

City of Perry, Georgia



Water and Sanitary Sewer

Standard Specifications

Revised October 16, 2012

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SECTION NO. 1

CLEARING FOR UTILITIES

1.01 SCOPE

The work under this section of the Specifications consists of the furnishing of all materials and equipment and performing all labor required for clearing of utility corridors.

1.02 CLEARING

The Contractor shall clear the corridor of only those items necessary to install the utility. These shall include but not be limited to trees, stumps, brush, shrubs, rubbish and debris with the exception of items designated to be left in place. Items outside the installation area shall not be damaged.

- A. Any trees, brush, stumps, wood and other debris must be disposed of by removing from the site. **Burning will be permitted only after a burn permit number is obtained from the Environmental Protection Division of the Georgia Department of Natural Resources and approval is granted by the Perry Fire Chief. The burn permit number must be given to the fire chief prior to any burning.**

SECTION NO. 2

WATER DISTRIBUTION

2.01 PURPOSE

This section of the Specifications describes products to be incorporated into the water mains and requirements for the installation and use of these items. The word "City" used herein shall mean City of Perry or a designated representative.

2.02 GENERAL

A. Applicable Standards: Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable. If requested by the City of Perry, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two (2) years.

B. Substitutions: Whenever a product is identified in the Specifications by reference to manufacturer's or vendor's names, trade names, catalog numbers, etc., the Contractor may freely choose from those referenced products which ones he wishes to provide.

Any item or product other than those so designated shall be considered a substitution. The Contractor shall obtain prior approval from the City of Perry for all substitutions.

C. Warranty: Water distribution systems installed by Contractors which are accepted by the City of Perry for ownership, operation and maintenance shall be warranted and guaranteed for a period of one (1) year from the date of final acceptance that the completed system is free from all defects due to faulty products or workmanship and that the Contractor shall make such corrections as may be necessary by reason of such defects upon notice by the Owner.

D. City of Perry representatives shall inspect all fittings, valves, fire hydrants and thrust blocks before backfilling. Contractor shall notify the City in advance of inspections.

2.03 CONSTRUCTION DRAWINGS

The term "construction drawings" shall mean drawings, prints, descriptive literature, test reports, samples, calculations, schedules, material lists, information and items of similar meaning.

A. Submittals Required: The Contractor shall furnish to the City of Perry, for review in accordance with the procedure outlined below, drawings and descriptive

literature for all manufactured or fabricated products. Additional information, such as special drawings, schedules, calculations and tests, shall be provided as specifically requested by the City.

- B. Contractor's Review:** The Contractor shall review and check drawings and submittals. He shall indicate his review by initials and date. The Contractor shall furnish the City with a minimum of three (3) copies of all submittals. A transmittal form shall accompany each submittal or group of submittals.
- C. Review:** All submittals will be reviewed, stamped and dated by the City before they are returned to the Contractor.

One (1) copy of reviewed submittals will be returned to the Contractor and the remaining copies retained by the City.

Submittals requiring minor corrections will be so noted. Drawings must be resubmitted for review prior to installation or use of products.

- D. Drawings for Construction:** The Contractor shall maintain at the job site a complete set of construction drawings. The Contractor shall maintain throughout the project a set of "As-Built" mark-up plans indicating the locations of valves, tees, etc. with field measurements. The developer/owner is to provide the City of Perry with one full printed set of as-built construction plans and an electronic copy of the as-built construction plans on CD-ROM in the AutoCad 14 format or a later version. The printed set and CD-ROM are to be provided upon completion of the project and before final acceptance.

2.04 MATERIALS

Furnish all pipe, fittings, valves, tapping sleeves and valves, hydrants and all other materials required for completion of the work. **All materials shall be made in AMERICA.** Furnish materials in accordance with the following:

- A. Polyvinyl Chloride Pipe:** Pipe shall be PVC Class 150, DR 18, C-900 for 12" and smaller and Class 235, DR 18, C-905 for 14" and larger. All pipe shall conform to ASTM D-2241 and be installed in accordance with ASTM-D-2321. Joints shall be in accordance with ASTM D-3036. Sizes and dimensions shall be as follows:

150 PSI, DR 18, C-900			235 PSI, DR 18, C-905		
Nom. Pipe Size	O.D. (in.)	Min. Wall Thickness (in)	Nom. Pipe Size	O.D. (in.)	Min. Wall Thickness (in)
4"	4.800	0.267	14"	15.300	0.850
6"	6.900	0.383	16"	17.400	0.967
8"	9.050	0.503	18"	19.500	1.083
10"	11.100	0.617	20"	21.600	1.200
12"	13.200	0.733	24"	25.800	1.433

All PVC pipe less than 2" diameter shall be Schedule 40 unless otherwise noted.

Pipe shall bear the National Sanitation Foundation seal of approval and shall comply with the requirements of Type I, Grade I (PVC 1120) of the ASTM resin specification D-1784 (AWWA C 151-76). Certificates of conformance with the foregoing specifications shall be furnished with each lot of pipe supplied. Plastic pipe shall be jointed by means of a rubber ring bell joint which shall be an integral part of the barrel or solvent welded at the factory. The joints shall have a space to provide expansion and contraction of the pipe without leaking. Fittings for plastic pipes shall be PVC with ring tight rubber joints; or ductile iron with adapters to PVC pipe.

The bell shall consist of an integral wall section with a bounded-in solid cross section designed to be at least as hydrostatically strong as the pipe wall and meet the requirements of UNI-BELL-B-11.

Each standard and random length of pipe shall be tested to two (2) times the rated pressure of the pipe for a minimum of five (5) seconds. The integral bell shall be tested with the pipe.

- B. Ductile Iron Pipe (DIP):** Ductile iron pipe shall conform to ANSI A21.50 (AWWA C-150) latest revisions and ANSI A21.51 (AWWA C-151) latest revision. For sizes 12" and smaller, pipe shall be pressure class 350 minimum. 16" pipe shall be pressure class 250 minimum.

Joints shall be push-on type for pipe and standard mechanical or flanged joints for fittings unless otherwise noted. Push-on and mechanical joints shall conform to AWWA C111. Restrained joint pipe (RJP) shall be either the bolted joint type or modified push-on type with joint restraint using ductile iron components. Restrained joint pipe where required shall be American, U.S. Pipe, McWane, or equal.

Provide the appropriate gaskets for mechanical or flange joints. Gaskets for flange joints shall be made of 1/8-inch thick cloth reinforced rubber; gaskets may be ring type or full-face type.

Provide the necessary bolts for mechanical or flange connections. Bolts for flange connections shall be steel with American Regular unfinished square or hexagon heads. Nuts shall be steel with American Standard Regular hexagonal dimensions, as all specified in ANSI B 17.2. All bolts and all nuts shall be threaded in accordance with ANSI B.1.1. Coarse Thread Series, Class 2A and 2B fit.

All pipe shall be furnished in lengths of at least 18 feet.

Acceptance will be on the basis of the Engineer's review and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

- C. **Ductile Iron Fittings:** Ductile iron fittings shall be compact weight, short body ductile iron fittings for 350 psi water pressure plus water hammer, conforming to ASA Specification A21.10 with mechanical joints conforming to ASA Specification A21.11, cement lined.

- D. **Gate Valves (GV):** Gate valves shall be mechanical joint end, resilient seat, parallel seat, iron body, bronze mounted, non-rising stem with O-ring stem seals, open left. Gate valves 2" through 12" shall be designated for a working pressure of 200 psi and a test pressure of 400 psi. Valves 14" and larger shall be designed for a water working pressure of 150 psi and a test pressure of 300 psi. Valves 2" through 12" will be designed for installing in a vertical position. Valves larger than 14" will be designed for a horizontal installation and equipped with bevel gearing, gear case, tracks, rollers, scrapers and by-pass valves. Gate valves shall conform to AWWA Standard Specification C-500, latest revision for "Ordinary Water Works Service" and shall be Mueller No. A2370-20, American Darling No. 85, or an approved equal.

Resilient seat gate valves conform to AWWA Standard Specification C-509.

- E. Valve Boxes (VB):** All gate valves shall be equipped with valve boxes. Valve boxes shall be heavy roadway type. The valve boxes shall be cast iron two-piece slip or screw type with drop covers. The valve boxes shall be adjustable to six inches (6") up or down from the nominal required cover over the pipe.
- F. Tapping Sleeves and Valves (TS&V):** Tapping sleeves shall be ductile iron of the split sleeve mechanical joint type or fabricated stainless steel according to application. All tapping saddles shall be pressure tested after installation and before main is cored. Valves shall be gate valves furnished in accordance with the specifications shown above with flanged connection to the tapping sleeve and mechanical joint connection the branch pipe. The necessary bolts, glands and gaskets shall be furnished.
- G. Fire Hydrants (FH):** All new fire hydrants shall conform to the requirements of AWWA C-502 for 150 psi working pressure. Hydrants shall be the compression type closing with line pressure. **The valve opening shall be five and one-quarter inches (5 ¼").**

In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve and permit rapid and inexpensive restoration without digging or cutting off the water. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.

New hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat shall be bronze and shall screw into a bronze retainer.

All working parts, including the seat ring, shall be removable through the top without disturbing the barrel of the hydrant.

The operating nut shall match those on the existing hydrants. The operating threads shall be totally enclosed in an operating chamber separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by a grease or oil reservoir. A stop nut shall be positioned in the top operating mechanism so that the valve cannot contact the bottom of the shoe when fully open.

New hydrants shall be a non-freezing design and provided with a simple, positive and automatic drain which shall be fully closed whenever the main valve is opened.

Hose and pumper connections shall be breech-locked, pinned and then caulked with lead; or threaded and pinned to seal them permanently into the hydrant barrel. Each hydrant shall have **two (2) each 2 1/2" hose connections using Perry Standard threads and one (1) each 4" pumper connection** with National Standard threads. Equip each connection with cap and chain.

New hydrants shall be furnished with a mechanical joint shoe connection to the spigot of the six inch (6") hydrant lead.

Minimum depth of bury shall be four feet (4') on vertical riser stem. Provide extension section where necessary for vertical installation and in accordance with manufacturer's recommendations.

Provide where indicated or directed, an adjustable six inch (6") fire hydrant lead pipe equivalent to GRADELOK. Adjustable lead pipe shall adjust to a maximum of 24 vertical inches. Pipe shall be ductile iron and meet the requirements of AWWA C-153/ANSI A21.53. Pipe shall be tar coated outside and cement-lined inside as per AWWA C-104/ANSI A21.4.

All new and relocated fire hydrants shall be painted. All outside surfaces of the barrel above grade shall be painted as follows:

BASE: Safety Yellow equal to Martin Senour Tough Coat, High Gloss Alkyd, Gloss Yellow, #727-1819.

TOP: Silver equal to Martin Senour Tough Coat, Chrome Aluminum, #727-1316.

New hydrants shall be Mueller Centurion or M & H.

- H. Polyethylene Film Encasement:** Each location of a ductile iron fitting within ten feet (10') of a natural gas line with cathodic protection will require polyethylene encasement.

The polyethylene film shall be manufactured of virgin polyethylene material conforming to the requirements of ASTM Standard Specifications D-1248-78. Polyethylene film shall have a minimum thickness of 0.008 inches.

The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and/or bedding material but it is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string or other material capable of holding the polyethylene encasement in place until backfilling operations are complete.

- I. **Pipeline Casing Spacers:** Each pipeline casing spacers shall be two (2) piece 14 gauge T-304 stainless steel with corrosion resistant clamps for carrier pipe. The runners shall be ultra high molecular weight polymer to resist abrasion and sliding wear and configured to center the carrier pipe in the casing pipe with adequate support.

Spacing shall be as recommended by the manufacturer. Spacers shall be Cascade or an approved equal.

- J. **Tie Rods, Bolts and Washers**

- 1. **Minimum rod size shall be ___” in diameter.** Table below gives numbers of various diameter rods required for a given pipe size. When using bolting rods, the diameter of mechanical joint bolts limits the size of rods to ¾.

Rod Number – Diameter Combinations

NUMBER OF RODS

Pipe Size	5/8 Inches	¾ Inches	7/8 Inches	1 Inch
4"	2	--	--	--
6"	2	--	--	--
8"	3	2	--	--
10"	4	3	2	--
12"	6	4	3	2
14"	8	5	4	3
16"	10	7	5	4

Table has been derived using pressure of 225 psi and design stress of 25,000 psi.

2.05 HANDLING MATERIALS

- A. **Unloading:** Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. All materials dropped or dumped will be subject to rejection without additional justification.
- B. **Handling:** Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift or front loader. Do not use material damaged in handling.
- C. **Distribution:** Distribute and place pipe and materials to not interfere with traffic. Do not string pipe more than 1,000 feet beyond the area where pipe is being laid. Do not obstruct drainage ditches.

- D. **Storage:** Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Do not interfere with other contractors right to access.

2.06 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

Install pipe lines and accessories along highways, streets and roadways in accordance with the applicable regulations of the City of Perry, Houston County and/or the Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.

- A. **Protection of Traffic:** Provide and maintain suitable signs, barricades and lights for protection of traffic.

Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street, or roadway without first obtaining permission from the proper authorities.

Provide flagmen to direct and expedite the flow of traffic.

- B. **Construction Operations:** Perform all work along highways, streets and roadways to least interfere with traffic.

- 1. **Stripping:** Where the pipe line is laid along road shoulders, strip and stockpile all sod, topsoil and other material suitable for shoulder restoration.

- 2. **Trenching, Laying and Backfilling:** Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

- 3. **Shaping:** Reshape damaged slopes, side ditches and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

- C. **Excavated Materials:** Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off of the pavement.

- D. **Drainage Structures:** Keep all side ditches, culverts, cross drains and other drainage structures clear of excavated material and free to drain at all times.

- E. **Maintaining Highways, Streets, Roadways and Driveways:** Maintain streets, highways and roadways in suitable condition for movement of traffic until completion and final acceptance of the work. Use steel running plate to maintain traffic until pavement replacement is completed.

Note: Traffic must be maintained at all times. When one lane is closed, flagmen must be utilized to maintain traffic flow.

Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work.

2.07 EXISTING UNDERGROUND UTILITIES AND OBSTRUCTIONS

It is the responsibility of the Contractor to locate all existing utilities along the path of his construction. His drawings shall indicate underground utilities or obstructions that are known to exist. Where these or unforeseen underground utilities are encountered, the location and alignment of the water main may be changed upon written approval of the Engineer and the Owner to avoid interference.

2.08 CONNECTIONS TO EXISTING PIPE LINE

Before laying pipe, the Contractor shall locate the points of connection to existing pipe lines and uncover as necessary for the City to confirm the nature of the connection to be made. The Contractor shall furnish materials and made the connection to all existing pipe lines. **The Contractor will be observed by the City during construction of tie-ins.** The Contractor shall use all available practices and resources to minimize the time the customers are without water. **The Contractor shall notify the City of water outages at least 24 hours in advance.**

2.09 LAYING PVC PIPE

- A. **General:** Unless specifically indicated on the plans or called for in the specifications, PVC water lines shall be constructed of rubber gasket joint pipe with mechanical joint fittings and valves.
- B. **Construction Methods**
1. **Field Inspections:** All pipe and accessories shall be laid, jointed, tested for defects and for leakage with pressure and chlorinated in the manner herein specified. The City's representative shall inspect all fittings, valves and hydrants before backfilling. Thrust block shall also be inspected. The Contractor shall be responsible for notifying the City in advance of each inspection.

2. Handling Pipe and Accessories

- a. **Care:** PVC pipe, fittings, valves and other accessories shall 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 towed 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.
- b. **At Site of Work:** 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 and shall be laid on high ground so that it will not be in a drainage way.
- c. **Bell Ends, How Faced:** Pipe shall be placed on the site of the work parallel with the trench alignment and with the bell ends facing the direction in which the work will proceed, unless otherwise directed by the Engineer.
- d. **Pipe Kept Clean:** The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

3. Alignment and Grade

- a. **General:** All pipe shall be laid and maintained in the required lines and grades with fittings and valves at the required locations, joints centered and spigots home, and with all valve stems plumb.
- b. **Depth of Pipe:** The top of the barrel of the pipe shall have a minimum cover of forty-eight inches (48”).

