gate valves shall be designed for a working pressure of not less than 250 psig.

Valves shall take full pressure on either face. Valves shall be from one manufacturer and similar sizes shall be identical and parts interchangeable. They shall be constructed with bolted bonnets provided with two O-ring stem seals which can be replaced with the valve under pressure in the full-open position.

Valves shall be constructed of materials conforming to AWWA C509. All internal and external surfaces shall be coated with fusion bonded epoxy to a minimum thickness of 8 mils.

Valve seats shall be coated with a rubber material conforming to AWWA C509 so that there shall be no rubber to metal contact when the valve is in the fully closed position.

Valves shall be hydrostatically tested in accordance with AWWA C509.

Valves shall be American, Waterous or approved equal and shall be furnished with standard hand wheels, chain wheels or nuts as shown on the Drawings and/or as specified.

2) Ball Valves (2 Inches & Smaller.)

Ball valves 2 inches and smaller shall be designed for a working pressure of not less than 300 psi, domestic made brass, and shall conform to AWWA standard C 800-89.

a) Standard tee head stops in body permit 90 degree turn only.

b) Padlock wings shall be used on the tee head.

d) Butterfly Valves 14 Inches and Larger:

Butterfly valves 14-inches and larger shall be of the tight-closing, rubber seated type, with rubber seat positively locking in place against flow from either direction. No metal-to-metal seating surfaces will be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction. Butterfly valves shall conform to ANSI/AWWA C504, Class 150B.

- 1) Valve body shall be high-strength cast iron ASTM A126 Class B with 18-8 Type 304 stainless steel body seat. Valves shall have Mechanical Joints per AWWA C111. All MJ accessories (bolts, glands, gaskets) shall be supplied by the valve manufacturer. Valves for below ground service shall be installed using restrained joints.
  - 2) Valve shafts shall be 304 stainless steel and shall consist of a one-piece, extending full size through the entire valve or 18-8 stainless steel stub shaft design keyed to the vane with stainless steel torque plugs.
  - 3) Valve discs shall be solid ductile iron with an epoxy coating making it corrosion resistant. The thickness of the discs shall not exceed 2-1/4 times the shaft diameter.
  - 4) Valve seats shall be natural or synthetic rubber providing 360 degrees uninterrupted seating. The resilient seat shall be adjustable or replaceable in the field without burning or grinding. The seat shall be molded over a stainless steel ring for support and secured to the disc by corrosion resistant, self locking stainless steel screws.
  - 5) All internal ferrous metal surfaces in the waterway shall be factory coated with a non-toxic, two-component, holiday-free, thermosetting epoxy to a nominal thickness of 4 mils. All external surfaces shall be coated with an epoxy coating conforming to AWWA C-550, with a minimum thickness of 10 mils.
  - 6) All butterfly valves shall be manually operated. Operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position without creeping or fluttering. Operators shall be furnished with externally adjustable mechanical stop limiting devices. Valves shall have a 2-inch square operating nut and shall be installed with extension stems to extend the operating nut in accordance with the project details. The operator shall be integrally mounted on the valve mounting flange and shall have all gearing totally enclosed for buried service. Maximum force for operating nut shall be 40 pounds.
  - 7) All valves shall be M&H model 4500, or approved equal.
- e) Hydrants.  
Hydrants shall conform to AWWA C502. Main Valve opening size shall be 4-2 inches minimum and inside barrel diameter shall be 7 inches minimum with 3 feet minimum bury. Hose connections shall be two 22 inches and one 42 inches. Nipple caps shall be chained to the barrel. Hydrant shall be DRY TOP type protecting operating threads from coming in contact with water. Operating

threads will be grease lubricated through easily accessible Alemite fitting in top of operating nut. Direction of opening shall be counterclockwise and be cast on the head of the hydrant. Hose nipples shall be bronze or non-corrosive metal and threads shall be National Standard.

Hydrants shall be traffic type utilizing stem breaking coupling and breakaway traffic flange. (Breakable bolts or nuts are not acceptable.)

Hydrants shall be painted with 1 coat of red paint and 2 finish coats of approved paint of fire hydrant yellow color or as otherwise directed.

Hydrants shall be American Darling, Mueller, M&H or approved equal.

f) Tapping Sleeves and Valves

Tapping sleeves and valves shall be used for making branch connections to an existing water main. Tapping sleeves shall be provided at the locations indicated on the Drawings and shall be mechanical joint type, Mueller No. H-615, Clow F-5205 or approved equal. Tapping valves shall be mechanical joint type gate valves, Mueller No. 667, Clow F-5093 or approved equal, and shall conform to the requirements of this Section.

g) Tapping Saddles (Service Saddle):

Tapping saddles shall be used for making service connections on 4" and larger PVC and/or Ductile Iron Pipe. Drawings shall show a Smith Blair Series 317 service saddle or approved equal. At each point where a 1 2" or 2" connection is required.

h) Air Release Valves

Air Release Valve shall be 2-inch screwed inlet. The air release valve shall be designed to permit automatic escape of large quantities of air from the pipeline when the line is being filled and must also allow accumulating air to escape while the line is in operation and under pressure. The body and cover shall be able to operate at pressures up to 300 psi. The open end of and air relief pipe from automatic valves or from a manually operated valve shall be extended to the top of the pit and provided with a screened downward facing elbow.

Air release valve manufacturer shall be Crispin Model No. PL-10 or VENT O MAT Series RBX, or approved equal.

i) Water Service Pipe Material

Pipe shall conform to AWWA Specifications C901-96, Polyethylene Pressure Pipe and Tubing, and shall be marked with AWWA requirements and the following:

<u>Polyethylene</u>	<u>To Be Marked On Pipe</u>
Nominal Size	X
ASTM D2837	X
SDR 9	X
PE 3408	X
Working Pressure - 160 psi	X
Water Service Tubing	X
National Sanitation Foundation (NSF 14)	X
Pipe Color	Blue

Unmarked pipe, without information noted above, will not be accepted. Polyethylene pipe shall comply with ASTM D1248 PE3408 Class III, A, 5, P34. Brass (Domestic Made) or bronze compression type fittings shall be used. Flared connections will not be permitted. Continuous metallic tape over the pipe and tracing wire will be required. No gooseneck will be allowed nor will solvent weld joints be allowed. Corporation and curb stops will be required on all laterals. Minimum nominal size shall be 1 inch.

j) Corporation Stops.