Whenever water mains cross existing sanitary sewer lines, a minimum vertical separation of eighteen inches (18”) must be maintained between the two pipes.

4. Excavation and Preparation of Trench

- a. **Description:** The trench shall be dug to the alignment and depth requirement and not to exceed 200 feet in advance of the pipe laying. The trench shall be braced if work therein safely and efficiently. It is essential that the discharge from any pumps be led to natural drainage channels, drains or storm sewers.

- b. **Width:** Minimum width of trench shall be eighteen inches (18”) or six inches (6”) outside the barrel of the pipe on each side of pipe. Maximum width of trench shall be nine inches (9”) outside the barrel of the pipe on each side of pipe. Sides of trench shall be dug and maintained substantially vertical to a height of twelve inches (12”) above the pipe.
- c. **Pipe Foundation:** The pipe shall be laid upon a sound earthen foundation cut true and even so that the barrel of the pipe will have a bearing for its full length. If unsuitable foundation material is encountered, crushed stone stabilization will be required. Crushed stone trench stabilization shall be No. 57 stone.
- d. **Correcting Faulty Grade:** Any part of the trench excavated below grade shall be corrected with approved materials, thoroughly compacted.
- e. **Bell Holes, Required:** Bell holes of ample dimensions shall be dug in trenches at each joint to permit the joint to be made properly.
- f. **Braced and Sheeted Trenches:** Wherever necessary to prevent caving, excavations shall be adequately sheeted and braced. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until the pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted to a depth of two feet (2’) over the top of the pipe. All methods shall comply with latest OSHA standards.
- g. **Care of Surface Materials for Re-Use:** If local conditions permit their re-use, all surface materials suitable for re-use in restoring the surface shall be kept separate from the general excavation material.
- h. **Manner of Piling Excavated Materials:** All excavated materials shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other provisions made for street drainage.
- i. **Trenching by Machine or by Hand:** The use of trench digging machinery will be permitted except in places where operation of same will cause damage to existing structures above or below ground; in which case hand methods shall be employed. Excavation shall be made by ladder type machine or backhoe.

5. Pipe Handling

- a. **Manner of Hauling Pipe and Accessories:** Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient execution of the work. All pipe, fittings and valves 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 pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- b. **Inspection:** Before lowering and while still suspended, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected.
- c. **Pipe Kept Clean:** All foreign matter or dirt shall be removed from the pipe and shall be kept clean by approved means during and after laying.
- d. **Laying of the Pipe:** The spigot shall be centered in the bell, the pipe forced “home” and brought into true alignment; it shall be secured there by earth carefully tamped under and on each side of it, except at the bell holes. Care shall be taken to prevent dirt from entering the joint space. No “blocking up” of pipe or joints will be permitted. The joint shall be made as hereinafter described.
- e. **Trench Water Entering Pipe:** At 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.
- f. **Cutting Pipe:** Cutting of pipe for inserting valves, fittings closure pieces shall be done in a neat workmanlike manner without damage to the pipe.
- g. **Bell Ends Face Direction of Laying:** Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying; and for lines on an appreciable slope, bells shall, at the direction of the Engineer, face up-grade.
- h. **Permissible Deflections at Joints:** Wherever necessary to deflect pipe from a straight line either in the vertical or horizontal plane to avoid obstructions, mechanical joint fittings shall be used. Bending the pipe will not be allowed.

- i. **Unsuitable Conditions for Laying Pipe:** No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work.
6. **Jointing Pipe – Mechanical Joints:** The following steps shall be taken in making mechanical joints:
- a. All lumps, blisters and excess coal-tar enamel shall be removed from socket and spigot of the pipe.
 - b. Wash socket and plain end with soapy water containing chloride solution; then slip gland and gasket over plain end. The small side of gasket and lip gland shall face bell.
 - c. Paint gasket and pipe with a lubricant recommended by the manufacturer.
 - d. Push gasket into position being sure it is evenly seated in socket.
 - e. Slide gland into position; insert bolts and run nuts up finger tight.
 - f. Tighten bolts to uniform tightness with correct ratchet wrench. The first bolt tightened shall be the bottom bolt, then top. All other bolts shall be tightened in sequenced at 180 degrees apart.

7. **Setting Valves, Valve Boxes and Fittings**

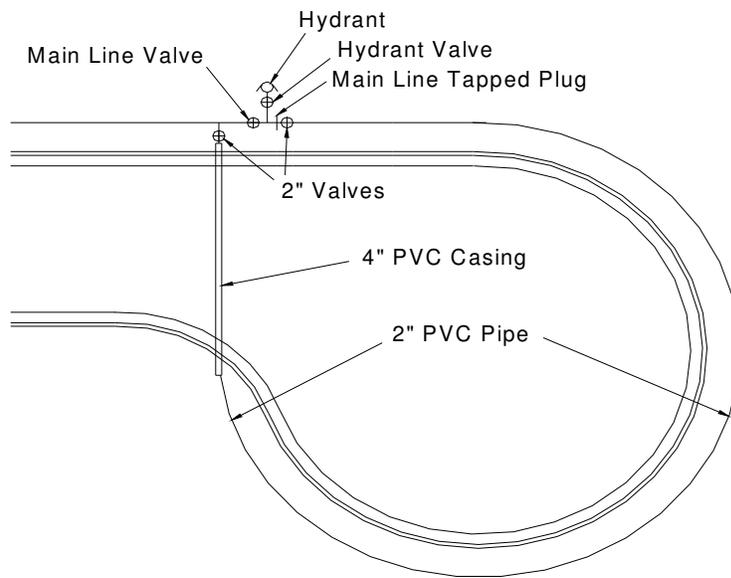
- a. **General:** Gate valves and pipe fittings shall be set and joined to new pipe in the manner heretofore specified for cleaning, laying and joining pipe.
- b. **Valve Boxes:**

Cast iron valve boxes shall be firmly supported centered and plumb over the wrench nut of the gate valve. Mechanical compaction shall be utilized to eliminate settlement of concrete collar.

A concrete collar shall be poured around all valve boxes flush with grade. Collars shall be formed with 24” diameter round “Sonotube” forms or equal. These forms may be left in place.

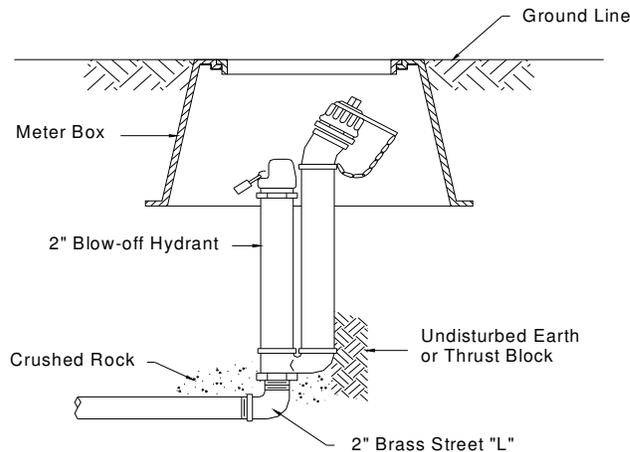
Wood forms may also be used to form collars with dimensions of 18”x18”x6”. Forms shall be removed after concrete has sufficiently cured.

8. **Cul-de-sac Streets:** Water mains terminating on cul-de-sac streets shall be installed in accordance with the drawing entitled “**Cul-de-sac Water Line Detail**”. Note that all 2” gate valves shall be wheel operated, manufactured of brass and made in America. . Two-inch double strap tapping saddles shall be used when tapping the 2” line.



Cul-de-sac Water Line Detail

9. **Blow-off Hydrant:** Blow-off hydrants shall be installed on the end of any main not requiring a fire hydrant. On cul-de-sac streets the blow-off shall be positioned in the location of the hydrant on the drawing entitled “Cul-de-sac Water Line Detail”. In this case the blow-off shall be installed on the 2” line and all valves shown on the detail will be 2”. Note that all 2” gate valves shall be wheel operated, manufactured of brass and made in America. Blow-off hydrants shall be non-freezing, self-draining type, with an overall bury depth of 48”. Set underground in a standard, rectangular, plastic water meter box with a cast iron lid. The top of the hydrant shall be set 6” below the top of the meter box. Minimum opening in meter box should be 10”. These hydrants will be furnished with a 2” FIP, 90 degree inlet, a non-turning operating rod and shall open to the left. All the working parts shall be of bronze-to-bronze design and be serviceable from above grade with no digging. The outlet shall also be bronze and be 2-1/2” NST. Hydrants shall be lockable to prevent unauthorized use as manufactured by Kupferle Foundry Co., St. Louis MO, model number 78, or approved equal. **Metal connections and pipe to the inlet shall be brass. PVC or galvanized steel will not be acceptable.** See drawing entitled “Blow-off hydrant detail”.



Blow-off Hydrant Detail

10. **Water Main Sizes:** Water mains on streets less than 500 feet in length may be 6” in diameter. If the possibility exists that the line will be extended or looped in the future an 8” diameter line is required. Any line over 500’ will require an 8” diameter main.
11. **Thrust Blocking: Ready-mixed concrete having compressive strength of not less than 2,500 psi shall be used as a cradle or thrust blocking where shown on the plans or where directed by the Engineer.** Bends exceeding 11 ¼ degrees, crosses with one opening plugged and all tees shall be backed with concrete as a thrust block. Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on ground in each instance shall be that shown on the plans. **The blocking shall be so placed that the pipe fitting joints will be accessible for repair.**
12. **Detection Tape:** Plastic marking tape shall be installed over all water pipe. Tape shall be blue in color and at least two inches (2”) wide and shall bear the printed identification “Caution: Buried Water Line Below”. Marking tape shall be buried one foot (1’-0”) below the ground surface above the water line.
13. **Tracer Wire:** All non-metallic water main pipe and water service tubing shall have 12 gauge, insulated, copper wire placed on each pipe crown for detection purposes.
14. **Pressure and Leakage Tests**
 - a. **Pressure During Test:** Immediately after the pipe has been laid and backfilled, but prior to the placement of pavement, each valved section of newly laid pipe shall be subjected to a leakage and pressure test. **For any section being tested, the pressure applied shall be such that at the highest point in the section, the pressure shall be 150 psi or at least 50 psi above the normal operating pressure at this point, whichever is greater. The test shall be witnessed by representatives of the City and recorded on a circular chart recorder provided by the City.**
 - b. **Duration of Test:** The duration of each pressure test shall be two (2) hours.
 - c. **Procedures:** Each valved section of pipe shall be slowly filled with water and the specified test pressure measured at the point of highest elevation shall be supplied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection and all necessary apparatus, gauges and meters shall be furnished by the Contractor. The Contractor shall furnish all necessary labor

and assistance in conducting the tests. The Owner will furnish, through connections made by the Contractor to existing mains, water for filling the lines for making the test.

- d. **Expelling Air Before Tests:** Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation and afterwards tightly plugged.
- e. **Examination Under Pressure:** At intervals during the test, the route of the pipe line shall be inspected to locate any leaks or breaks. Any cracked or defective joints, cracked or defective pipe, fittings or valves discovered in consequence of this pressure test shall be removed and replaced with sound material in the manner provided and the test shall be repeated until satisfactory results are obtained.
- f. **Permissible Leakage:** Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe of any valved section thereof, to maintain the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if leakage is greater than that determined by the following formula:

$$L = \frac{SD(P)0.5}{7400}$$

Where: L is the allowable leakage in gallons per hour; S is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch (psi) gauge. Leakage values determined by the above formula are to be found in the following tables:

**ALLOWABLE LEAKAGE FOR PVC PLASTIC
WITH ELASTOMERIC JOINTS IN GALLONS PER HOUR**

Nominal Pipe Size	Average Pressure in Line - PSI	
Inches	150	200

ALLOWABLE LEAKAGE PER 1,000 FEET

4"	.33	.38
6"	.50	.57
8"	.66	.76
10"	.83	.96
12"	.99	1.15

15. Backfilling, Cleaning Up and Maintaining Surfaces

- a. Time of Backfilling:** As soon as practicable after the completion of laying and jointing of the pipe, the trench shall be backfilled and **at no time shall the completed backfilling of the trench be more than 300 feet behind the pipe laying.**
- b. Backfill Procedure at Pipe Zone:** Select backfill material free from rock fragments shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench and to an elevation of six inches (6") above the top of the barrel of the pipe. The backfill material shall be moistened, if necessary, tamped in thin (about four inch (4")) layers and thoroughly compacted under and on each side of the pipe to provide solid backing against the external surface of the pipe.
- c. Backfill Procedure Above the Pipe Zone:** Succeeding layers of backfill may contain coarser materials and shall be compacted thoroughly to the natural ground surface.
- d. Procedure Where Settlement is Important:** Where it is important that the surface of the backfill be made safe for vehicular traffic at unpaved street crossings and along existing unpaved streets, the entire backfill shall be approved moist material, thoroughly compacted in six inch (6") layers by tamping and shall be brought to the required surface grade. **All backfill for trenches in these areas be compacted to 98% to the Standard Proctor Maximum Density (ASTM D-698).**
- e. Procedure Where Settlement is Unimportant:** Where pipe is laid outside city streets or drives, hand tamping may be omitted in the layers above six inches (6") of the pipe crown. However, backfill shall be compacted by other means to the surface and left neatly rounded over the trench to a sufficient height to allow for the settlement to grade after consolidation.
- f. Compaction Test:** Where settlement is important, the Contractor shall furnish the City proof of compaction at pavement subgrade. Test shall be at each street or drive crossing or at intervals not exceeding 400 feet in continuous pavement areas. **Contractor shall incur all costs for compaction tests performed by a testing laboratory selected by the Contractor and approved by the City.**

- g. Deficiency of Backfill by Whom Supplied:** Any deficiency in the quantity of material for backfilling the trenches or for filling depressions caused by settlement shall be supplied by the Contractor.
- h. Restoration of Surfaces:** The Contractor shall replace all curbing, sidewalks, gutters, shrubbery, fences, sod, grass and other surfaces disturbed to a condition equal to that before the work began, furnishing all labor and materials incidental thereto and complete the work in a manner satisfactory to the Engineer. Replacement of street base and surface removed to permit installation of pipe lines shall be provided for elsewhere in these specifications.
- i. Backfill Under Paved Streets:** Backfill under paved streets shall be thoroughly compacted and as shown on the detailed drawings.
- j. Surplus Earth:** Surplus excavated materials from trenches in streets or at railroad crossings shall be disposed of by the Contractor at his expense and in a manner satisfactory to the City.
- k. Cleaning Up:** Surplus pipe line materials, tools, surplus excavated materials, rubbish and temporary structures shall be removed by the Contractor and the construction site shall be left clean to the satisfaction of the Engineer. The line shall be cleaned up immediately after satisfactory pressure tests have been made.
- l. Maintenance of Surfaces:** Following the certification of completion by the Engineer, the Contractor shall maintain the surface of the unpaved trenches, adjacent curbs, sidewalks, gutters and other surfaces disturbed for a period of three (3) months thereafter.

All materials and labor required for the maintenance of the trenches and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

- 16. Disinfection of Mains:** Disinfection and flushing of water mains shall be done in accordance with AWWA C651 “Standard for Disinfecting Water Mains”. The Contractor shall disinfect all new mains, furnishing all labor, equipment and material necessary for the complete disinfection of the mains as hereinafter provided. Mains shall be disinfected by the application of a chlorinating agent into the water used for the initial filling of the mains. The chlorinating agent may be chlorine gas-water mixture,

calcium hypochlorite in water, or chlorinated lime of known chlorine content in water and shall be fed through a suitable solution feed device. The chlorinating agent shall be applied at or near the beginning point from which the main is being filled and shall be injected into the main through a corporation cock tapped into the horizontal exit of the newly laid main. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly and the rate of application of the chlorinating agent shall be in such proportion to the rate of the water entering the pipe that the chlorine dose applied to the water shall be at least 50-ppm. The chlorine treated water shall be retained in the new main at least 24 hours and a 10-ppm of residual chlorine shall remain after the 24 hour period. Following chlorination all treated water shall be flushed from the mains until replacement water shall have a chlorine content of not more than 0.1-ppm in excess of the residual in water from the supplying main and in any event not less than 0.2-ppm. Samples of the water shall be taken by City of Perry representatives and delivered to a state approved lab for bacteriological analysis. **The Contractor shall contact the City of Perry 48 hours prior to sampling time.** Should the analysis show contamination, the system shall be re-chlorinated and further samples taken and submitted for analysis until no contamination is indicated.

2.10 BORING

Furnish and install steel casing pipe by jacking and boring through whatever material may be encountered. Construction shall be as described in Department of Transportation State of Georgia Standard Specification Section 615.

- A. **General:** Where groundwater is encountered, operate well points or drainage systems in the vicinity of the casing to prevent the accumulation of flood water in the casing and to maintain the groundwater table below the casing invert.
- B. **Pipe Casing:** Furnish all material and equipment and perform all labor required to install steel pipe casing at locations indicated on the drawings and as specified.
 - 1. **Boring:** The steel casing pipe shall be Schedule 30 steel pipe manufactured from steel conforming to ASTM A-139, Grade B. Size and thickness is as follows:

UNDER HIGHWAYS

Carrier Pipe PVC (C-900) Pipe Diameter, Inches	Minimum Casing Diameter, Inches	Casing Wall Thickness, Inches
4	8	0.250
6	12	0.250
8	14	0.250
10	16	0.250
12	18	0.250

The outside of the casing pipe shall be primed and coated with two (2) coats of coal-tar epoxy a minimum of six (6.0) mils DPT (TNEMEC Series 65 Poxiprime or equal). Only new primed and coated pipe shall be used.

Install the steel pipe casing by the dry boring method. Bore the hole and install the casing through the soil simultaneously by a cutting head on a continuous auger mounted inside the casing pipe. Fully weld lengths of casing pipe to the preceding section in accordance with AWS recommended procedures. After the boring and installation of the casing is complete, install a cleaning pig on the rig and clean the casing.

C. Installation of Pipe

1. **In Casing:** After installation of the casing is complete, install the pipe line by a method which has received prior approval of the Engineer. Casing spacers shall be provided such that the carrier pipe is centered and restrained.

Close the ends of the casing with four inch (4") brick walls plastered with Portland Cement mortar and waterproofed with asphaltic roofing cement.

Leave a four inch by eight inch (4"x8") opening at the bottom of the lowest closure for drainage.

D. Safety

1. **Boring:** Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it. If in the opinion of the City the installation is being conducted in an unsafe manner, the Contractor will be required to stop work and bulkhead the heading until suitable agreements are reached between the Contractor and the City.

2.11 STREAM AND DITCH CROSSING

At all points where banks of streams or drainage ditches are disturbed by excavation or where natural vegetation is removed, carefully compact backfill and place rip-rap to prevent subsequent settlement and erosion.

This requirement applies equally to construction along side a stream or drainage ditch as well as crossing a stream or drainage ditch. Place rip-rap a distance of not less than ten feet (10') upstream and ten feet (10') downstream from any disturbed area. Extend rip-rap from one foot (1') below streambed to top of bank. Place to conform with the natural slope of the stream bank.

- A. **Stone Rip-Rap:** Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be two (2.0) or higher.

Minimum weight of individual stones shall be fifty (50) pounds. The maximum allowable dimension for an individual stone is 24 inches. The minimum allowable dimension for an individual stone is six inches (6"). At least fifty percent (50%) of the stones shall have a minimum dimension of twelve inches (12").

Embed stone rip-rap by and so as to form a compact layer at least twelve inches (12") thick. Place rip-rap in such a way that the smaller stones are not segregated but evenly distributed. Place chinking stones in the crevices between the larger stones so that a dense, well graded mass is produced.

SECTION NO. 3

TRANSFER OF WATER SERVICES AND NEW METERED SERVICES

3.01 SCOPE

This item shall govern for the installation of new and transferred water connections to new mains.

3.02 MATERIALS

- A. Service Pipe:** Service pipe shall be one inch (1") C.T.S. – O.D. polyethylene tubing, 200 psi, SDR-9, unless noted otherwise.
- B. Repair Fittings:** Fittings for service tubing shall be of the required sizes and shall be standard waterworks fittings for polyethylene tubing. **Fittings shall be Cambridge Brass or Mueller Insta-tite.**
- C. Brass fittings and pipe:** In situations where small diameter metal fittings and pipe are required, brass material shall be used. **Galvanized materials are not acceptable.**
- D. Corporation Cock:** Corporation cocks shall be as follows:
- | | |
|--------------------|----------|
| Cambridge Brass | 302-A4J4 |
| Mueller Insta-tite | H15024 |
| McDonald | 4701-22 |
- E. Curb Stop:** Curb stops shall be full port with locking service as follows:
- | | |
|--------------------|----------|
| Cambridge Brass | 212-J4F4 |
| Mueller Insta-tite | H15197 |
| Ford | B41-333 |
- F. Tapping Saddle:** Tapping saddles shall be double strap brass tapping saddle, Ford 202B, H-10517 Mueller or equal.
- G. Meter Boxes:** **Meter boxes shall be plastic with plastic tops**, Mueller or approved equal.
- H. Meters:** The City of Perry will furnish all meters for new and relocated services.

All pipe, solder and flux used during installation of the water lines, must be "lead-free" with not more than eight percent (8%) lead in pipes and fittings and not more than 0.2% lead in solder and flux.

3.03 COPPER PIPE AND FITTINGS

A. Description

1. This section covers requirements for copper pipe and associated pipe fittings.
2. Include materials for and properly install and connect in place at the locations indicated on the drawings, specified or directed, all copper tubing for the proper completion for the work included under the contract, except such tubing and fittings as are specifically included under other sections.
3. Attention is called to the fact that copper tubing is not necessarily indicated or completely detailed on the drawings which are more or less schematic for all piping work required for the proper operation of equipment or services requiring such piping.

B. Quality Assurance: All copper pipe and fittings shall conform to ASTM B88 “Specifications for Seamless Copper Tube” Type “K” or “L”.

C. Pipe and Fittings

1. For copper tubing meet the requirements of ASTM Designation B99 “Specifications for Seamless Copper Tube”, American Brass Company, Waterbury, Connecticut, Revere Copper and Brass, Inc., or equal.
2. In general, provide Type “K” annealed water tubing for lines to be laid in the ground. Furnish in coil or straight lengths as may be directed.
3. For annealed water tubing provide cast bronze flared-type fittings.
4. For exposed water tubing, unless otherwise, provide Type “L” hard-drawn copper tubing. Make bends in exposed water tubing with fittings.
5. For hard-drawn copper tube fittings provide the cast bronze sweat type.
6. Provide cast bronze fittings as manufactured by the Mueller Company, the Stanley G. Flagg and Company, or equal.

D. Installation

1. Carefully place tubing to proper lines and grades and run true and plumb to surfaces in an approved workmanlike manner.
2. Cut annealed “Type K” water copper tube square, preferably with a hacksaw, ream ends and flare using suitable tools. Use bending tools for making ends.
3. Assemble hard drawn “Type L” copper using solder and flux as recommended by the manufacturer of the tubing. Cut tubing square, preferably with hacksaw, then ream ends and polish both fitting and tube with steel wool before fluxing. Properly heat taking care not to over heat. After running solder, wipe joint clean. Install copper tubing only in accordance with the manufacturer’s instructions.
4. Install pipe in such a manner and at such times as will require no cutting and repairing of work in place. In case such cut and repair is necessary, do only with the permission of the Engineer. Perform cutting and repairing by the mechanics who originally installed the work. Make repairs match the original condition. Follow the pipe practices in the installation of copper tubing and fittings, insofar as applicable, as follows:
 - a. Where copper tubing is connected to ferrous piping or equipment with ferrous fittings, provide approved insulating bushings to be used.
 - b. Where copper lines pass through exterior wall, carry “Type K” through a pipe sleeve provided for this purpose and connect “Type L” inside the building by use of adapter fittings.

3.04 CONSTRUCTION METHODS

All service connections shall be made before the new main has been tested and sterilized. Installation of corporation cocks on pipe shall be made with the use of a service clamp of the proper size to fit the main. **Water taps shall be ten feet (10’) apart minimum.**

- A. Transfer of an existing water service shall consist of digging down to the existing main, closing the corporation cock, cutting/plugging the existing service, tapping the new main, installing a new corporation cock, running new service pipe to the existing or relocated meter, tying the new pipe into the existing meter and backfilling all ditches.
- B. New services shall consist of tapping the new main, installation of corporation cock, installation of service pipe to meter location and installation of curb stop.

- C. **Location of Services:** Services shall be located in the center of proposed residential lots. In other cases the intent is to avoid a location that places the service under a proposed driveway or other permanent structure. Ten foot (10') separation is required between the water service and sanitary sewer service.
- D. **Marking for Future Reference:** New water service lines shall be marked for future reference with six foot (6') 4"x4" pressure-treated posts installed plumb. Four feet (4') of the post shall be above finish grade and painted "blue".
- E. **All one inch (1") water service lines under pavement shall be installed in a two inch (2") diameter Schedule 40 PVC casing. The casing shall extend beyond the pavement edge or back of curb two feet (2') on each end.**
- F. Where required, the Contractor shall relocate existing meter and box.
- G. The Contractor shall free bore or open cut paved driveways, sidewalks and curbing for the placement of services; however, the Contractor must bore services under all city streets and federal or state highways.
- H. Where services are to be transferred to the new main and the existing main lies within a paved street, a new water service shall be run from the new main to the existing meter box and terminate with a curb stop. The existing service pipe shall then be abandoned by shutting it off at its source.
- I. **Whenever sanitary sewers cross existing or proposed water mains, a minimum vertical separation of eighteen inches (18") must be maintained between the two (2) pipes (measured edge to edge).**

SECTION NO. 4

SANITARY SEWERS

4.01 DESCRIPTION

This section of the specifications consists of the materials and construction methods for sanitary sewer mains, appurtenances and connections at the locations shown on the plans. The word "City" used herein shall mean City of Perry, or a designated representative.

4.02 DESIGN CRITERIA

Slopes: All sewers shall be designed and constructed to generate mean velocities when flowing full of not less than 2.0 feet per second based on Manning's formula using a "n" value of 0.013. The following are minimum slopes which should be provided, however, slopes greater than these are desirable.

<u>Sewer Size Inches</u>	<u>Minimum Slope Ft./100</u>
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24 and larger	0.08

Slopes less than 0.08 for pipe sizes larger than 24 inches may be approved by the City on a case by case basis. Slopes resulting in mean velocities when flowing full of greater than 10 feet per second must be approved by the City before construction. Sewers shall be laid with uniform slope between manholes.

<u>Minimum Center to Center Spacing</u>	<u>Slope</u>
36 feet	20% to 35%
24 feet	35% to 50%
16 feet	Greater than 50%

Manholes: Maximum distance between manholes for sewers 16 inches or less shall not be greater than 400 feet. Sewers 18 inches and larger shall have a maximum manhole spacing of 500 feet. Manholes shall be installed at the end of each line, at all changes in grade, pipe size, alignment and at all intersections.

Manhole size in relation to pipe size and changes in alignment are identified in Appendix A.

4.03 CONSTRUCTION DRAWINGS

The term “construction drawings” shall mean drawings, prints, descriptive literature, test reports, samples, calculations, schedules, material lists, information and items of similar meaning.

- A. Submittals Required: The Contractor shall furnish to the City of Perry, for review in accordance with the procedure outlined below, drawings and descriptive literature for all manufactured or fabricated products. Additional information, such as special drawings, schedules, calculations and tests, shall be provided as specifically requested by the City.
- B. Contractor’s Review: The Contractor shall review and check drawings and submittals. He shall indicate his review by initials and date. The Contractor shall furnish the City with a minimum of three (3) copies of all submittals. A transmittal form shall accompany each submittal or group of submittals.
- C. Review: All submittals will be reviewed, stamped and dated by the City before they are returned to the Contractor.

One (1) copy of reviewed submittals will be returned to the Contractor and the remaining copies retained by the City.

Submittals requiring minor corrections will be so noted. Drawings must be resubmitted for review prior to installation or use of products.

- D. Drawings for Construction: The Contractor shall maintain at the job site a complete set of construction drawings. The Contractor shall maintain throughout the project a set of “As-Built” mark-up plans indicating the locations of manholes, taps, etc., and changes to the original plans with field measurements. **At project completion, the developer/owner is to provide the City of Perry a survey of the sanitary sewer system prepared by a land surveyor licensed by the State of Georgia. The survey shall include the elevation(s) of the invert(s) of each manhole, the elevation of the top of each manhole, the location of each manhole and the length of each pipeline between manholes. The survey shall be tied to the State Plane Coordinate System. This information is to be incorporated into the final as-built drawings prepared by the design engineer.** The developer/owner is to provide the City of Perry with one full printed set of as-built construction plans and an electronic copy of the as-built construction plans on CD-ROM in the AutoCad 14 format or a later version. The printed set and CD-ROM are to be provided upon completion of the project and before final acceptance. (Note: Dimension each sewer service from the downstream manhole along the centerline of the sewer main).

4.04 MATERIALS

A. **Pipe:** Sewer pipe shall conform to the requirements of the specifications as follows:

1. **General:** All pipe shall be subject to inspection at the pipe plant, trench or other point of delivery for the purpose of culling and rejecting pipe which does not conform to the requirements of these specifications. The manufacturer of the pipe shall submit evidence of having consistently produced both pipe and joints of satisfactory quality and performance results in service over a period of at least two (2) years.

2. **Polyvinyl Chloride (PVC)** – pipe shall conform to the following specifications: Polyvinyl chloride (PVC) plastic sewer pipe shall be unplasturized polyvinyl chloride with integral wall bell and spigot joints with a rubber ring gasket. Pipe and fittings shall meet all the requirements of ASTM D-3034 SDR 35 or use as a gravity sewer main conduit. Provisions must be made for contraction and expansion at each joint with a rubber ring. The bell shall consist of an integral wall section stiffened with two (2) PVC retainer rings which securely lock the solid section rubber ring into position or shall be equal to the confined rubber gasket joint that meets the requirements of AWWA C-302, ASTM D-443 and ASTM D-3212. Standard lengths shall not exceed twenty feet (20’). Sizes and dimensions shall be as shown in the table as follows:

Nominal Size	Outside Diameter		Minimum Wall Thickness SDR-35
	Average	Tolerance	
4"	4.215	±0.007	0.120
6"	6.275	±0.009	0.180
8"	8.400	±0.010	0.240
10"	10.500	±0.013	0.300
12"	12.500	±0.016	0.360
15"	15.300	±0.210	0.437

Minimum “pipe stiffness” (F/Y) at 5% deflection shall be 46 for all sizes when tested in accordance with ASTM Designation D-2412. External loading properties of plastic pipe by Parallel Plate loading.

Installation of PVC sewer pipe shall be in accordance with the provisions of ASTM-2321, “Underground Installation of Flexible Thermoplastic Sewer Pipe” with additional bedding as required in these specifications.

- a. **Detection Tape:** Plastic marking tape shall be installed over all sewer pipe. Tape shall be green in color and at least two inches (2”) wide and shall bear the printed identification “Caution: Buried Sewer Line Below”. Marking tape shall be buried one foot (1’-0”) below the ground surface above the sewer line.
 - b. **Tracer Wire:** All non-metallic sewer main pipe and sewer service pipe shall have 12 gauge, insulated, copper wire placed on each pipe crown for detection purposes.
- 3. Ductile Iron Pipe (DIP):** Ductile iron pipe shall conform to AWWA C151 and shall be a minimum of Pressure Class 350. Sizes will be as shown on the drawings. Pipe and fittings shall be cement lined in accordance with AWWA C104. Joints shall be push-on type for pipe and standard mechanical or flanged joints for fittings unless otherwise noted. Push-on and mechanical joints shall conform to AWWA C111. Restrained joint pipe (RJP) shall be either the bolted joint type or modified push-on type with joint restraint using ductile iron components. Restrained joint pipe where required shall be American, U.S. Pipe, McWane or equal.
- a. **Ductile iron pipe shall be used when the cover over the pipe is less than three feet, when the sanitary sewer line crosses under a storm drain line and the vertical separation between the two lines is less than 3 feet, and when the depth of cover over the pipe is greater than 25 feet.**
 - b. **Detection Tape:** Plastic marking tape shall be installed over all sewer pipe. Tape shall be green in color and at least two inches (2”) wide and shall bear the printed identification “Caution: Buried Sewer Line Below”. Marking tape shall be buried one foot (1’-0”) below the ground surface above the sewer line.