At each tapped point a connection to the pipe shall be made by installing a corporation stop. Corporation stops shall be Ford F 1000-4-G AWWA/CC Ground Key Corporation Stop, or approved equal, as required for the type of pipe being tapped.

k) Curb Stops

Curb stop shall be 1 inch size or as shown on the Drawings and shall be Ford C14-44G1 FIP x GJCTS with a Brass, domestic made, square head cored plug, or approved equal.

l) Service Saddles

Service saddles shall epoxy coated, ductile iron, double strap - stainless steel manufactured by Smith-Blair, Model 317 Service Saddle, or approved equal.

m) Post Indicator Valve

Each post indicator valve shall consist of a gate valve which meets these specifications and an indicator post which meets National Fire Protection Association Code, NFPA 13. The gate valve and post indicator shall be



compatible. Post indicator shall be painted with one coat of red paint and two coats of paint suitable for exterior finish.

n) Post Hydrant

Post hydrant shall have main valve opening of 2-3/16-inches, with all working parts brass. The operating rod shall be non-turning, and all operating parts shall be removable from above ground with no special wrenches. The hydrant shall have a two and one half (2 1/2) inch NFS outlet and a two (2) inch inlet, unless otherwise specified on the Drawings. The hydrant shall be non-freezing, and self-draining with a three (3) inch ductile iron barrel. Post hydrant shall be M&H Post Hydrant Style 33, or approved equal.

o) Valve Box

Each buried valve shall be accompanied by a valve box of the adjustable type of heavy pattern, constructed of cast iron, and provided with cast iron cover.

The upper section of each box shall have a flange at the bottom, having sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the operating nut of the valve. Boxes shall be of lengths consistent with pipe depths as shown on the Drawings. Boxes shall be adjustable, with a lap of at least 6-inches when in the most extended position. Covers shall have the word "WATER" cast in the top. Each valve box shall have a concrete round collar installed around the top along with a concrete valve marker at each valve.

p) Valve Manhole

a) General.

Manholes shall be constructed at such points as designated on the Drawings. Riser and top sections shall be installed level and plumb, such that all manhole steps are in alignment. The top of manholes outside of roads, streets and highways shall be built to grades 2 inches above ground surface, unless otherwise shown. Manholes in roads, streets and highways shall be built to grades shown on the Drawings.

b) Precast Concrete Manholes.

Precast Concrete manholes shall be constructed of reinforced Class "A" Concrete. Walls shall be not thinner than 5 inches, or 1/12 of the inside diameter, whichever is greater. Precast manholes shall meet all requirements of ASTM C478, "Specification for Precast Reinforced Concrete Manhole Sections."

Rings shall be custom made with openings to meet the necessary pipe alignment conditions and invert elevations. All inlets and outlets shall be cast in or core drilled. Joints and gaskets shall conform to the applicable provisions of ASTM

C443, "Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gasket" or Ram-Nek Pre-molded Plastic Joint Sealer. The sealing compound shall not leak at the joints (while being tested, if required, at 10 psi) for a period of 24 hours. Bell and spigot surfaces shall be smooth, accurately formed, and provide a loose, sliding fit, with a clearance between the bell and spigot of not more than 1/6 inch. Precast manholes shall be bedded on not less than 6 inches of compacted crushed stone at the Contractor's expense. The crushed stone shall extend not less than 6 inches outside the walls of the manhole and under the entire length of pipe within the excavation for the manhole.

q) Meter Box - 3/4" and 1"

Meter boxes shall be of cast iron and shall be 3/4" stretch box Ford LYLVI41-243T or stretch box Ford LY 111-444-YBL-T, or approved equal. The lid shall have the word AWATER@ cast in it.

r) Polyethylene Encasement

Polyethylene encasement of pipes and fittings shall be installed on all Ductile Iron Pipe. The polyethylene encasement shall have a nominal thickness of eight (8) mils and shall conform to AWWA C105.

s) Yard Hydrants

Yard hydrant shall have large cushion type plunger, positive shut-off, automatic drain feature to prevent freezing, with a depth of bury of four (4) feet. Yard hydrant shall have a 1" NPT inlet and a brass nozzle with 3/4" hose threads. Yard hydrants shall be Woodford Freezeless IOWA Model Y1, or approved equal.

t) Backflow Preventer:

Backflow preventer shall comply with the Effingham County=s Backflow - Prevention and Cross-Connection Control Manual.

u) Sampling Station

Sampling Station shall have a 3/4-inch un-threaded nozzle. All stations shall be enclosed in a lockable, non-removable, aluminum-cast or stainless steel housing. When opened, the station shall require no key for operation and the water will flow in an all brass waterway. All parts shall be brass and be removable from above ground with no digging. A copper vent tube will enable each station to be pumped free of standing water to prevent freezing and to minimize bacteria growth. The exterior piping will be galvanized and shall be Model Eclipse No. 88 as manufactured by Kupferle Foundry or approved equal.

v) Insulated Enclosures:

Insulated enclosures shall consist of a fiberglass shell, insulated with urethane foam, provide security and freeze protection and shall provide drains sized for

full port discharge, testing and maintenance access, vandal protection and optional freeze protection. The enclosure shall be GREEN in color. Insulated enclosures shall be manufactured by EzBox - Jacksonville, Florida, or approved equal.

w) Tracing Wire:

Tracing wire shall be single strand #12 AWG, Vinylon - A THWN or THHN or gasoline and oil resistant II VW 600V or AWM. Tracing wire shall be continuous with all water mains, fire hydrants, post hydrants, sample stations. Tracing wire for water laterals shall be a single strand from the main to the end of the service lateral terminating in the meter box. Tracing wire shall be a single strand installed from the main to all Utility Marking Post line markers with sufficient length at the marker to be wrapped around the marker several times.