B. Pipe Joints

- 1. Polyvinyl Chloride (PVC):** Flexible gasketed joints for PVC sewer main pipe shall be compression type conforming to ASTM D-3212. The gasket shall comply with ASTM F-477. Joints shall be tested for tightness as follows:

Assemble two (2) sections of pipe in accordance with the manufacturer's recommendations. Subject the joints to an internal hydrostatic pressure of 25 psi for one (1) hour. Consider any leakage a failure of the test requirements.

- 2. Ductile Iron Sewer Pipe:** Flexible rubber gasket joint Type II, or mechanical joint Type III, conforming to ASA Specifications A21.11.
- 3. Transition Joints:** The transition between sewer pipes of different materials shall be made in accordance with the detail for concrete collars. The transition between clay pipe and cast iron pipe shall be by clay double bell cast iron adapters with compression joints conforming to ASTM Specifications C-425 (latest). Adapters between iron pipe and pipe of materials other than clay will be accepted upon approval of the City. In most cases where special adapters are not available or not approved by the City, concrete collars will be used.

- C. Pipeline Casing Spacers:** Each pipeline casing spacer shall be two (2) piece 14 gauge T-304 stainless steel with corrosion resistant clamps for carrier pipe. The runners shall be ultra high molecular weight polymer to resist abrasion and sliding wear and configured to center the carrier pipe in the casing pipe with adequate support. Spacing shall be as recommended by the manufacturer. Spacers shall be Cascade or an approved equal.

4.05 CONSTRUCTION METHODS

- A. General:** The Contractor shall excavate the trenches and manholes to the required dimensions; excavate the bell holes; construct and maintain all bridges required for traffic control; sheet, brace and support the adjoining ground or structures where necessary; replace all damaged water services, drains, sewers or other structures; backfill trenches; restore the roadway surfaces; remove surplus excavated materials; clean the site of the work and maintain the street or other surfaces of the trenches.

- B. Manholes shall be constructed at the locations shown on the plans. Manholes shall be the type as specified in Section 5.
- C. Where inlet leads and main or lateral pipe sewers enter a manhole, such pipes shall be cut-off flush with the inside of the manhole and any irregularities shall be pointed up with mortar.
- D. The inverts of the sewer lines entering manholes at or near the flow line elevation of the manhole shall be shaped and routed across the floor of the manhole using concrete and mortar to obtain the proper contour.
- E. Where the sewers enter a new manhole, an appropriate seal (neoprene boot) shall be used to positively seal against infiltration or exfiltration.
- F. **Where sewers enter existing manholes, the wall of the manhole shall be core drilled and an appropriate seal (boot) shall be used as shown on the drawings to positively seal against infiltration or exfiltration.**
- G. **Location of Services:** Services shall be located in the center of proposed residential lots. In other cases the intent is to avoid a location that places the service under a proposed driveway or other permanent structure. Ten foot (10') separation is required between the water service and sanitary sewer service.
- H. **Location of Service Fittings:** All tees and other fittings shall be placed at the points indicated on the plans. Tee branches shall be laid to correspond with the sewers and house service lines entering them. When service lines are installed and short runs of service lines are constructed to a point for future extension, **they shall be closed with caps made for the same pipe material and sealed with like joint material as used for jointing bell and sockets of regular sewer pipe.**

Each service connection shall be referenced on the as-built drawings with a dimension measured from the downstream manhole.

I. Inspection

1. **Of Materials at Delivery Point:** During the process of unloading all pipe and accessories, each shall be inspected by the Contractor for loss or damage in transit.
2. **Field Inspection:** All pipe and accessories shall be laid and jointed in the manner herein specified in the presence of the City's authorized inspector.
3. **Disposition of Defective Material:** All material found during the process of the work to have cracks, flaws or other defects will be rejected and the Contractor shall promptly remove such material from the job site.

J. Contractor's Responsibility for Materials: The Contractor shall be responsible for all material furnished to him and he shall replace at his own expense all such materials that have become damaged in handling after delivery. The Contractor shall be responsible for the safe storage of materials furnished by or to him and accepted by him, intended for the work until it has been incorporated in the completed project.

K. Alignment and Grade

1. **General:** All pipe shall be laid and maintained in the required lines and grades with wyes or tees at the required locations and with joints centered and spigots home. The Contractor shall at his own expense, furnish and place in position all necessary stakes and batter boards for locating the work. The Contractor must also furnish at his own expense, good spun twilled lines or wire for use in giving lines and grades and the necessary plummets and grade poles. The laser beam method may be employed.

2. **Protecting Underground and Surface Structures:** Temporary support, adequate protection and maintenance of all underground and surface utility structures, water services, gas services, poles, guy wires, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense.

a. Protection of Water Supplies

(1) **Water Supply Interconnections:** There shall be no physical connection between a public or private potable water supply system and a sewer, or an appurtenance thereto, which would permit the passage of any sewage or polluted water into the potable supply.

(2) **Relation to Water Works Structures:** While no general statement can be made to cover all conditions, it is generally recognized that sewers shall meet the requirements of the approving agency with respect to minimum distances from public water supply wells or other water supply sources and structures.

(3) **Relation to Water Mains**

- (a) **Horizontal Separation:** Whenever possible, sewers should be laid at least ten feet (10'), horizontally, from an existing or proposed water main. Should local conditions prevent a lateral separation of ten feet (10'), a sewer may be laid closer than ten feet (10') to a water main if:
- (1) It is laid in a separate trench.
 - (2) It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth.
 - (3) **In either case, the elevation of the crown of the sewer is at least eighteen inches (18") below the invert of the water main.**
- (b) **Vertical Separation:** Whenever sewers must cross under water mains, the sewer laid at such an elevation that the top of the sewer is at least eighteen inches (18") below the bottom of the water main.

When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstructed with slip-on or mechanical joint ductile iron pipe, or pre-stressed concrete cylinder pipe for a distance of ten feet (10') on each side of the sewer. One (1) full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

3. **Deviations Occasioned by Other Utility Structures:** Wherever existing utility structures or branch connections leading to main sewers or storm sewers, or other conduits, ducts, pipes or structures present, obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the Owner of the utility structures or obstructions. Wherever necessary to move service poles, guy wires, pipe lines or other obstructions, the Contractor shall notify and cooperate with the utility owner. In those instances where their location or reconstruction is impracticable, a deviation from line and grade will be ordered and the change shall be made in the manner directed.

4. **Sub-Surface Explorations:** Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor, after examination of available records, shall make the explorations and excavations for such purpose at his own expense.
5. **Pipe Alignment and Grade:** The pipes and specials shall be laid in the trench so that after the sewer is completed the interior surface thereof shall conform accurately to the grades and alignments fixed and shown on the plans. On completion, no pipe sewer will be accepted unless a clear lamp may be seen from manhole to manhole.

L. Excavation and Preparation of Trench

1. **Description:** The trench shall be dug to the alignment and grade required. The trench shall be braced if necessary and drained in order that workmen therein may work safely and efficiently. It is essential that the discharge from any pumps be led to natural drainage channels or to drains.
2. **Width:** Minimum width of trench shall be six inches (6”) from the outside of barrel of pipe on each side of pipe. Maximum width of trench shall be nine inches (9”) from the outside of barrel of pipe on each side of pipe. Sides of trench shall be dug and maintained substantially vertical except Contractor shall adhere to all applicable requirements of OSHA for trench safety.
3. **Correcting Faulty Grade:** Any part of the trench excavated below grade shall be corrected with approved material thoroughly compacted.
4. **Trench Stabilization:** Wherever the material at the bottom of the trench is unsuitable for the proper installation of the pipe, the City will direct the removal and replacement of the unsuitable material.

When so directed, undercut the trench and backfill with No. 57 stone meeting the requirements of Georgia Department of Transportation Specification 800.01. Place and compact this material to bring the trench to the required grade.

5. **Pipe Alignment and Grade:** The pipe shall be laid in the trench so that after the sewer is completed the interior surface thereof shall conform accurately to the grades and alignments fixed and shown on the plane. On completion, no pipe sewer will be accepted unless a clear circular lamp may be seen from manhole to manhole.

6. Rock Excavation

- a. **Definition of Rock:** Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 18,300 pounds (Caterpillar Model 215 or equal) and occupying an original volume of at least one-half (1/2) cubic yard.
- b. **Excavation:** Where rock is encountered in trenches, excavate to the minimum depth which will provide clearance below the pipe barrel of four inches (4") plus required bedding depth for pipe and manholes. Remove boulders and stones to provide a minimum of six inches (6") clearance between the rock and any part of the pipe or manhole.
- c. **Blasting:** Provide experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all structures from the effects of the blast. Repair any resulting damage.

If the Contractor persistently uses excessive blasting charges or blasts in an unsafe or improper manner, the City may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

- d. **Removal of Rock:** Do not use excavated rock as backfill material. Dispose of rock which is surplus or not suitable for use as rip-rap.

7. Haunching of Sewer: Haunch pipelines in accordance with detail drawings and the following specifications. Haunching will be required for all gravity sewers. **Haunching material shall be No. 57 stone.**

8. Bedding of Sewer: Bed pipelines in accordance with the following specifications:

a. **Bedding Materials**

- (1) **Ductile Iron Sewer:** All bedding materials shall be crushed stone unless shown or specified otherwise. Crushed stone bedding material shall meet the requirements of **Georgia Department of Transportation Specification 800.01 for No. 57 stone.**

- (2) **PVC Sewer:** All bedding materials shall be crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 57 stone.
 - (3) **Sewer Laterals:** The bedding requirement for laterals from the sewer to the edge of the road right-of-way or easement shall be the same as applicable to the main sewer and as explained above in (2).
 - (4) **Manholes:** All bedding materials shall be crushed stone unless shown or specified otherwise. Crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 57 stone.
- b. **General:** Compact stone bedding material by tamping or slicing with a flatblade shovel. Prepare the trench bottom to support the pipe uniformly throughout its length. Provide bell holes to relieve pipe bells of all load. If the trench is excavated to excessive width or depth, provide the next better class of bedding. In rock trenches, bed pipe in at least six inches (6") of bedding material.
- (1) **PVC Pipe:** Excavate the bottom of the trench flat at a minimum depth shown on the drawings below the bottom of the pipe barrel. Place the compacted bedding and haunching material to the proper grade. Bedding and haunching shall then be carefully placed by hand and compacted to **provide full support under and on each side of the pipe to six inches (6") above the top of the barrel.**
 - (2) **Sewer Laterals:** The bedding requirement for the laterals from the main sewer to the edge of the road right-of-way or easement **shall be the same as applicable to the main sewer and as explained above in (2).**
 - (3) **Manholes:** Excavate to a minimum of eight inches (8") below the planned elevation of the base of the manhole. Place and compact stone bedding material to the required grade before constructing the manhole.

- (5) **Compaction: Bedding under pipe and manholes shall be compacted to a minimum of 85 percent of the maximum dry density as determined by the Standard Proctor Compaction Test, ASTM D-698.**
9. **Care of Surface Material for Reuse:** If local conditions permit their reuse, all surface materials suitable for reuse in restoring the surface shall be kept separate from the general excavation material.
10. **Manner of Piling Excavated Materials:** All excavated materials shall be piled so that it will not endanger the work and so that it will avoid obstructing roads and driveways. Drainage channels shall be kept clear or other satisfactory provisions made for drainage.
11. **Trenching by Machine or by Hand:** The use of trench digging machinery will be permitted except in places where operation of same will cause damage to existing structures above or below the ground; in which case hand methods shall be employed.

M. Pipe Handling

1. **Manner of Handling Pipe:** Proper implements, tools and facilities shall be provided and used by the Contractor for convenient prosecution of the work. All pipe shall be carefully lowered into the trench piece by piece by means of suitable tools or equipment in such a manner as to prevent damage to pipe. Under no circumstances shall pipe be dropped or dumped into the trench.
2. **Inspection:** Before lowering and while suspended, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected.
3. **Pipe Kept Clean:** All foreign matter or dirt shall be removed from the pipe and it shall be kept clean by approved means during and after laying.
4. **Laying of Pipe:** The laying of pipes in finished trenches shall commence at the lowest point so that spigot ends point in the direction of flow. All pipe shall be laid with ends abutting the true to line and grade. They shall be fitted and matched so that when laid in the work they will form a sewer with a smooth and uniform invert. All possible care shall be taken when shoving the pipes together so that the joints will not be unnecessarily large. Sockets and spigots shall be carefully cleaned before pipes are jointed.

5. **Unsuitable Conditions for Laying Pipe:** No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work except in an emergency.
6. **Encasement and Blocking of Sewer Pipes:** Where specifically indicated on the plans, the Contractor shall encase or block sewer pipes in conformity with details and type of concrete specified. Sewer lines to be encased shall be encased in 3,000 psi concrete a minimum of six inches (6") on all sides of the pipe.

N. Backfilling Trenches

1. **Time of Backfilling:** As soon as practicable after the completion of laying and jointing of the pipe, the trench shall be backfilled and at no time shall the completed backfilled trench be more than 200 feet behind the pipe laying.
2. **Backfill Procedure at Pipe Zone:** Haunching material shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to an elevation as shown on the detail for type pipe selected. Initial backfill material shall be moistened if necessary, tamped in thin six inch (6") layers and thoroughly compacted on each side of the pipe as shown on the Typical Sewer Pipe Bedding Detail. Walking or working on the completed pipe line, except as may be necessary in tamping or backfilling, will not be permitted until the trench has been compacted to a height of at least two-and-one-half feet (2 ½') over the barrel of the pipe for PVC pipe and two feet (2') over the barrel of the pipe for ductile iron (DI) pipe.
3. **Compaction Requirements:** All backfill for trenches under paved or roadway areas shall be compacted to 98 percent of the Standard Proctor maximum density (ASTM D-698). Backfill for trenches other than under pavement areas shall be compacted to 95 percent of the Standard Proctor maximum density (ASTM D-698) to eighteen inches (18") above the crown of the pipe. The remainder shall be compacted to 93 percent of the Standard Proctor maximum density (ASTM D-698).

The Contractor shall furnish the City proof of compaction at a point eighteen inches (18") above the crown of the sewer pipe at all pavement, driveway or roadway crossings. Additional compaction tests are required at each crossing eight inches (8") below the surface of the pavement or on the pavement subgrade before pavement placement. Contractor shall incur all costs for compaction tests performed by a testing laboratory approved by the City and selected by the Contractor.

4. **Rock and Rock Fragment Exclusion:** No rock or rock fragments shall be used in the backfill for at least eighteen inches (18”) above the top of the pipe and no stone larger than eight inches (8”) in its greatest dimension shall be used in the backfill.
 5. **Deficiency of Backfill:** Any deficiency in the quantity of material for backfilling the trenches or for filling depressions caused by settlement shall be supplied by the Contractor.
- O. Boring:** Furnish and install steel casing pipe by jacking and boring through whatever material may be encountered. Construction shall be as described in State of Georgia Department of Transportation Standard Specification Section 615.
1. **General:** Where groundwater is encountered, operate well points or drainage systems in the vicinity of the casing to prevent the accumulation of flood water in the casing and to maintain the groundwater table below the casing invert.
 2. **Pipe Casing:** Furnish all material and equipment and perform all labor required to install steel pipe casing at locations indicated on the drawings and as specified.
 - a. **Boring:** The steel casing pipe shall be Schedule 30 steel pipe manufactured from steel conforming to ASTM A-139, Grade B. Size and thickness shall be as follows:

UNDER HIGHWAYS

Carrier Pipe PVC Pipe Diameter, Inches	Minimum Steel Casing Diameter, Inches	Casing Wall Thickness, Inches
4	8	0.250
6	12	0.250
8	14	0.250
10	16	0.250
12	18	0.250

UNDER RAILROADS

Pipe Diameter, Inches	Casing Diameter, Inches	Wall Thickness, Inches
6	14	0.250
8	18	0.250
10	20	0.281
12	22	0.312

The outside of the casing pipe shall be primed and coated with two (2) coats of coal tar epoxy a minimum of six (6) mils DFT (TNEMEC Series 65 Poxiprime or equal). Only new primed and coated pipe shall be used. Install the steel pipe casing by the dry boring method. Bore the hole and install the casing through the soil simultaneously by a cutting head on a continuous auger mounted inside the casing pipe. Fully weld lengths of casing pipe to the preceding section in accordance with AWS recommended procedures. After the boring and installation of the casing is complete, install a cleaning pig on the rig and clean the casing.