x) Concrete Valve Marker

Concrete valve marker shall be 4"x4" square by 4'-6" in length with 4-#3 re-bar cast in 4,000 psi concrete. All corners shall have a 3/4" chamfer. A 2" brass marker plate with anchor shall be embedded in the top. The brass plate shall have a directional arrow pointing to valve with the distance to the nearest foot and shall be labeled "Water Valve". The concrete valve marker shall be set 24" in the finish grade and shall be painted BLUE.

y) Utility Marking Post:

Utility parking post shall be placed every 500 feet or as shown on the Drawings above the utility and at fittings and labeled accordingly. The marking post shall be rigid enough to be easily installed in most soil conditions and durable to withstand repeated impacts. The marking post shall be a four (4) inches in width and remain flexible from -40E F to +140EF with UV stabilizers. The marker shall highly visible standard fade resistant colors, White Background and Blue Lettering with the following imprinted thereon: international ANo Dig@ symbol, federal law warning,@WATER PIPELINE BELOW@ with letter size and stroke to comply with the Federal Office of Pipeline Safety Specifications, Effingham County=s name, phone number and State one-call number. Markers shall be Rhino 3-Rail with poly tech coating, or approved equal.

4. INSTALLATION.

a) General.

Pipe, fittings, valves, hydrants and other accessories shall, unless otherwise directed, be unloaded at the point of delivery, hauled to and distributed at the site of the project by the Contractor. They shall at all times be handled with care to avoid damage. In loading and unloading, they shall be lifted by hoists or slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. In distributing the material at the site of the

work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Coated pipe shall be handled in such a manner that a minimum of damage to the coating will result. Damaged coating shall be repaired. Pipe shall be placed on the site of work parallel with the trench alignment and with bell ends facing the direction in which the work will proceed unless otherwise directed. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing before installation. Before installation of any materials, an Effingham County representative shall inspect and approve all material before installation.

Cutting pipe for inserting fittings, or closure pieces, shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise directed, pipe shall be laid with the bell ends facing the direction of laying. For lines on an appreciable slope, bells shall face upgrade. Wherever necessary to deflect the pipe from straight line, whether in the vertical or horizontal plane to avoid obstructions, the degree of deflection shall not exceed 2-1/2 degrees. No pipe shall be laid in water or when the trench condition or the weather is unsuitable for such work. Installation shall be in accordance with manufacturer's instructions.

All pipe and fittings shall be carefully lowered into the trench piece by piece by means of derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage to the pipe. Under no circumstances shall pipe or accessories be dropped into the trench. Before lowering and while suspended, ductile iron pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged or unsound pipe shall be rejected. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying. Care shall be taken to prevent dirt from entering the joint space. At all times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means and no trench water shall be permitted to enter the pipe.

- b) Ductile Iron Pipe.  
Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work.
- c) PVC.  
Pipe shall be installed in accordance with AWWA C605. Excavation, bedding and backfill shall be as specified in Section 02221.
- d) Hydrants.  
Hydrants shall be set at such elevations that the connecting pipe will have the same depth of cover as the distribution mains. The connecting pipe shall be

ductile iron pipe. The hydrant assembly shall be restrained from the main to the hydrant. Hydrants and valves shall have the interior cleaned of all foreign matter before installation. Not less than one (1) cubic foot of broken stone shall be placed around the base of the hydrant. Contractor shall place a bag over the hydrant to indicate its not being in service until after the water main is put into service.

e) Water Service Connection

Service lines shall be connected to 4-inch and larger mains with a corporation stop. Connections to mains smaller than 4-inches shall be made with a rigid connection. Plugged tees or crosses for future connections shall be installed where shown on the Drawings. A house service connection shall be provided to vacant lots and the exact location marked on the curb with a AW@. The mark shall be made on the vertical face of the curb and shall be a minimum of 1/4-inch deep made with a branding iron. Where services are provided at locations without curb, a 2"x4" 30-inch long pressure treated flag stake painted white shall locate the end of the lateral. Minimum cover of 30-inches shall be provided until a short transition to the service is stubbed out of the ground.

Water service laterals installed under roadways shall be installed a minimum of 30 inches below the road (laterals shall not be installed in the base of the road). Water service laterals shall be installed one foot short of the property line of all lots along street and right -of-ways in which water main is constructed.

f) Brass Nipples and Brass Pipe Fittings (Domestic Made):

Threads shall be cleanly cut with sharp tools and the jointing procedure shall conform with the best practice. Before jointing, all scale shall be removed from pipe by some suitable means. After cutting, all pipe shall be screwed together with an application for graphite and engine oil, Teflon tape, or other sealing compound applied to all threads and once a joint has been screwed on it shall not be backed off unless the threads are re-cleaned and new compound or Teflon tape applied. Unions shall be installed at every connection to the supply line.

g) Hydrostatic Tests.

The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. Each section shall be tested by hydrostatic pressure of 150 pounds per square inch. Each section shall be slowly filled with water, care being taken to expel all air from the pipes. If necessary, the pipe shall be tapped at high points to vent the air. The required pressure as measured at the point of lowest elevation shall be applied for not less than 2 hours and all pipe, fittings, valves, hydrants and joints shall be carefully examined for defects. Each valve shall be opened and closed several times during the test. All defective joints shall be repaired or replaced.

h) Connection to Existing Water System.

The Contractor shall furnish necessary materials and perform all excavation, dewatering, shoring, backfilling, etc., necessary to make the connection of a new main to the existing water main. The Contractor shall notify the Engineer and Effingham County, a minimum of 48 hours in advance of construction. The Contractor shall be responsible for coordinating his construction with Effingham County.

i) Damage to Water System.

Damage to any part of the water system by the Contractor, or subcontractors, that is repaired by Effingham County shall be charged to the Contractor on the basis of time and material, plus 30 percent for overhead and administration.

j) Protection of Water Supply Systems.