3. Installation of Pipe

- a. **In Casing:** After installation of the casing is complete, install the pipe line by a method which has received prior approval of the engineer. Casing spacers shall be provided such that the carrier pipe is centered and restrained.

Close the ends of the casing with four inch (4") brick walls, plastered with Portland Cement mortar and waterproofed with asphaltic roofing cement.

Leave a four inch by eight inch (4" x 8") opening at the bottom of the lowest closure for drainage.

4. Safety

- a. **Boring:** Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it. If in the opinion of the City the installation is being conducted in an unsafe manner, the Contractor will be required to stop work and bulkhead the heading until suitable agreements are reached between the Contractor and the City.

- P. Stream and Ditch Crossing:** At all points where banks of streams or drainage ditches are disturbed by excavation or where natural vegetation is removed, carefully compact backfill and place rip rap to prevent subsequent settlement and erosion.

This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing stream or drainage ditch. Place rip rap a distance of not less than 10 feet upstream and 10 feet downstream from any disturbed area. Extend rip rap from 1 foot below streambed to top of bank. Place to conform with the natural slope of the stream bank. The pipe material for stream and ditch crossing shall be ductile iron pipe. A geotextile fabric shall be placed over the entire ditch and extend outward on either side a minimum of (10) ft.

Use only one method, either (a) or (b), throughout the job.

- (a) Stone Rip Rap: Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or higher.

Minimum weight of individual stones shall be 50 pounds. The maximum allowable dimension for an individual stone is 24 inches. The minimum allowable dimension for an individual stone is 6 inches. At least 50% of the stones shall have a minimum dimension of 12 inches. A geotextile fabric shall be placed over the entire ditch and extend outward on either side a minimum of 10 feet.

Rip rap shall be placed on a (6) inch layer of soil, crushed stone, or sand overlaying the fabric. Rip rap shall be placed with its top elevation conforming with the finished grade or the natural existing slope of the stream bank and stream bottom. The stone shall be dropped no more than three feet during construction.

Imbed stone rip rap by hand so as to form a compact layer at least 12 inches thick. Place rip rap in such a way that the smaller stones are not segregated but evenly distributed. Place chinking stones in the crevices between the larger stones so that a dense, well graded mass is produced.

- (b) Sand-Cement Bag Rip Rap: Use cement sacks or burlap bags having a capacity of from 1 to 2 cubic feet. Do not use bags previously used for sugar or chemicals. Fill bags with a mixture of one part Portland Cement to five parts sand.

Imbed bags by hand to form a compact layer at least 12 inches thick. Place with overlapping joints. The finished surface shall not deviate from that specified by more than 3 inches at any point.

Q. Concrete Piers: Construct piers as shown on the Drawings and in accordance with the following requirements:

(a) Material: Concrete shall have a compressive strength of not less than 3000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, grade 40.

(b) Bearing:

- (1) Earth: Where excavation reveals undisturbed earth subsurface, construct piers with spread footing foundations as shown in the Appendix.
- (2) Rock: Where excavation reveals level or benched rock having a minimum safe bearing value of 20,000 psf, construct piers with foundations bearing directly on rock. Drill a minimum of four holes into the rock under each pier and grout dowels into place to anchor the pier to the rock. Hole and dowel sizes shall be in accordance with the requirements of the table at the end of this section.

Grout holes from the bottom up using a group pump. Take extreme care to ensure that the entire hole is filled with grout prior to inserting the dowel.

- (c) **Installation:** Employ experienced formwork carpenters to construct forms. Build formwork sufficiently strong to resist movement and distortion during pouring and to protect the pier from caving in or lateral movement.

Before placing concrete, dewater the bottom of the hole and clean out all mud, loose earth, and extraneous matter.

Pour concrete as soon as possible after the forms have been approved. Do not leave the excavation open for prolonged periods of time. Protect the excavation from surface water. Do not allow water to accumulate in the excavation or in surrounding areas.

Take all necessary precautions to protect the work and personnel on the site. Cover open holes when work is not in progress. Examine all surrounding excavations and embankments for possible hazards.

ANCHORAGE REQUIREMENTS FOR PIERS ON ROCK

<u>Carrier Pipe Size</u>	<u>Grout Hole Diam. In</u>	<u>Grout Hole Depth, Ft.</u>	<u>Reinforcing Bar Dowell Size</u>
8-24	2.5	8	5
27-36	4	8	6
42-48	4	8	6
54	4	8	6

- (d) **Inspection:** Select and, with the approval of the Engineer, employ a consulting soil and foundation Engineer to perform the following:
- (1) Inspect the bearing material and evaluate its suitability.
 - (2) Inspect pneumatically drilled grout holes where applicable.
 - (3) Check dimensions and plumbness of forms to ensure conformity with Drawing and Specifications.
 - (4) Evaluate material penetrated by excavation with regard to lateral stability and uplift resistance.
 - (5) Recommend remedial measures should insufficient lateral stability or uplift resistance exists.

R. Restoration of Surfaces: The Contractor shall replace all curbing, sidewalks, pavements, gutters, shrubbery, fences, sod and other surfaces disturbed to a condition equal to that before the work began, furnishing all labor and materials incidental thereto.

- S. **Unsuitable Soil Conditions:** Where the subgrade is too soft or mucky for the proper installation of the sewer pipe, the Contractor shall undercut the trench and backfill with crushed stone. The stone shall be brought to grade and thoroughly compacted to conform to the outside of the pipe barrel.
- T. **Dewatering Trenches:** Where quicksand is encountered, dewatering shall be done by well pointing. If soil conditions are not suitable for well points, trench drains or crushed stone or gravel shall be constructed to carry the water to sumps and the water removed by pumps or bailing.
- U. **Cleaning Up:** Surplus pipe line materials, tools, rubbish and temporary structures shall be removed by the Contractor and the construction site shall be left clean.
- V. **Marking for Future Reference:** New sewer service lines shall be marked for future reference with 4" x 4" pressure-treated posts extending to the sewer service installed plumb. Four feet (4') of the post shall be above finish grade and painted "green".
- W. **A cleanout shall be placed at the property line in all new sewer service installations to facilitate the removal of stoppages on the City owned portion of the line.**
- X. **Inspection and Testing:** The City of Perry reserves the right to inspect construction methods to insure compliance with these specifications. Sewer lines and related facilities will be inspected and tested by the City before acceptance or tie-in to the City's system is permitted. All lines must be clean and all obstructions removed prior to requesting inspection and testing. When requested by the City, flush out lines and manholes before testing and inspection.

1. Testing Requirements

Gravity Sewers: Pipe lines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.

- a. **Pipe Deflection Testing:** Each section of sewer shall be checked for deflection by internal television inspection. A copy of the VCR tape in suitable format shall be provided to the City of Perry Engineering Department. As an option a mandrel with dimensions suitable for the pipe being tested may be pulled through the pipe. Any sections of pipe where the deflection exceeds the allowable amount of deflection shall either be removed or corrected such that the deflection is within the allowable limits as recommended by pipe manufacturer, but shall not exceed 5%.

- b. **Air Testing:** An approved air pressure test shall be required on all sections of gravity sewer pipe. The portion of the line segment being air tested shall be termed “acceptable” if the allocated line pressure decreases less than one (1) psi in the time for the given diameter as follows:

Nominal Pipe Size	Time
Inches	Minutes per 100 Feet
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	2.6

Air testing procedures shall follow guidelines outlined in ASTM Specification C-828, C-924 and/or UniBell B6. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs.

- c. **The Contractor shall conduct all testing in the presence of City of Perry representatives.**

4.06 SAFETY AND PROPERTY PROTECTION

- A. **Barricades, Guards and Safety Provisions:** To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards shall be placed and maintained and guards shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the trenches areas. Rules and regulations of the local authorities respecting safety provisions shall be observed.
- B. **Traffic and Utility Controls:** Excavations for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes or other utility controls shall be left unobstructed and accessible during the construction period.

C. Flow of Drains and Sewers Maintained: Provisions shall be made for the flow of storm and sanitary sewers, drains and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of work.

D. Protection

1. **General:** Return all items and all areas disturbed, directly or indirectly by work under these specifications, to their original condition or better as quickly as possible after work is started.
2. **Man-Made Improvements:** Protect or remove and replace with the Owner's approval, all fences, piers, docks, walkways, mailboxes, pipe lines, drain culverts, power and telephone lines and cables, and other improvements that may be encountered in the work.
3. **Cultivated Growth:** Do not disturb cultivated trees or shrubbery unless approved by the Owner. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.
4. **Cutting of Trees:** Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage from equipment. Do not store spoil from excavation against the trunks. Remove excavated materials stored over the root system of trees within thirty (30) days to allow proper natural watering of the root system. Repair any damaged trees over three inches (3") in diameter, not to be removed under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site. The fruit trees encountered in the line right-of-way must be either transplanted or replaced and guaranteed to live for twelve (12) months.
5. **Erosion Control:** Plan excavation work to prevent erosion and the washing of soil into adjacent streams. Limit the amount of open excavation at any one time. Place spoil in the proper place and keep natural water routes open. All erosion control procedures must comply with the Georgia Erosion and Sedimentation Control Act.
6. **Disposal of Rubbish:** Dispose of all materials cleaned and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate regulatory agencies; county, state and federal.

SECTION NO. 5

SEWER MANHOLES

5.01 DESCRIPTION

This item shall govern the construction, manholes and manhole drop connections, complete in place including the furnishing, adjustment to grade and installation of manhole frames and covers.

5.02 MATERIALS

- A. Cast Iron:** Cast iron manhole frames, covers and steps shall conform to the shape and dimensions shown on the detailed drawings and shall be clean and perfect, free from sand and blow holes or other defects. Cast iron shall conform to ASTM Designation A-48 for Class No. 20 gray cast iron. No casting will be accepted which weighs less than 95 percent of design weight. Shop drawings shall indicate design weight and provide sufficient dimensions for checking. Cast iron manhole steps shall be coated with a non-corrosive material such as plastic or they shall be manufactured of a non-corrosive material such as aluminum, galvanized metal or other material approved by the engineer. All castings shall be thoroughly cleaned in the shop and given two (2) coats of approved bituminous paint before rusting occurs.

<u>Type</u>	<u>Design Weight</u>	<u>Manufacturer's Reference</u>
Traffic	450 #	Neenah R-1712B
Watertight Traffic	400 #	Neenah R-1916F1
Vented	410 #	Neenah R-1781

All frames and covers shall have machined horizontal bearing surfaces.

Bolt-down covers shall be equipped with four (4) each one-half-inch (1/2") stainless steel bolts and a one-eighth-inch (1/8") neoprene O-ring gasket. Cover shall be rotatable and interchangeable. Bolt holes shall be bore through so that debris entering the bolt hole will fall into the manhole.

- B. Brick:** Bricks for manholes shall be first quality, sound, hard-burned, perfect shaped brick presenting a smooth regular shape. Bricks shall not absorb more than 16 percent of water by weight when submerged in water for 24 hours, having been in a thoroughly dry state prior to placing in water. Concrete brick for manholes will be accepted only for adjustment of frame to grade (eight inch (8")) maximum) and filler for manhole table contouring.

- C. **Sewer Pipe and Fittings:** All sewer pipe and fittings shall meet the requirements as specified in Section No. 4, Sanitary Sewers.
- D. **Mortar:** All cement used in mortar shall conform to ASTM Designation C-150 and the latest revision thereof. All mortar used shall be comprised of one (1) part Portland Cement and two (2) parts fine sand.
- E. **Concrete:** Concrete shall be Class “A” and shall conform to the applicable provisions of ASTM Designation C-150, C-175, C-33 (Aggregates). Class “A” concrete shall have a minimum 28-day compressive strength of 3,000 psi.
- F. **Joint Gasket:** Preformed plastic gasket with primer to meet Federal Specification SS-S-00210, “RAM-NEK” or approved equal.
- G. **Waterproofing:** Where called for on the plans, the Contractor shall apply exterior waterproofing to concrete surfaces. Waterproofing shall be an Asphalt Base Coating TNEMEC 47-461 or an approved equal (10-12 mils DFT minimum thickness).

5.03 CONSTRUCTION METHODS

- A. All bedding materials shall be crushed stone unless shown or specified otherwise. Crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 57 stone and be eight inches (8”) thick.
- B. Manhole and manhole drop connections shall be constructed at the locations shown on the plans. Manholes shall be to the depth shown on the plans or as directed by the engineer. Details of manholes and drop connections are shown on the plans and construction shall be in accordance with these details.
- C. Where inlet leads and mains or lateral pipe sewers enter a manhole, such pipes shall be cut off flush with the inside of the manhole and any irregularities shall be pointed up with mortar. All pre-cast manhole joints, both inside and outside, shall be wiped with mortar for a smooth surface.
- D. The inverts of the sewer lines entering manholes at or near the flow line elevation of the manhole shall be shaped and routed across the floor of the manhole using concrete and mortar to obtain a minimum of 1” drop across the manhole.
- E. After the manhole construction has been completed to the proper elevation, the cast iron manhole frame shall be set in a full bed of mortar and adjusted to the elevation established by the engineer.

- F. The two sides of the concrete encasement on standard drop connections which are adjacent to the manhole shall extend four inches (4") outside the bells of the pipe in the drop connection. The side of the encasement opposite the manhole shall be flush with the pipe bells. The entire drop connection shall be joined with the wall of the manhole in a solid mass of concrete. Drop connections shall be constructed at the time the manhole is constructed. Unless a lateral is to be immediately connected into the drop connection, it shall be plugged at the outer end of the wye or tee with a standard concrete pipe plug. A drop manhole shall be required if the invert of sewer entering manhole is 24" or more than the manhole invert.
- G. **Waterproofing:** Waterproofing shall be applied to the outside of below grade concrete surfaces of all manholes indicated on the plans. The bituminous waterproofing shall be applied according to manufacturing recommendations to a minimum thickness of 10-12 mils DFT.
- H. Backfilling around manholes and drop connections shall be in accordance with the applicable provisions for backfilling trenches specified in Section No. 4, Sanitary Sewers.

5.04 PRECAST SEWER MANHOLES AND WET WELLS

The Contractor shall furnish and install precast reinforced concrete manholes meeting all requirements of ASTM Designation C478-69. Reinforcing shall meet all requirements of ASTM A-185.

- A. **Types:** Precast risers and grade rings shall be the eccentric cone type for manhole top sections.
- B. **Joints:** The reinforced concrete manhole in riser sections, excepting grade rings, shall be formed with male and female ends with rubber gasket rings between the male and female end to reduce infiltration and leakage.
- C. **Manhole Steps:** Manhole steps that are cast or mortared into the walls of risers or conical top sections shall be aligned in each section so as to form a continuous ladder with rungs equally spaced vertically not more than twelve inch (12") centers. Steps shall be installed in manholes to within two feet (2') of crown of lowest pipe.
- D. **Finished Grade:** Precast manholes shall be furnished and set with proper allowance for the cast iron frame and cover to be set at the correct finished grade as shown on the plans.
- E. **Dimensions:** All precast manholes shall be a standard four feet (4') inside diameter for pipe sizes eight inch (8") to twelve inch (12"), and five feet (5') inside diameter for pipe sizes fifteen inch (15") to thirty-six inch (36").