See Section 02221, Paragraph 13 for protection of Water Supply Systems.

k) Polyethylene Encasement

Polyethylene encasement shall conform to ANSI/AWWA C107/A21.5, latest revision for high density, cross-laminated polyethylene film. Polyethylene encasement shall be used where noted on the contract drawings or directed by the Engineer on all ductile iron piping, fittings, valves and appurtenances and installed according to the requirements of ANSI/AWWA C105/A21.5, Sec. 4.4, Method A.

l) Joint Restraints:

All restraints shall be used in accordance with engineering and manufacturer=s specifications. Thrust block is not allowed. Joint restraints shall be: Ford 1390 Series, Mega-Lug, EBBA Series 1100 for Ductile Iron 4" and larger, EBBA Series 2000 PV for PVC Pipe 4" and larger, Flexlock, T-lock, Uni-Flange, or approved equal.

5. HYDROSTATIC TESTING:

All pressure and leakage test shall be performed in accordance with the latest edition of AWWA C600. Leakage test shall be conducted simultaneously with the pressure test. The duration of the test shall be 2 hours and during the test the main or section of main under test shall be subjected to a pressure of 150 psi based on the lowest point in the line or section under test, and connected at that elevation to the test gauge. Test pressure shall not vary more than  $\pm 5$  psi for the duration of the test. Testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure in a test section over a period of time. Testing allowance is defined as the quantity of water to be supplied into the newly laid pipe or any valved section thereof, necessary to maintain the specified leakage test pressure after

the air has been expelled and the pipe has been filled with water at the test pressure. No pipe installation will be accepted until the testing allowance is less than the number of gallons per hour as determined by the formula.

$$L = \frac{S \times D \times P}{133,200}$$

L = testing allowance (makeup water) in gallons per hour

S = the length of pipe tested in linear feet.

D = the nominal diameter of the pipe in inches

P = the average test pressure during the hydrostatic test in pounds per square inch (gauge).

Should any test of pipe laid disclose leakage greater than the above specified, the Contractor shall at his own expense locate and repair the defective joints until leakage is within the specified testing allowance. All visible leaks shall be repaired regardless of the allowance used for testing. Line shall be retested until Testing Allowance requirement are within the allowable leakage. All additional testing shall be at the Contractors expense.

6. CLEANING AND DISINFECTION OF NEW MAINS:

All water mains, as well as those taken out of service for inspection, repair or other activities that might lead to contamination of water shall be disinfected before they are placed in or returned to service. The water passing through them must show by laboratory tests safe results before the system can be placed in service. Disinfection of all water lines and the disposal of the heavily chlorinated water, following the disinfection, shall be in accordance with AWWA C651, latest revision. Approved methods for the accomplishment of these are as follows:

The Atablet method@ of disinfection which consist of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed is not allowed.

Clean the interior of all pipe by brushing, swabbing or washing out all debris before laying. Stop up all branches and other openings with wooden plugs or heads until either capped or connected. The use of a cross connection device during flushing and disinfection to protect the active part of the water system shall be required. Before the main is chlorinated, it shall be filled to eliminate air pockets and shall be flushed to remove particulates. A flushing velocity of not less than 2.5 feet per second shall be maintained in pipe sizes less than 24-inches in diameter. For larger diameter mains, an alternative to flushing, such as broom-sweeping of the main, is acceptable prior to chlorinating the main.

Install sufficient number of sample points to give representative sampling on the newly installed lines. The hydrants should be at least 18 inches higher than main and must discharge toward the ground.

Quality of water used during the disinfection procedure shall meet the required drinking water standards.

Flush the new pipe lines for a full pipe open end flush until the water runs clear at the end of all mains and laterals. This should be done after the pressure test and before disinfection. Each valved section of the newly laid pipe should be flushed separately with potable water.

Disinfect the pipe lines with chlorine. The preferable point of application of the chlorinating agent is at the beginning of the pipe line extension, or any valved section of it, and through a corporation cock inserted in the horizontal axis of the newly laid pipe. Water from the existing distribution system should be controlled to flow very slowly into the newly laid pipe during the application of the chlorine. Partially open all hydrants or valves on the newly laid line under treatment to prevent the building up of water pressure. The chlorine solution used for disinfection of water mains shall have a free chlorine residual concentration not less than 25 mg/l. This heavily chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants shall be operated to ensure disinfection of the appurtenances.

Allow the treated water to remain in the pipe line for at least 24 hours, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine. Re-chlorinate if required results are not obtained on all samples. After the applicable retention period, the heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals, such as Sulfur Dioxide, Sodium Bisulfite, Sodium Sulfite or Sodium Thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted. Flush all mains and lines until all the heavily chlorinated water has been removed.

Test water samples to make sure all chlorine has been flushed out or until the concentration of chlorine in the newly laid lines is no higher than that of a sample taken on the supply line. After final flushing and before the water main is placed into service, water samples shall be collected from the main and tested for microbiological quality in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5. The laboratory results must show the absence of coliform organisms in the water. Re-flush and re-disinfect the lines, as necessary, until satisfactory bacteriological results are obtained.



**AMOUNT OF CHLORINE NECESSARY FOR DISINFECTION**

Chlorine required to produce 25 mg/l concentration in 100 feet pipe by diameter.

Pipe Diameter (inches)	100% Chlorine		1% Chlorine Solution	
	(lbs)	(g)	(gal)	(L)
4	0.013	5.9	0.16	0.6
6	0.030	13.6	0.36	1.4
8	0.054	24.5	0.65	2.5
10	0.085	38.6	1.02	3.9
12	0.120	54.4	1.44	5.4
16	0.217	98.4	2.60	9.8

Note: 1 % chlorine solution may be prepared with sodium hypochlorite (contains 5% to 15% available chlorine) or calcium hypochlorite (contains approximately 65% available chlorine by weight). To prepare 1% chlorine solution using calcium hypochlorite, add one (1) pound (454 grams) of calcium hypochlorite in approximately 8 gallons of water.

Amounts and types of chemicals advised to be used for neutralizing various residual chlorine concentrations on 100,000 gallons of water.