- F. Brick:** Bed bottom and sides of any bricks used with mortar. Apply a smooth coat of mortar three-quarter-inch (3/4") thick on the inside and outside.
- G. Manhole Boots:** Provide neoprene boot seals where sewer enters the manhole and wet well. Holes for pipe entering or leaving shall be core-drilled at the factory.
- H. Testing:**
- Vacuum Tests:** The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40psi to effect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10 inches of mercury shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than 60 seconds for 48 inch diameter manholes. If the manhole fails the initial test, necessary repairs shall be made and the manhole re-tested. Re-testing shall proceed until a satisfactory test is obtained. All the tests shall be witnessed by City of Perry inspectors.
 - Exfiltration Tests:** The manhole, after proper preparation as noted above, shall be filled with water. The maximum allowable leakage shall not exceed 8 gallons per foot of depth per 24 hours for 48 inch diameter manholes. Tests shall last a minimum of eight hours. The manholes may be backfilled prior to testing.

SECTION NO. 6

FORCE MAIN AND RELATED PIPING

6.01 SCOPE

This section of the Specifications describes products to be incorporated into the force main and requirements for the installation and use of these items. The Contractor shall furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

6.02 GENERAL

1. **Applicable Standards:** Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable. If requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two (2) years.

6.03 MATERIALS

Furnish all pipe, fittings, valves and all other materials required for completion of the work. **All materials shall be made in AMERICA.** Furnish materials in accordance with the following:

- A. **Ductile Iron Pipe (DIP):** *Ductile iron pipe shall conform to AWWA C151 and shall be a minimum of Class 50.* Sizes will be as shown on the drawings. Pipe and fittings shall be cement lined in accordance with AWWA C104. Fittings shall conform to AWWA C110 with rated working pressure of 250 psi. Pipe and fittings shall be furnished with a bituminous outside coating.

Joints shall be push-on type for pipe and standard mechanical or flanged joints for fittings. Push-on and mechanical joints shall conform to AWWA C111. Restrained joint pipe (RJP) shall be either the bolted joint type, or modified push-on type with joint restrained using ductile iron components. Restrained joint pipe on piers shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet. Restrained joint pipe where required shall be American, U.S. Pipe, Clow or equal.

Provide the appropriate gaskets for mechanical or flange joints. Gaskets for flange joints shall be made of 1/8-inch thick cloth reinforced rubber; gaskets may be ring type or full face type.

Provide the necessary bolts for mechanical of flange connections. Bolts for flange connections shall be steel with American Regular unfinished square or hexagon heads. Nuts shall be steel with American Standard Regular hexagonal dimensions, all as specified in ANSI B 17.2. All bolts and all nuts shall be threaded in accordance with ANSI B.1.1 Coarse Thread Series, Class 2A and 2B fit.

All pipe shall be furnished in lengths of at least 18 feet.

Acceptance will be on the basis of the Engineer's review and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

- B. PVC Pipe:** For sizes four inch (4") through twelve inch (12"), PVC pipe shall meet all requirements of AWWA C900, Class 100, DR 25 with single rubber gasket push-on joint conforming to ASTM D-3139.
- C. Fittings:** Fittings shall be ductile iron fittings in accordance with ANSI/AWWA C110/A21.10. Working pressure shall be a minimum of 250 psi. Fittings shall have a nominal wall thickness of Class 54 Ductile Iron Pipe. Cement lining and seal coating shall be in accordance with ANSI/AWWA C104/A21.4. Provide the necessary bolts and gaskets for mechanical joint fittings. RUSCO fittings are not acceptable.
- D. Polyethylene Film Encasement:** Each location of a ductile iron fitting within ten feet (10') of a natural gas line with Cathodic Protection will require polyethylene encasement.

The polyethylene film shall be manufactured of virgin polyethylene material conforming to the requirements of ASTM Standard Specifications D-12448-78. Polyethylene film shall have a minimum thickness of 0.008 in.

The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and/or bedding material but it is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string or other material capable of holding the polyethylene encasement in place until backfilling operations are complete.

- E. Pipeline Casing Spacers:** Each pipeline casing spacer shall be two (2) piece 14 gauge T-304 stainless steel with corrosion resistant clamps for carrier pipe. The runners shall be ultra high molecular weight polymer to resist abrasion and sliding wear and configured to center the carrier pipe in the casing pipe with adequate support. Spacing shall be as recommended by the manufacturer. Spacers shall be Cascade or an approved equal.

6.04 HANDLING MATERIALS

- A. **Unloading:** Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. All materials dropped or dumped will be subject to rejection without additional justification.
- B. **Handling:** Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift or front loader. Do not use material damaged in handling.
- C. **Distribution:** Distribute and place pipe and materials to not interfere with traffic. Do not string pipe more than 1,000 feet beyond the area where pipe is being laid. Do not obstruct drainage ditches.
- D. **Storage:** Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Do not interfere with other contractors right to access.

6.05 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

Install pipe lines and accessories along highways, streets and roadways in accordance with the applicable regulations of the Georgia Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair. Boring of casing pipe shall meet the minimum specifications as described in Section “*Sanitary Sewers*”.

- A. **Protection of Traffic:** Provide and maintain suitable signs, barricades and lights for protection of traffic. Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street or roadway without first obtaining permission from the proper authorities.

Provide flagmen to direct and expedite the flow of traffic.

- B. **Construction Operations:** Perform all work along highways, streets and roadways to least interfere with traffic.
 - (1) **Stripping:** Where the pipe line is laid along the road shoulders, strip and stockpile all sod, topsoil and other material suitable for shoulder restoration.
 - (2) **Trenching, Laying and Backfilling:** Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

- (3) **Shaping:** Reshape damaged slopes, side ditches and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.
- C. **Excavated Materials:** Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off the pavement.
- D. **Drainage Structures:** Keep all side ditches, culverts, cross drains and other drainage structures clear of excavated material and free to drain at all times.
- E. **Maintaining Highways, Streets, Roadways and Driveways:** Maintain streets, highways and roadways in suitable condition for movement of traffic until completion and final acceptance of the work. Use steel running plate to maintain traffic until pavement replacement is completed.

Note: *Traffic must be maintained at all times. When one lane is closed, flagmen must be utilized to maintain traffic flow.*

Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work.

6.06 EXISTING UNDERGROUND UTILITIES AND OBSTRUCTIONS

It is the responsibility of the Contractor to locate all existing utilities along the path of his construction. The drawings shall indicate underground utilities or obstructions that are known to exist. Where these or unforeseen underground utilities are encountered, the location and alignment force main may be changed, upon written approval of the Engineer and the Owner, to avoid interference. The Contractor shall record the location of all underground utilities which are encountered and are not shown on the drawings. These locations will be incorporated into the "Drawings of Record".

6.07 LAYING PVC PIPE

- A. **General:** Unless specifically indicated on the plans or called for in the specifications, PVC lines shall be constructed of rubber gasket joint pipe, with mechanical joint fittings.
- B. **Construction Methods:**
 - (1) **Field Inspection:** All pipe and accessories shall be laid, jointed, tested for defects and for leakage with pressure in the manner herein specified in the presence of the Engineer or his authorized representative and subject to their approval.

(2) **Handling Pipe and Accessories:**

- (a) **Care:** PVC pipe, fittings, valves and other accessories shall 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 towed on skid-ways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skid-ways must not be skidded or rolled against pipe already on the ground.
- (b) **At Site of Work:** 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 and shall be laid on high ground so that it will not be in a drainage way.
- (c) **Bell Ends, How Faced:** Pipe shall be placed on the site of the work parallel with the trench alignment and with the bell ends facing the direction in which the work will proceed unless otherwise directed by the Engineer.
- (d) **Pipe Kept Clean:** The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.
- (e) **Detecting PVC Pipe:** All PVC force main pipe shall have **12 gauge stranded, insulated, copper wire** placed on each pipe crown for detection purposes. Detectible metalized tape shall also be installed over all PVC pipe. Tape will be equal to "Terra Tape" Type D for force main as manufactured by Griffolyn Company, Inc. of Houston, Texas (distributed by Corrosion Specialties, Inc., Tucker, Georgia). Detection tape shall be buried 2' - 0" below the ground surface above the force main.

(3) **Alignment and Grade:**

- (a) **General:** All pipe shall be laid and maintained in the required lines and grades, with fittings and valves at the required locations, with joints centered and spigots home, and with all valve stems plumb. Unless shown otherwise grade shall be positive in the direction of flow.
- (b) **Depth of Pipe:** The top of the barrel of the pipe shall have a **minimum cover of forty-eight inches (48")**.

(4) Excavation and Preparation of Trench:

- (a) Description:** The trench shall be dug to the alignment and depth required and not to exceed 200 feet in advance of the pipe laying. The trench shall be braced if necessary and drained in order that workmen therein, may work safely and efficiently. It is essential that the discharge from any pumps be led to natural drainage channels, to drains or to storm sewers.
- (b) Width:** Minimum width of trench shall be six inches (6") outside the barrel of the pipe on each side of pipe. Maximum width of trench shall be nine inches (9") outside the barrel of the pipe on each side of pipe. Sides of trench shall be dug and maintained substantially vertically to a height of twelve inches (12") above the pipe.
- (c) Pipe Foundation:** The pipe shall be laid upon a sound earthen foundation cut true and even so that the barrel of the pipe will have a bearing for its full length. If unsuitable foundation material is encountered, crushed stone stabilization if directed by the Engineer will be required. Crushed stone trench stabilization shall be #57 stone paid for at the unit price bid per ton in the Proposal.
- (d) Correcting Faulty Grade:** Any part of the trench excavated below grade shall be corrected with approved materials, thoroughly compacted.
- (e) Bell Holes, Required:** Bell holes of ample dimensions shall be dug in trenches at each joint to permit the joint to be made properly.
- (f) Braced and Sheeted Trenches:** Wherever necessary to prevent caving, excavations shall be adequately sheeted and braced. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until the pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted to a depth of two feet (2') over the top of the pipe.
- (g) Care of Surface Materials for Re-Use:** If local conditions permit their re-use, all surface materials suitable for re-use in restoring the surface shall be kept separate from the general excavation material.

- (h) **Manner of Piling Excavated Materials:** All excavated materials shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other provisions made for street drainage.
 - (i) **Trenching by Machine or by Hand:** The use of trench digging machinery will be permitted except in places where operation of same will cause damage to existing structures above or below ground; in which case hand methods shall be employed. Excavation shall be made by ladder type machine or backhoe.
- (5) **Pipe Handling:**
- (a) **Manner of Hauling Pipe and Accessories:** Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings and valves shall be carefully lowered into the trench piece by piece by means of derrick ropes or other suitable tools or equipment, in such manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
 - (b) **Inspection:** Before lowering and while still suspended, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected.
 - (c) **Pipe Kept Clean:** All foreign matter or dirt shall be removed from the pipe, and it shall be kept clean by approved means during and after laying.
 - (d) **Laying of the Pipe:** The spigot shall be centered in the bell, the pipe forced “home” and brought into true alignment; it shall be secured there by earth carefully tamped under and on each side of it, excepting at the bell holes. Care shall be taken to prevent dirt from entering the joint space. No “blocking up” of pipe or joints will be permitted. The joint shall be made as hereinafter described.
 - (e) **Trench Water Entering Pipe:** At 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.
 - (f) **Cutting Pipe:** Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe.

- (g) **Bell Ends Face Direction of Laying:** Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying; and for lines on an appreciable slope, bells shall, at the discretion of the Engineer, face up-grade.
 - (h) **Permissible Deflections at Joints:** Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, the degree of deflection shall be approved by the Engineer.
 - (i) **Unsuitable Conditions for Laying Pipe:** No pipe shall be laid in water, or when the trench conditions or the weather is unsuitable for such work except in an emergency.
- (6) **Jointing Pipe-Mechanical Joints:** The following steps shall be taken in making mechanical joints:
- (a) All lumps, blisters and excess coal-tar enamel shall be removed from socket and spigot of the pipe.
 - (b) Wash socket and plain end with soapy water containing chloride solution; then slip gland and gasket over plain end. The small side of gasket and lip gland shall face bell.
 - (c) Paint gasket with soapy solution containing chlorine.
 - (d) Push gasket into position, being sure it is evenly seated in socket.
 - (e) Slide gland into position; insert bolts and run nuts up finger tight.
 - (f) Tighten bolts to uniform tightness with correct ratchet wrench. The first bolt tightened shall be the bottom bolt, then top. All other bolts shall be tightened in sequence at 180 degrees apart.
- (7) **Setting Fittings:**
- (a) **General:** Pipe fittings shall be set and joined to new pipe in the manner heretofore specified for cleaning, laying and jointing pipe.
- (8) **Concrete Backing:** Concrete having compressive strength of not less than 1,500 psi shall be used as a cradle or backing where shown on the plans. Bends exceeding 11 ¼ degrees shall be backed with concrete as a thrust backing. Backing shall be placed between solid ground and the fitting to be anchored. The backing shall be so placed that the pipe fitting joints will be accessible for repair. No extra payment will be made for the concrete backing.

(9) **Backfilling, Cleaning Up and Maintaining Surfaces:**

- (a) **Time of Backfilling:** As soon as practicable after the completion of laying and jointing of the pipe, the trench shall be backfilled, and at no time shall the completed backfilling of the trench be more than 300 feet behind the pipe laying.
- (b) **Backfill Procedure at Pipe Zone:** Select backfill material free from rock fragments shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench and to an elevation of six inches (6") above the top of the barrel of the pipe. The backfill material shall be moistened if necessary, tamped in thin (about four inches (4")) layers and thoroughly compacted under and on each side of the pipe to provide solid backing against the external surface of the pipe.
- (c) **Backfill Procedure Above the Pipe Zone:** Succeeding layers of backfill may contain coarser materials, and shall be compacted thoroughly to the natural ground surface.
- (d) **Procedure Where Settlement is Important:** Where it is important that the surface of the backfill be made safe for vehicular traffic at unpaved street crossings and along existing unpaved streets, the upper thirty-six inches (36") of backfill shall be approved moist material, thoroughly compacted in eight inch (8") layers by tamping, and shall be brought to the required surface grade.
- (e) **Procedure Where Settlement is Unimportant:** Where pipe is laid behind curbs or outside city streets, tamping may be omitted in the layers above those described under Paragraph (a) and (b) and the backfill shall be neatly rounded over the trench to a sufficient height to allow for the settlement to grade after consolidation.
- (f) **Compaction Test:** Where settlement is important, the Contractor shall furnish the City of Perry proof of compaction at pavement subgrade. Test shall be at each street or drive crossing or at intervals not exceeding 400 feet in continuous pavement areas. Contractor shall incur all cost for compaction test performed by a testing laboratory selected by the Contractor and approved by the City of Perry.
- (g) **Deficiency of Backfill, by Whom Supplied:** Any deficiency in the quantity of material for backfilling the trenches, or for filling depressions caused by settlement, shall be supplied by the Contractor.

- (h) **Restoration of Surfaces:** The Contractor shall replace all curbing, sidewalks, gutters, shrubbery, fences, sod and other surfaces disturbed to a condition equal to or better than that before the work began, furnishing all labor and materials incidental thereto and complete the work in a manner satisfactory to the Engineer. Replacement of street base and surface removed to permit installation of pipe lines shall be provided for elsewhere in these Specifications.
- (i) **Backfill Under Paved Streets:** Backfill under paved streets shall be thoroughly compacted, and as shown on the detailed drawings.
- (j) **Surplus Earth:** Surplus excavated materials from trenches in streets or at railroad crossings shall be disposed of by the Contractor at his expense and in a manner satisfactory to the Engineer.
- (k) **Cleaning Up:** Surplus pipe line materials, tools, surplus excavated materials, rubbish and temporary structures shall be removed by the Contractor and the construction site shall be left clean to the satisfaction of the Engineer. The line shall be cleaned up immediately after satisfactory pressure test has been made.
- (l) **Maintenance of Surfaces:** Following the Certification of Completion by the Engineer, the Contractor shall maintain the surface of the unpaved trenches, adjacent curbs, sidewalks, gutters and other surfaces disturbed for a period of three (3) months thereafter.