Residual Chlorine Concentrations	Chemicals							
	Sulfur Dioxide (SO <sub>2</sub> )		Sodium Bisulfate (NaHSO <sub>3</sub> )		Sodium Sulfide (Na <sub>2</sub> SO <sub>3</sub> )		Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> .5H <sub>2</sub> O)	
mg/l	lb	Kg	lb	Kg	lb	Kg	lb	Kg
1	0.8	0.36	1.2	0.54	1.4	0.64	1.2	0.54
2	1.7	0.77	2.5	1.13	2.9	1.32	2.4	1.09
10	8.3	3.76	12.5	5.67	14.6	6.62	12.0	5.44
50	41.7	18.91	62.6	28.39	73.0	33.11	60.0	27.22

The Engineer will arrange for the Effingham County inspection. Lines will not be placed in operation until Effingham County approval and Engineer directs Contractor to do so.

A hydrant flow test will be performed after the lines are placed in service as directed by the Engineer. Results of the test will be reported in writing by the Engineer to Effingham County.

7. IDENTIFICATION AND TRACER WIRE:

- a. Mylar tape shall be installed 18 inches below the finished grade over the top of the water mains. The tape shall be 2 inches wide, of blue color and have imprinted on the tape "Caution - Water Line Below." The tape shall be laid the entire length of the trench.
- b. No. 12 AWG solid plastic-coated copper wire shall be installed on top of all water mains where non-metallic pipe is used and attached by means of securing the wire on top of the water main with a 12-inch long by 2-inch wide piece of duct tape. Attach the wire to the main every ten (10) feet.

Wire shall be bonded at splices with 3M DBY-6 Direct Bury Splice Kit at every connection

The wire shall be laid the entire length of the trench and shall be continuous. The Contractor shall demonstrate continuity in wire through the entire length of the project. At every valve manhole the wire shall be run through the pipe opening, up to the ring and cover, secured at the ring by means of grouting the ring to the top of the manhole. The wire shall continue in the same loop back to the opposite pipe opening, through it and continuing in one continuous loop along the main.

At every fire and post hydrant, the wire shall be run from the main to the hydrant tee, to the gate valve, wrapped around the gate valve once, then run to the bottom of the hydrant flange, up the hydrant, wrapped around it once at the finish grade, then back to the main in one continuous loop, and continuing along the water main.

At every water service lateral, the wire shall be run from the main and corporation stop to the curb stop and attached to the polyethylene pipe by a piece of duct tape wrapped around the wire and tubing. The wire shall be connected to the tracer wire at the main with a single strand from the water main to the curb stop or into the meter box.

At every sampling station, the wire shall be run from the main service connection up to the bottom inside of the sampling station, then back in one continuous loop to the water main, then continuing with the utility along the water main.

The Effingham County will test all tracer wire prior to acceptance.

8. SHOP DRAWINGS:  
Shop drawings shall be submitted on each manufactured item supplied under this Section along with other information as specified herein.
9. CLEANUP  
Upon completion of the installation of water lines and appurtenances, all debris and surplus materials resulting from the work shall be removed.
10. WATER VALVES:  
All 4-inch or larger gate valves that are installed on the transmission line(s) and /or tie into a major transmission line shall be installed in a manhole. All Gate Valves that are located at the entrance of subdivision or other development that tie into a transmission line shall be installed in a manhole. All other Gate Valves can be install in a cast iron valve box with a concrete collar and concrete valve marker post.
11. RECORD DRAWINGS:  
The Effingham County will require Record Drawings seventy two (72) hours before final inspection will be made. The Contractor shall keep on the work site one (1) set of clean Drawings to which at the end of every day the necessary information will be marked by the Contractor=s superintendent. All deviations from the Drawings shall be stationed and clearly marked. Record drawings shall include measurements between each valve, bends, permanent land markers, manholes, laterals locations from property corners, fire hydrants & manholes.

END OF SECTION 02700

**SECTION 02600****FUSIBLE POLYVINYL CHLORIDE (PVC) PIPE FOR INSTALLATION BY  
HORIZONTAL DIRECTIONAL DRILLING (HDD)****PART 1 –GENERAL****1.01 DESCRIPTION****A SCOPE**

1. This section specifies fusible polyvinyl chloride (PVC) pipe, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, storage and installation of the pipe by horizontal directional drilling, directional boring, or guided boring.

**B REQUIREMENTS:**

1. Contractor shall provide fusible polyvinyl chloride (PVC) pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by horizontal directional drilling, directional boring, or guided boring.
2. Contractor shall be responsible for all installation processes and procedures associated with the installation by horizontal directional drilling, directional boring, or guided boring in accordance with this specification.

**C PIPE DESCRIPTION**

1. Pipe Supplier shall furnish fusible polyvinyl chloride (PVC) pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.
2. Pipe shall conform to the following table of dimensions and designations:

<u>Pipe Name &amp; Reference Standard</u>	<u>Nominal Diameter (in.) &amp; Convention (e.g., CIOD, IPS, or other)</u>	<u>Dimension Ratio (DR)</u>	<u>Pressure Class or Rating (psi)</u>	<u>Required Inside Diameter (in.)</u>

**1.02 QUALITY ASSURANCE****A REFERENCES:**

1. This section contains references to the following documents. They are a part of this section as specified and modified. In the event of a conflict between the requirements of this section and those of the listed documents, the

requirements of this section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of design.

Reference	Title
ANSI/AWWA C110/A21.10	Standard for Ductile-Iron and Gray-Iron Fittings
ANSI/AWWA C111/A21.11	Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53	Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900 <sup>1</sup>	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100mm Through 1,500mm)
AWWA C907	Standard for Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service
AWWA M23	AWWA Manual of Practices for PVC Pipe—Design and Installation
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

<sup>1</sup> Prior to 2017, AWWA C905 was the standard for PVC pipe and fabricated fittings larger than 12 in. (300 mm). “AWWA C905” marking on pipe larger than 12 in. is acceptable.