All materials and labor required for the maintenance of the trenches and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

6.08 HYDROSTATIC TESTING

A. Pressure and Leakage Tests:

- (1) **Pressure During Test:** Immediately after the force main pipe has been laid and backfilled, but prior to the placement of pavement, each section of newly laid pipe shall be subjected to a leakage and pressure test. For any section being tested the pressure applied shall be such that at the highest point in the section, the pressure shall be 75 pounds per square inch (psi) or at least two-thirds (2/3) of pipe rated pressure whichever is greater.
- (2) **Duration of Test:** The duration of each pressure test shall be two (2) hours.

- (3) **Procedures:** Each valved section of pipe shall be slowly filled with water and the specified test pressure, measured at the point of highest elevation shall be supplied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection and all necessary apparatus, gauges and meters shall be furnished by the Contractor. The Contractor shall furnish all necessary labor and assistance in conducting the tests. The Owner will furnish, through connections made by the Contractor to existing mains, water for filling the lines for making the test.
- (4) **Expelling Air Before Tests:** Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation and afterwards tightly plugged.
- (5) **Examination Under Pressure:** At intervals during the test, the route of the pipe line shall be inspected to locate any leaks or breaks. Any cracked or defective joints, cracked or defective pipe, fittings or valves discovered in consequence of this pressure test shall be removed and replaced with sound material in the manner provided and the test shall be repeated until satisfactory results are obtained.
- (6) **Permissible Leakage:** Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, of any valved section thereof, to maintain the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if leakage is greater than that determined by the formula:

$$L = \frac{SD(P)^{0.5}}{7400}$$

Where: *L* is the allowable leakage, in gallons per hour; *S* is the number of joints in the length of pipeline tested; *D* is the nominal diameter of the pipe, in inches; and *P* is the average test pressure during the leakage test, in pounds per square inch gauge. Leakage values determined by the above formula are to be found in the following table:

**ALLOWABLE LEAKAGE
WITH ELASTOMETRIC JOINTS IN GALLONS PER HOUR
PER 1000 FEET OF PIPE AT 75 PSI**

Nominal Pipe Size (Inches)	Allowable Leakage
4"	.23
6"	.35
8"	.46

6.09 STREAM AND DITCH CROSSING

At all points where banks of streams or drainage ditches are disturbed by excavation or where natural vegetation is removed, carefully compact backfill. Place rip-rap to prevent subsequent settlement and erosion as shown on the plans or as directed by the Engineer.

This requirement applies equally to construction beside a stream or drainage ditch as well as crossing stream or drainage ditch. Place rip-rap as shown on the plans or as directed by the Engineer, a distance of not less than ten feet (10') upstream and ten feet (10') downstream from any disturbed area. Extend rip-rap from one foot (1') below stream-bed to top of bank. Place to conform with the natural slope of the stream bank.

- A. **Stone Rip-Rap:** Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable Specific gravity shall be 2.0 or higher.

Minimum weight of individual stones shall be fifty pounds (50#). The maximum allowable dimension for an individual stone is 24 inches. The minimum allowable dimension for an individual stone is six inches (6"). At least 50 percent of the stones shall have a minimum dimension of twelve inches (12").

Embed stone rip-rap by and so as to form a compact layer at least twelve inches (12") thick. Place rip-rap in such a way that the smaller stones are not segregated but evenly distributed. Place chinking stones in the crevices between the larger stones so that a dense, well graded mass is produced.

6.10 MEASUREMENT AND PAYMENT

Force mains shall be measured and paid based on the linear foot measure from centerline of fittings for the various sizes shown in the Proposal. Pipe installation in casing shall be measured and paid based on the linear foot measure from end of casing to end of casing and include casing spacers. Other items shall be measured and paid based on the contract unit price for each complete item installed and tested. Fittings shall be measured and paid based on the weight of a standard cast iron mechanical joint fitting (AWWA C110) (body only).

Trench stabilization materials (#57 stone) shall be measured by the ton based upon tickets provided by the material supplier and verified by the Owner. Stabilization material will be used only in areas where necessary as approved by the Engineer.

Steel casing pipe based under highways or roadways shall be measured from end of casing to end of casing and based on the linear foot measure.

SECTION 7 WETWELL MOUNTED PUMP STATIONS

7.01 GENERAL

The contractor shall furnish and install one factory-built, automatic pumping station as manufactured by Smith & Loveless, Inc., Lenexa, Kansas. The station shall be complete with all needed equipment, factory-installed on a welded steel base with fiberglass cover.

The principal items of equipment shall include two vertical, close-coupled, motor driven, vacuum primed, non-clog pumps; valves; internal piping; central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; and all internal wiring.

Each pump station installation shall be enclosed within a chain link fence. Also to be provided will be a 1" waterline with yard hydrant and work light.

7.02 CONSTRUCTION

The station shall be constructed in one complete, factory-built assembly. It shall be sized to rest on the top of the wet well as detailed in the construction drawings. The supporting floor plate shall be minimum 3/8" thick steel with reinforcing, as required, to prevent deflection and ensure an absolutely rigid support. Steel plate shall meet or exceed ASTM A-36 specifications.

The pump station shall be enclosed by a hinged fiberglass cover made of molded reinforced orthophthalic polyester resins with a minimum of 30% glass fibers with a minimum average length of 1-1/4". The outside of the enclosure shall be coated with a polyester protective in-mold coating for superior resistance to weathering, ultra-violet radiation, yellowing and chalking. The completed fiberglass enclosure shall be resistant to mold, mildew, fungus and corrosive liquids and gasses normally found in pump station environments. The dimensions of the enclosure shown on the drawings shall be considered a minimum, for internal component clearances and accessibility, and nothing smaller will be acceptable. The cover shall have a suitable drip-lip around the edge and shall be provided with a hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock.

The cover shall be attached with a multi segment stainless steel hinge, constructed of 7 gauge (minimum) type 304 stainless steel with a 3/8" diameter stainless steel pin and supporting at least 75% of the width of one end. Stainless steel bolts with tamperproof heads and a full width 3/8" thick anodized aluminum backing plate shall anchor the hinge to the fiberglass cover.

Dual high pressure gas struts shall be provided to counteract the dead weight of the cover assembly and limit the maximum lifting force required for opening to less than 20 pounds. The cover shall be self-latching upon opening, with a manually operated release for closing. Duplex heavy gauge safety chains shall be provided to prevent over-extension. All hardware and components of the cover assembly which are exposed to the weather shall be constructed of corrosion resistant materials.

Heavy extruded aluminum, adjustable ventilating louvers shall be provided on each end of the fiberglass cover, which are capable of being closed during cold weather operation.

An aluminum manway cover fabricated of 1/4" treadplate, located exterior to the fiberglass pump chamber shall be provided, complete with padlocking provisions. The manway shall be an integral part of the station floor plate and provide access to the wet well. The minimum open area of the manway access into the wetwell shall be at least 4.2 square feet.

The manway cover shall have a three color 7" x 10" (minimum) corrosion resistant sign permanently affixed to it, reading "DANGER – Before Entering, Test For Explosive Gasses. Test For Oxygen Deficiency. Supply Fresh Air To Work Area".

Enclosures utilized to house the valve train and/or controls, which are defined under OSHA Article 29CFR, Parts 1910 as a Confined Space shall not be acceptable.

To allow on-site maintenance of the pumps, a stanchion with lifting arm shall be provided to lift each pump. The lifting arm shall have a hook over the center of the motor to support a hoist (provided by others) for removal of the motors, impellers and pumps from the station.

The pump casings and discharge piping shall be mounted in relation to the floor plate as detailed in the construction drawings. The suction and discharge connections, where they pass through the floor, shall be sealed by gaskets, rather than being welded, to allow adjustment and replacement.

7.03 WELDING

All steel structural members shall be joined by electric arc welding with welds of adequate section for the joint involved. Structural welding shall be preformed in accordance with AWS standards and procedures.

7.04 PROTECTION AGAINST CORROSION

All structural steel surfaces shall be factory blasted with steel grit, in an environmentally controlled booth, to remove rust, mill scale, weld slag, etc. Sandblasting is specifically prohibited. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of VERSAPOX[®], a self-priming Cycloaliphatic Amine Epoxy, shall be factory applied. This coating shall be as formulated by Smith & Loveless for abrasion and corrosion resistance.

Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components such as the electrical enclosure, ventilating blower and vacuum pumps shall be furnished with the original manufacturer's coating.

Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the pump station manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

7.05 MAIN PUMPS

The pumps shall be vertical, centrifugal non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by linear movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8" for motor frame sizes 213 through 286; 2-1/8" for motor frame sizes 324 and 326; and 3" for frame 364 and larger. The dimension from the lowest bearing to the top of the impeller shall not exceed 6". The motor shaft shall be directly connected to the impeller without the use of drive belts or couplings, which require alignment and maintenance, and which increase power consumption due to their inherent energy losses.

Pumps with less than a standard 4" suction or 4" discharge connection, or with less than a 3" spherical solids handling capacity will be rejected for this application.

The oversized shaft incorporating oversized bearings and heavier bearing frame construction provides for extended mechanical seal, bearing and overall pump/motor life. Since the larger shaft with the specified minimum overhang is the key to heavier, more rigid construction throughout, no deviation from the specified shaft diameter or tolerances will be allowed.

The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move in a linear direction with the thermal expansion of the shaft and shall carry only radial loads.

The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

The pump shall have an integral adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication. Pumps which do not use hollow priming adapters for positive lubrication of the seal will not be acceptable. Self priming pumps are specifically unacceptable due to the need for suction check valves, air vent piping and the possibility of overheating and damaging the pump or producing steam or high temperatures in the pump, which may be a hazard to the operator, when the pump is run dry. The pump controls must be set so that the main pumps cannot be turned on unless they are filled with liquid, and the pump is completely primed.

The pump shall be constructed so as to permit priming from the lower pressure area behind the impeller. Priming from high pressure connections, which tends to cause solids to enter and clog the priming system, will not be acceptable. The priming bowl shall be transparent, enabling the operator to monitor the priming level.

The pump shall be arranged so that the rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal, so that any foreign object may be removed from the pump or suction line. Enclosed impellers must be used to avoid the necessity of wear plates and the associated costs of replacement and maintenance of wear plate clearances with semi-open impellers.

The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime in order to allow both the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.

The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring. The entire seal assembly shall be held in place by a bronze seal housing to prevent excessive heat build-up. Use of cast iron or other ferrous material for the seal housing which will rust and damage the seal, shortening its life, will not be acceptable.

The pump volute shall be furnished with mounting lugs and bolted to the station floor plate, forming a gas-tight seal.

7.06 NON-CLOG TWO-POT IMPELLER

The pump impeller shall be of the enclosed two-port type made of close-grained cast iron and shall be balanced. The eye of the impeller as well as the ports shall be large enough to permit the passage of a sphere 3" in diameter in accordance with nationally recognized codes. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shrouds. The shrouds shall remain full diameter so that close minimum clearance from shrouds to volute is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

7.07 MOTORS

The pump motors shall be vertical, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 phase, 60 cycle, 230 or 460 volt electric current. They shall have Class F insulation. Insulation temperature shall, however, be limited to Class B. The motors shall have normal starting torque and low-starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

The motors shall have 1.15 service factor. The service factor shall be reserved for the owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design conditions, nor at any head in the operating range as specified under Operating Conditions.

The motor-pump shaft shall be centered, in relation to the motor base, within .005". The shaft runout shall not exceed .003".

The motor shaft shall equal or exceed the diameter specified under Main Pumps at all points from immediately below the top bearing to the top of the impeller hub.

A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.

7.08 CONTROLS

The control equipment shall be mounted in a NEMA Type 1 steel enclosure with a removable access cover. The circuit breakers, starter reset buttons, and control switches shall be operable without removing the access cover, for deadfront operation. The electrical equipment in the panel shall be protected by a lightning arrestor and a surge suppression capacitor.

A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 120 volt AC devices.

Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive protection. Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

To control the operation of the pumps with variations of liquid level in the wet well, a minimum of three (3) displacement switches shall be provided. A 30' cord shall be provided with each switch. The cord shall have a corrosion-resistant vinyl jacket and be multi-stranded in order to prevent fatigue.

An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps every eight hours. Alternating the pumps at less than eight-hour intervals will not be acceptable.

Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the low level pump.

An adjustable displacement switch shall be provided to sense a high water level condition. The switch shall hang into the wet well and shall activate a contact to indicate the high water condition.

7.09 SINGLE PHASE 120 VOLT POWER TRANSFORMER

A (5) KVA insulating-type transformer shall be provided to supply power for lights, controls and auxiliary devices. The transformer shall have 240/480 volt primary, 120/240 volt secondary, Class F insulation, with temperature rise not to exceed 115° C above 40° C ambient. The core and coil assembly shall be given a double dip and bake. The coil shall be protected by a metal housing to prevent damage. The transformer shall be protected by a separate circuit breaker on the supply side.

7.10 VACUUM-PRIMING SYSTEM

A vacuum priming system shall be furnished to prime the main pumps. The system shall be as shown on the vacuum priming schematic and shall include two vacuum pumps, providing 100 percent standby. Vacuum pumps shall have corrosion-resistant internal components. The vacuum priming system shall be complete with large port vacuum control solenoid valves, vapor filters to protect the solenoid valves, solid stainless steel prime level sensing probes, float-operated check valves to protect the vacuum pumps, and all necessary shut-off valves as shown on the piping schematic. The float-operated check valves shall have a transparent body for visual inspection. All hoses and tubing used in the priming system shall be at least 3/8" nominal diameter.

The solenoid valves used in the vacuum priming system shall be of the high flow, direct acting brass body type, with threaded ports, NBR seals and 300 Series stainless steel plunger, rod, plate and springs. The minimum orifice diameter shall be 5/16". The solenoid valves shall be UL Listed, with Class F coil rating and of suitable voltage and thermal capacity for the application.

Each solenoid valve shall be protected by a vapor filter, installed in the vacuum line between the valve and the priming dome. The vapor filter shall be constructed of corrosion resistant materials and shall have a minimum filtration area of 2.74 square inches and be suitable for operation from 25" Hg to 100 PSI. They shall be readily replaceable without the use of special tools.

Liquid level in the pump priming chamber shall be sensed by an electrode system, rather than mechanical means such as a float, to avoid moving parts inside the chamber which may accumulate debris, bind or fail. Only an electrical level sensing system, proven in over 20,000 pump installations and with no moving parts in the priming chamber shall be used.

The priming system shall automatically provide positive lubrication of the mechanical seal each time a main pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which the pumped liquid must pass shall be smaller than the equivalent of a 2-1/2" opening.

7.12 ENVIRONMENTAL EQUIPMENT

A ventilating blower capable of delivering 250 CFM at 0.1" static water pressure shall be provided in order to remove the heat generated by continuous motor operation. The ventilating blower shall be turned on and off automatically by a preset thermostat. A heavy extruded aluminum louvered grille with adjustable openings shall cover the discharge of the blower. A similar grille shall be provided in the other end of the station enclosure for air intake. A 500 watt electric heater controlled by a preset thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal.

7.13 MAIN PIPING

The pump suction shall be drilled and tapped for a 125 pound American Standard flange for easy connection of the suction riser. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location and quantity of check valves and plug valves shall be as shown on the construction drawing. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed with an adjustable Teflon seal. Ball type check valves are specifically unacceptable for this application. An operating wrench shall be provided for the plug valves.

Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump casings or suction pipes in order to prevent corrosive, noxious fumes from entering the station. Welded joints that do not allow adjustment or replacement will not be considered for this application. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas-tight seals.

The manufacturer of the pump station shall provide a compression-type sleeve coupling for installation in the common discharge pipe.

The pump and pump station specifications and the following checklist must be met in total. There are many reasons for incorporating a good pump specification. For example, the stainless steel shaft with tapered impeller attachment is provided to minimize corrosion, extend seal life, and provide ease of impeller removal and seal replacement without use of a wheel puller. All items specified are for long life, durability and maintainability of the pumping equipment. Deviations from the pump specification will not be allowed.

The checklist is also provided to insure that the proper pumping system is provided to the owner.

7.14 FACTORY TESTS

All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.

Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator; and a Vibrometer capable of measuring both amplitude and frequency.

7.15 SPARE PARTS

A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions. A spare casing gasket and seal gasket shall be provided.

7.16 INSTALLATION AND OPERATING INSTRUCTIONS

Installation of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer.