Reference	Title
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
UNI-PUB-08	PVC Pressure Pipe Tapping Guide
NSF/ANSI – 61-G	Drinking Water System Components--Health Effects
PPI TR-2	PVC Range Composition Listing of Qualified Ingredients

**B MANUFACTURER REQUIREMENTS**

1. All piping shall be made from PVC compound having a minimum cell classification of 12454 per ASTM D1784.

**C FUSION TECHNICIAN REQUIREMENTS**

1. Fusion technician shall be qualified by the pipe supplier to install fusible polyvinyl chloride (PVC) pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

**D SPECIFIED FUSION PROCESS AND PIPE SUPPLIERS**

1. The pipe fusion joining process shall be that of Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051.
2. The pipe manufacturers shall be fully experienced, reputable, and qualified in the manufacture of fusible polyvinyl chloride (PVC) products for Underground Solutions, Inc., Poway, CA, (858) 679-9551. Fusible polyvinyl chloride (PVC) pipe marking shall include either Fusible PVC®, Fusible C-900®, or FPVC®.

**E WARRANTY**

1. The pipe shall be warranted for one year per the pipe supplier's standard terms.
2. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per the fusion service provider's standard terms.

**F PRE-CONSTRUCTION SUBMITTALS**

1. The following PRODUCT DATA is required from the pipe supplier and/or fusion provider:
  - 1) Pipe Size
  - 2) Dimensionality
  - 3) Pressure Class or Pressure Rating per applicable standard
  - 4) Color
  - 5) Recommended Minimum Bending Radius

- 6) Recommended Maximum Safe Pull Force
- 7) Fusion technician qualification indicating conformance with this specification
2. The following WORK PLAN AND INFORMATION is required from the contractor and/or horizontal directional drilling Contractor. This WORK PLAN AND INFORMATION shall also be supplied to the pipe supplier upon request:
  - 1) Work plan shall include for each HDD installation any excavation locations and dimensions, interfering utilities, bore dimensions and locations including bend radii used, and traffic control schematics.
  - 2) A project safety and contingency plan which shall include but shall not be limited to drilling fluid containment and cleanup procedures, equipment and plan for compromised utility installations including electrical and power lines, water, wastewater and any other subsurface utility in the area.
  - 3) An HDD schedule identifying daily work hours and working dates for each installation.

**G POST-CONSTRUCTION SUBMITTALS**

1. The following is required from the contractor and/or fusion provider to the owner or pipe supplier upon request:
  - 1) Approved datalogger device reports
  - 2) Fusion joint documentation containing the following information:
    - a) Pipe Size (Diameter) and Wall Thickness
    - b) Fusion Machine Size (Make & Model Number)
    - c) Fusion Technician Identification
    - d) Job Identification (Name, location & project number)
    - e) Fusion Joint Number
    - f) Fusion, Heating, Cool Down and Drag Pressure Settings
    - g) Heat Plate Temperature
    - h) Time Stamp
    - i) Fusion Heating and Cool Down Time
    - j) Ambient Temperature and Weather Conditions
  - 3) As-recorded Information
    - a) The as-recorded plan and profile will reflect the actual installed alignment, and reflect the horizontal offset from the baseline and depth of cover.
    - b) All fittings, valves, or other appurtenances will also be referenced and shown.

- c) A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include all that apply, including inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.

## **PART 2 - PRODUCTS**

### **2.01 FUSIBLE POLYVINYL CHLORIDE (PVC) PIPE FOR POTABLE WATER, RECLAIMED WATER, AND WASTEWATER**

- A Fusible polyvinyl chloride (PVC) pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785, as applicable. Testing shall be in accordance with the test methods provided or referenced in the applicable pipe standard.
- B Fusible polyvinyl chloride (PVC) pipe shall be extruded with plain ends. The ends shall be square to the pipe and without any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe unless specified for connections with appurtenances or for connections at the fusible pipeline termination locations.
- C Fusible polyvinyl chloride (PVC) pipe shall be manufactured in a standard 40' or 45' nominal length, or custom lengths as specified.
- D Fusible polyvinyl chloride (PVC) pipe for potable water use shall be blue in color.
- E Marking on the pipe shall include:
  - 1. Pipe size (nominal diameter)
  - 2. PVC
  - 3. Pipe Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule (SCH)
  - 4. AWWA pressure class, or ASTM pressure rating, as applicable,
  - 5. Designation of the applicable AWWA or ASTM standard, (e.g., "AWWA C900")
  - 6. Extrusion production-record code
  - 7. Trademark or trade name
  - 8. Cell Classification 12454 and/or PVC material designation code 1120 may also be included
  - 9. NSF-61-G (designating suitability for potable water service, including the lead-free requirements of the Safe Drinking Water Act) on all potable water pipe.
- F Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

### **2.02 FUSION JOINTS**



- A Unless otherwise specified, fusible polyvinyl chloride (PVC) pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

## 2.03 CONNECTIONS AND FITTINGS

### A DUCTILE IRON MECHANICAL AND FLANGED FITTINGS

Acceptable fittings for use with fusible polyvinyl chloride (PVC) pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

1. Connections to fusible polyvinyl chloride (PVC) pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
2. Ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
3. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

### B PVC GASKETED, PUSH-ON FITTINGS

Fittings for use with fusible polyvinyl chloride (PVC) pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C907.

1. Fittings for use joining fusible polyvinyl chloride (PVC) pipe with other sections of fusible polyvinyl chloride (PVC) pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the construction documents.
2. PVC gasketed, push-on fittings and mechanical restraints, if used, shall be installed per the manufacturer's guidelines.

### C FUSIBLE POLYVINYL CHLORIDE (PVC) SWEEPS OR BENDS

1. Fusible polyvinyl chloride (PVC) sweeps or bends shall be manufactured from the same fusible polyvinyl chloride (PVC) pipe being used for the installation and be of the same sizing convention, diameter, wall thickness and pressure class of the pipe being joined using the sweep or bend.
2. Fusible polyvinyl chloride (PVC) sweeps or bends shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. Unless otherwise specified, there shall be no gasketed connections utilized with a fusible polyvinyl chloride (PVC) sweep.
3. Standard fusible polyvinyl chloride (PVC) sweep or bend angles shall not be greater than 22.5 degrees, and unless otherwise specified, shall be used in nominal diameters ranging from 4-inch through 16-inch.

### D SLEEVE-TYPE COUPLINGS

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe.

2. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

E EXPANSION AND FLEXIBLE COUPLINGS

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.
2. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

F CONNECTION HARDWARE

Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

G CONNECTION TO SANITARY SEWER MANHOLES AND STRUCTURES

1. Fusible polyvinyl chloride (PVC) pipe shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.
2. Connections to existing manholes and structures shall be as indicated in the construction documents.
  - 1) For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
  - 2) For a knock out opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
  - 3) Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.
3. Connections to a new manhole or structure shall be as indicated in the construction documents.
  - 1) A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
  - 2) Drop connections shall be required where shown on drawings.
  - 3) Grout internal joint space with non-shrink grout.

2.04 DRILLING SYSTEM EQUIPMENT

A GENERAL

1. The directional drilling equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to

operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project. All required equipment shall be included in the emergency and contingency plan as submitted per these specifications.

**B DRILLING RIG**

1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
2. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.
3. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.

**C DRILL HEAD**

1. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steer-able drill head and any subsequent pre-reaming heads.
2. The system must be able to control the depth and direction of the drilling operation.
3. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.

**D DRILLING FLUID SYSTEM**

**1. DRILLING FLUID (DRILLING MUD)**

- a) Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer(s).
- b) The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
- c) Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).
- d) Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
- e) No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this specification.

**2. MIXING SYSTEM**

- a) A drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.

- b) The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
- c) The mixing system shall continually agitate the drilling fluid during drilling operations.

### 3. DRILLING FLUID DELIVERY AND RECOVERY SYSTEM

- a) The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.
- b) The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
- c) Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.
- d) A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment be reused in the drilling system.

### E DRILLING CONTROL SYSTEM

- 1. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.
- 2. The drilling head shall be remotely steer-able by means of an electronic or magnetic detection system. The drilling head location shall be monitored in three dimensions:
  - a) Offset from the baseline,
  - b) Distance along the baseline, and
  - c) Depth of cover.
- 3. Point of rotation of the head shall also be monitored.
- 4. For gravity application and on-grade drilling, sonde/beacon or approved equipment applicable for grade increments of 1/10<sup>th</sup> of one percent shall be used.

### 2.05 PIPE PULL HEADS

- A Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- B Pipe pull heads shall be specifically designed for use with fusible polyvinyl

chloride (PVC) pipe, and shall be as recommended by the pipe supplier.

## 2.06 PIPE ROLLERS

- A Pipe rollers, if used, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- B A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and excessive sagging of the product pipe.

## PART 3 – EXECUTION

### 3.01 DELIVERY AND OFF-LOADING

- A All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.
- B Each pipe shipment shall be inspected for damage and to determine if the load has shifted prior to unloading. The owner or engineer shall be notified immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, and type.
- C Pipe should be loaded, off-loaded, and otherwise handled following all of the pipe supplier's guidelines.
- D Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
- E During off-loading and handling, care shall be taken to avoid the pipe striking hard objects. Significant impact could cause damage, particularly during cold weather.
- F If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to ensure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

### 3.02 HANDLING AND STORAGE

- A Visibly damaged pipe sections, or sections with suspected damage shall be cut out and removed. Cutting shall be performed per the pipe supplier's recommendations.
- B Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.
- C Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

- D Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
- E If pipe is to be stored for periods of 1 year or longer, the pipe should be shielded from direct sunlight. The pipe cover should be opaque and provide for adequate air circulation above and around the pipe to prevent excess heat accumulation.
- F Pipe shall be stored and stacked per the pipe supplier's guidelines.

### 3.03 FUSION PROCESS

#### A GENERAL

1. Fusible polyvinyl chloride (PVC) pipe will be handled in a safe manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
2. Fusible polyvinyl chloride (PVC) pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
  - a) HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
  - b) CARRIAGE – Carriage shall travel smoothly with no binding at low pressure. Jaws shall be in good condition with proper and clean inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
  - c) GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, hydraulic leaks or potential safety issues prior to fusion.
  - d) DATA LOGGING DEVICE – An approved, fully functional datalogging device, with the current version of the pipe supplier's software shall be used. Datalogging device operations and maintenance manual shall be kept with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the

following:

- a) Pipe rollers shall be used for support of pipe to either side of the machine
- b) An infrared (IR) pyrometer, with an accuracy of 1% or better, for checking pipe and heat plate temperatures.
- c) Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
- d) Facing blades specifically designed for cutting fusible polyvinyl chloride (PVC) pipe shall be used.
- e) For fusion in inclement weather, and/or windy conditions; a weather protection canopy with sides that allow full machine motion of the heat plate, fusion assembly and carriage shall be provided per the pipe supplier's recommendations. When the pipe temperature is below 40°F, the pipe supplier's cold weather operating procedures shall be followed.

#### **B JOINT RECORDING**

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine hydraulic system. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride (PVC) pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Required data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

### **3.04 DRILLING OPERATIONS**

#### **A GENERAL**

1. Bore path and alignment are as indicated in the contract documents. The path of the bore may be modified based on field and equipment conditions. Entry and exit locations and control-point elevations shall be maintained as indicated in the contract documents.
2. Bend radii shown in the contract documents are minimum allowable radii and shall not be reduced.

#### **B LOCATION AND PROTECTION OF UNDERGROUND UTILITIES**

1. Correct location of all underground utilities that may impact the HDD installation is the responsibility of the Contractor, regardless of any locations shown on the drawings or previous surveys completed.
2. Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
3. All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of HDD installation as determined for the project specific site conditions. It is the Contractor and HDD system operator's responsibility to

determine this envelope of safe offset from existing utilities. This will include, but is not limited to, soil conditions and layering, utility proximity and material, HDD system and equipment, and foreign subsurface material.

**C SITE LOCATION PREPARATION**

1. Work site as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made
2. Contractor shall confine all activities to designated work areas.

**D DRILLING LAYOUT AND TOLERANCES**

1. The drill path shall be accurately surveyed with entry and exit areas placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, drill path will be surveyed for any surface geomagnetic variations or anomalies.
2. Instrumentation shall be provided and maintained at all times that accurately locates the pilot hole, measures drill-string axial and torsional loads and measures drilling fluid discharge rate and pressure.
3. Entry and exit areas shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe supplier.

**E PILOT HOLE BORE**

1. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require contractor to pull-back and re-drill from the location along bore path before the deviation.
2. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe supplier and as indicated on the drawings.

**F REAMING**

1. After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed. The following table is offered as an estimated guide:

<b>Nominal Pipe Diameter</b>	<b>Bore Hole Diameter</b>
< 8 inches	Pipe Dia. + 4 inches
8 inches to 24 inches	Pipe Dia. X 1.5
> 24 inches	Pipe Dia. + 12 inches

2. Multiple reaming passes shall be used at the discretion of the Contractor and shall conform to this specification.
3. In the event of a drilling fluid fracture, returns loss or other loss of drilling



fluid, the Contractor shall be responsible for restoring any damaged property to original condition and cleaning up the area in the vicinity of the damage or loss.

### 3.05 PIPE PULL-BACK AND INSERTION

- A Pipe shall be fused prior to insertion, if the site and conditions allow, into one continuous length.
- B Contractor shall handle the pipe in a manner that will not over-stress the pipe prior to insertion. Vertical and horizontal curves shall be limited so that the pipe does not bend past the pipe supplier's minimum allowable bend radius, buckle, or otherwise become damaged. Damaged portions of the pipe shall be removed and replaced.
- C The pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.
  - 1. The pipe shall be guided into the bore hole to avoid deformation of, or damage to, the pipe.
  - 2. The fusible polyvinyl chloride (PVC) pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to, or during installation.
  - 3. A swivel shall be used between the reaming head and the fusible polyvinyl chloride (PVC) pipe to minimize torsion stress on the pipe assembly.
- D Buoyancy modification shall be at the sole discretion of the Contractor, and shall not exceed the pipe supplier's guidelines in regards to maximum pull force or minimum bend radius of the pipe. Damage caused by buoyancy modifications shall be the responsibility of the Contractor.
- E Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.
- F The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, or movement and distortion of surface features. Any damages caused by the Contractor's operations shall be corrected by the Contractor.
- G Pneumatic hammer shall not be used to dislodge a stuck pipe.

### 3.06 INSTALLATION CLEANUP

- A Following the installation, the project site shall be returned to a condition as required in the construction documents. All excavations will be backfilled and compacted per the construction documents and jurisdictional standards. All pavement and hardscape shall be repaired per applicable jurisdictional standards. All drilling fluid shall be properly disposed of per these specifications and all applicable jurisdictional laws.
- B Contractor shall verify that all utilities, structures, and surface features in the immediate project area are sound.

### 3.07 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS

- A Prior to making connections into existing piping systems, the contractor shall:
1. Field verify location, size, piping material, and piping system of the existing pipe.
  2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, mechanical restraints, tees, or others as shown in the construction documents.
  3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- B Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

### 3.08 PIPE SYSTEM CONNECTIONS

- A Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.
- B If possible, pipe installed via HDD shall be filled with water prior to making any connections to the existing system or other portions of the project.

### 3.09 TAPPING FOR POTABLE AND NON-POTABLE PRESSURE WATER APPLICATIONS

- A Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. **NO DIRECT TAPPING WILL BE PERMITTED.** Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per UNI-PUB-08, "PVC Pressure Pipe Tapping Guide".
- B All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.
- C Equipment used for tapping shall be made specifically for tapping PVC pipe:
1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' and drill bits made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
  2. Manually operated or power operated drilling machines may be used.
- D Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap,) or when the pipeline is not filled with water and not under pressure ('dry' tap).

### 3.10 TESTING

A Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

B HYDROSTATIC TESTING AND LEAKAGE TESTING FOR FUSIBLE POLYVINYL CHLORIDE (PVC) PRESSURE PIPING

1. Hydrostatic and leakage testing shall be conducted in accordance with the requirements of AWWA C605.
2. Unless agreed to or otherwise designated by the owner or engineer, for a simultaneous hydrostatic and leakage test following installation, a pressure equal to 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation shall be applied. Unless otherwise agreed to, the duration of the pressure test shall be for two (2) hours.
3. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
4. In preparation for pressure testing the following parameters must be followed:
  - 1) All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by 'flushing' the pipeline in accordance with the parameters and procedures as described in AWWA C605.
  - 2) The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer's guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.
  - 3) Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to provide for the removal of trapped air in the pipeline.

C LEAKAGE TESTING FOR NON-PRESSURE FUSIBLE POLYVINYL CHLORIDE (PVC) PIPING

1. Gravity sanitary sewers that contain mechanical jointing in addition to fused PVC joints may need to be tested for excessive leakage.
2. Gravity sanitary sewer leakage testing may include appropriate water or low-pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of two feet. The air test, if used,

shall be conducted in accordance with one of the following Standards:

- 1) ASTM F1417
- 2) UNI-B-6
3. The testing method selected shall properly consider the existing groundwater elevations during the test.

**D DEFLECTION TESTING FOR NON-PRESSURE PIPING**

1. After completion of the backfill, the engineer or owner may require that a deflection test be performed.
2. Deflection tests can be conducted using a go/no-go mandrel. The mandrel's outside dimension shall be sized to permit passage through no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. When the internal fusion beads are not removed, the base inside diameter shall include the height of the internal bead. The mandrel shall be approved by the owner or engineer prior to use. Other deflection test options, such as direct measurements, can be used for lines large enough for safe entry.

**E INTERMEDIATE TESTING**

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer. Testing of each HDD installation prior to connection to the system or other piping is preferred.

**3.11 DISINFECTION OF POTABLE WATER PIPING**

Chlorine granules shall not be used or present near the pipe ends while the pipe sections are being joined. After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. Unless otherwise directed by the owner or engineer, the pipeline will be disinfected per AWWA C651.

**\*\*END OF SECTION\*\***