Operation and maintenance manuals shall be furnished which will include parts lists of components and complete service procedures and troubleshooting guide.

7.17 START-UP

The Manufacturer shall provide the services of a factory-trained representative for a maximum period of one day on-site to perform initial start-up of the pump station and to instruct the owner's operating personnel in the operation and maintenance of the equipment.

7.18 WARRANTY

The manufacturer of the station shall warrant for one year from date of start-up, not to exceed eighteen months from date of shipment, that the structure and all equipment he provides will be free from defects in material and workmanship. Warranties and guarantees of the suppliers of various components in lieu of a single source responsibility by the Manufacturer will not be accepted. The Manufacturer shall assume prime responsibility for the warranty of the station and all components.

In the event a component fails to perform as specified or is proven defective in service during the warranty period, the Manufacturer shall repair or replace, at his discretion, such defective part. He shall further provide, without cost, such labor as may be required to replace, repair or modify major components such as the steel structure, main pumps, main pump motors and main piping manifold. After start-up service has been performed, the labor to replace accessory items, such as the blower, priming pumps, alternator, etc., shall be the responsibility of others.

The repair or replacement of those items normally consumed in service, such as seals, grease, light bulbs, etc., shall be considered as part of routine maintenance and upkeep.

It is not intended that the Manufacturer assume responsibility for contingent liabilities or consequential damages of any nature resulting from defects in design, material, workmanship or delays in delivery, replacement or otherwise.

7.19 MANUFACTURED EQUIPMENT

The specifications and drawings detail Smith & Loveless equipment and represent the minimum standard of quality for both equipment and materials of construction. The contractor shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid.

The owner has standardized on the named equipment in order to optimize their operation, facilitate maintenance and safety programs, provide for interchangeability of costly equipment items, reduce stocking levels required for necessary spare parts and provide increased flexibility in the utilization of their pumping equipment. Equipment substitutions, since incompatible with the district's standardization program, will not be considered.

7.20 ADDITIONAL ACCESSORIES

Three-Phase Power Failure – A relay with double pole, double throw contacts to monitor and protect against phase loss (single phasing), under voltage (brownouts) and phase reversal (improper sequence). Automatically resets when three-phase service returns to normal.

<u>Adjustable</u> <u>Voltage</u>	<u>Operating</u>	<u>Drop Out Voltage</u>
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158 – 224		171 – 243
430 – 480		387 - 432

Alarm Light 120 Volts VAC – A vapor-proof light fixture with 50 watt lamp for outdoor pole mounting with red globe and guard.

Alarm Horn 120 Volts VAC – A vibratone-type horn mounted on a weather-tight box suitable for pole mounting.

Silence Switch – An On/Off switch to disable the audible alarm mounted in the station control panel.

Running Time Meters - A running time meter shall be supplied for each pump to show the number of hours of operation. The meter shall be enclosed in a dust and moisture-proof molded plastic case. The flush mounted dial shall register in hours and tenths of hours up to 9999.9 hours before repeating. The meter shall be suitable for operation from a 115 volt, 60 cycle supply.

Pressure Gauges – Provide compound pressure gauges for each pump

SUBMERSIBLE PUMPS

7.21 GENERAL

Each pump station installation shall be enclosed within a chain link fence. Also to be provided will be a 1" waterline with yard hydrant and work light.

7.22 PUMP DESIGN

The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor.

7.23 PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

7.24 COOLING SYSTEM

Motors are sufficiently cooled by the surrounding environment or pumped media. A water jacket is not required.

7.25 CABLE ENTRY SEAL

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

7.26 MOTOR

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

7.27 BEARINGS

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

7.28 MECHANICAL SEAL

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with an lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

7.29 PUMP SHAFT

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI type 431 stainless steel.

If a shaft material of lower quality than 431 stainless steel is used, a shaft sleeve of 431 stainless steel is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

7.30 IMPELLER

The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, double shrouded non-clogging design having a long throughlet without acute turns. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Whenever possible, a full vaned, not vortex, impeller shall be used for maximum hydraulic efficiency; thus, reducing operating costs. Impeller(s) shall be keyed to the shaft, retained with an Allen head bolt and shall be capable of passing a minimum inch diameter solid. All impellers shall be coated with an acrylic dispersion zinc phosphate primer.

7.31 WEAR RINGS

A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet.

7.32 VOLUTE

Pump volute(s) shall be single-piece grey cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

7.33 PROTECTION

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.

A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.

The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

7.34 CONTROL PANEL

The control system shall be designed to operate the required number of pumps specified on the drawing at the power characteristics shown on the plans. The control function shall provide for the operation of the pumps under normal conditions, and shall alternate the pumps on each pump down cycle to equalize the run time. In the event the incoming flow exceeds the capacity of the lead pump, subsequent pumps shall automatically startup to handle the increased flow. As the flow decreases the pump shall cut off at the elevations as shown on the plans.

The control shall function as described below. The equipment listed below is a guide and does not relieve the supplier from supplying a system that will function as required.

- (A) Enclosure: The enclosure shall be a 14 gauge, NEMA 4X rated enclosure manufactured from 304 stainless steel. The enclosure shall be a wall mounted type with a minimum depth of 12", sized to adequately house all the components. The door gasket shall be rubber composition with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees.
- (B) Inner dead front door: A polished, aluminum dead front shall be mounted on a continuous aircraft type hinge. It shall contain cutouts for mounted equipment, and provide protection of personnel from live, internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, duplex receptacle, and other operational devices shall be mounted on the external surface of the dead front. The dead front shall open a minimum of 150 degrees to allow access to equipment for maintenance. A 3/4" break shall be formed around the perimeter of the dead front to provide rigidity.

- (C) Back plate: The back plate shall be manufactured of 12 gauge steel and be finished with a primer coat and two (2) coats of baked on, white enamel. All hardware mounted to the subpanel shall be attached with machine thread, tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified.
- (D) Power distribution: The panel power distribution shall include necessary components and be completely wired stranded copper conductors rated at 90 degrees C. All conductor terminations shall be as recommended by the device manufacturer.
- (E) Circuit breakers: All circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to Square D Type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics and shall have a minimum of 14,000 amps interrupting capacity at 480 VAC. The control circuit shall be controlled by heavy duty breakers.
- (F) Circuit breakers shall be indicating type, providing “on-off-trip” positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating “trip.”

Thermal magnetic breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.

Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be acceptable.

- (G) Motor starters: Motor starters shall be open frame, across-the-line, NEMA rated with individual overload protection in each leg. Motor starter contacts and coil shall be replaceable from the front of the starter without removal from its mounted position. Overload heaters shall be block type, utilizing melting alloy spindles and shall have visual trip indication. Overloads shall be sized for the full load amperage draw of the pumps. Adjustable type overloads, definite purpose contactors, fractional size starters and horsepower rated contactors or relays shall not be acceptable.
- (H) Probe controller system: A conductance actuated MultiTrode control system shall be provided. The system shall utilize a one-piece multi-sensored probe and an indicating controller with necessary intrinsic barriers to both operate pumps at designated levels and actuate alarms as required.

The MultiTrode MT2PC is a self-contained switchboard device used to control two pumps and two alarms. Status information for pumps, pump fault, mode of operation, next pump to start, and level alarms are clearly indicated on the front display.

The MT2PC incorporates the main control components of standard pump panels. It allows all essential operating parameters to be adjusted via the front keypad or communication port. This includes setting levels, time delays, sensitivities, pump alternation, hand-off-automatic selection, and fault resets. It will accept level information from a MultiTrode probe or an analog device (4 - 20 mA or 0-10 V).

Provide extra probe with specified cable length as a spare.

The MT2PC keypad can be disabled to prevent unauthorized keyboard entry. The MT2PC also provides a communication link for the connection of other MultiTrode equipment or "smart" monitoring and control equipment.

- (I) Level control systems: The control system shall provide for the automatic and manual control and alternation of the pumps to maintain a pumped down condition of the wet well. Levels shall be sensed through a measurement device adjusted to the specified levels. The device shall sense the "off", "lead", "lag", and "alarm" levels. As the level in the wet well rises, the lead pump, as determined by the alternator, shall start and pump the station to the "off" level. In the event the incoming flow exceeds the capacity of the lead pump, the lag pump shall start and both pumps shall run to the "off" level. If the level continues to rise, alarm functions shall be activated. The control system shall include, but not be limited to, the ancillary equipment listed below.

7.34 Ancillary equipment:

- (A) BOM (Bypass/Off/MT2PC) switches: A three-position BOM switch shall be provided for each motor. The switch shall be NEMA 4X rated with 10 amp contacts. A position indicating legend plate shall be provided. The BOM switches shall be mounted on the dead front door.

The BOM in the bypass position will allow the pump to run and bypass all safety shutdowns except for the overloads. In the MT2PC position the MT2PC will control the pumps while monitoring all shutdowns and stop the pump.

- (B) Run indicators: A green run pilot indicator shall be mounted on the dead front door.
- (C) Elapsed time meter: An elapsed time meter shall be mounted on the dead front door. The meter shall operate on 120 VAC, shall indicate in hours (6 digits) and tenths and shall not be re-settable.
- (D) Moisture and thermal measurement: A plug-in, solid state control and status relay with indicating LED's shall be provided to measure motor thermal overload and moisture in the pump housing. Any moisture or thermal condition shall signal failure and stop the pump. The failure mode shall also be indicated by an illuminated light on the MT2PC controller.

- (E) Heater: An internal 100 watt heater shall be provided to maintain temperature above the dew point. The unit shall be thermostatically controlled.
- (F) Trouble light: An internal trouble light shall be installed to illuminate the internal portion of the enclosure.
- (G) Alarm system: The alarm light shall be a weatherproof, shatterproof, red light fixture with a 40 watt bulb to indicate alarm conditions. The alarm light shall be turned on by the alarm relay.
- (H) Lightning-transient protection: Each complete suppression unit shall be UL listed as a secondary surge arrestor and bear CSA certification and meet ANSI/IEEE C62-11-1987; suitable for indoor and outdoor applications; suitable for use in service entrance location; meet requirements of NEC Article 280; rated at 650V phase-to-ground maximum.
- (I) Optional: Main and emergency circuit breakers shall be interlocked using a walking beam type interlock. This will not allow both breakers to be in the “on” position. Both breakers may be in the “off” position. There shall be a lockable handle on the main and emergency breakers. This handle must be in the “off” position to open the dead front door.
- (J) Transformers: Control transformers shall be provided to produce the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The secondary circuits shall be grounded.
- (K) Phase monitor: A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reverse phase, and loss of phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.
- (L) Drawings: A final, “as built” drawing encapsulated in Mylar shall be attached to the inside of the front door. A list of all legends shall be included.
- (M) Panel markings: All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers at each end, as close as practical to the end of the conductor.
- (N) Testing: All panels shall be tested to the power requirements as shown on the plans to assure proper operation of all components. Each control function shall be activated to check for proper indication.

Warranty:

Flygt offers a warranty for a period of three (3) years from date of shipment. The warranty is effective against all defects in workmanship and/or defective components. The warranty is limited to replacement or repair of the defective equipment.

Manufacturer: The manufacturer shall be a UL listed shop for industrial control systems and shall serialization evidence of such on the control panel enclosure.

7.35 SHOP DRAWING SUBMITTAL

Initial submittal of Shop or Setting Drawings shall consist of one (1) paper copy of all items. Upon notification by the Engineer of Approval, One (1) additional paper copy and an electronic file in an acceptable format shall be submitted to the Engineer. Acceptable formats shall include Microsoft Word, and AutoCAD.

Warranty:

Warrant all parts to be free from defects in materials and workmanship for a period of one year after first beneficial use of the system. Furnish replacement parts to the Owner for any items found to be defective within the one year warranty period.

SECTION 8 - ELECTRICAL

8.01 EQUIPMENT AND MATERIALS

Electrical equipment and materials shall be furnished and installed in accordance with the latest IEEE, NEC, ASA, and NEMA Standards. All materials used shall be approved by the National Board of Fire Underwriters and samples shall be submitted upon request to the Engineer for approval. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. If any apparatus has been damaged, such damage shall be made good by the Contractor at his own expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried and put through such special tests as will be directed by the Engineer, at the expense of the Contractor, or shall be replaced by the Contractor at his own expense.

8.02 RATINGS APPROXIMATE

The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchase of equipment. The ratings shown for motor branch circuit protective devices are the maximum ratings permitted. Lower ratings may be used where approved as being proper for the dynamic characteristic of the motor and its connected load.

It shall be the responsibility of the Contractor to verify the exact rating of each item of equipment before performing the work required under the Contract. Motor ratings are given for determination of wire and equipment sizes only. The Contractor shall determine the ratings of overload and other protective devices in accordance with motor nameplate or other data furnished with the motors.

8.03 LOCATIONS APPROXIMATE

The locations of equipment, fixtures, outlets and similar devices shown on the Plans are approximate only. The Contractor shall determine the exact locations of the equipment, outlets, box-outs, sleeves, and similar items required for the coordination of electrical work with the structural, architectural, mechanical or other work.

The Contractor shall submit to the Engineer for approval, shop drawings showing the locations and arrangement of electrical work, including electrical equipment, conduit and cable runs, details of conduit and cable supports, location of sleeves, box-outs, concrete inserts or other work required for the proper coordination of the various trades.

8.04 DRAWINGS DIAGRAMMATIC

Circuit diagrams shown are diagrammatic and functional only and are not intended to show exact circuit layouts, number of fittings, or other installation details. The Contractor shall furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown.

Conduits beyond first pushbutton and control device and conduits containing lighting circuits beyond panel boards are not scheduled. The number of conductors shown is not necessarily the correct number required. As many conductors as required in each case shall be installed.

8.05 TESTING

When all wires and cables are in place, but before the final connections have been made, a high potential test voltage shall be applied and maintained for a period of one minute between all conductors in the same enclosure and between each conductor and the ground. The test voltage for high potential tests shall be not less than 1,000 volts in excess of the rated circuit voltage, or it shall be 1,500 volts, whichever is greater. Grounding systems shall be tested for continuity.

After the final connections have been made, the equipment and controls shall be tested to demonstrate capacity and performance.

If damage occurs during any of the test, the Contractor shall make it good without additional payment. The Contractor shall furnish all necessary testing equipment and all tests shall be at the expense of the Contractor. All testing equipment shall be subject to the Engineer's approval and all tests shall be made in the presence of the engineer. The Contractor shall give the Engineer at least three days written notice in advance of the time when equipment will be ready for tests. A list of test instruments shall also be submitted.

8.06 INSPECTION

All workmanship and materials shall be in accordance with the provisions of the National Electrical Code; the work shall be subject to inspection by a representative of the National Board of Fire Underwriters and by the local authorities having jurisdiction; and all work shall pass inspection.

The Contractor shall furnish to the Engineer a Certificate of compliance of the completed installation with the requirements of the National Board of Fire Underwriters.

8.07 FASTENING METHODS

Acceptable fastening methods include wood screws on wood construction, toggle bolts on hollow masonry, expansion bolts with lead anchors in brick or concrete, and machine screws on metal surfaces. Explosive fasteners may be used in steel and concrete in accordance with the manufacturer's recommendations. All fastenings and supports shall result in a permanent and rigid installation except where a flexible or swivel arrangement is specifically required. Wire, perforated metal strap, nails, and wooden plugs are not acceptable as fastening material.

GROUNDING SYSTEMS

8.08 GENERAL

This section shall include the system and equipment grounding, and the grounding grid where shown on the Plans. Grounding systems are intended to protect personnel and equipment from abnormal over-voltages and the effects of ground faults. Grounding grid conductors shall be placed as shown prior to the backfill of structures unless otherwise specified.

8.09 SYSTEM AND EQUIPMENT GROUNDING

All equipment enclosures, motor and transformer frames, neutral transformer taps, conduit systems, cable armor, exposed structural steel and similar items shall be grounded effectively and in strict accordance with the National Electric Code, except as modified herein.

Grounding conductors shall be bare copper conductors, not less than 4/0 AWG. They shall be embedded in backfill material around the structure.

Copper grounding conductors shall be provided for all transformer frames, neutral transformer taps, frames of electric motors 10 horsepower and larger, and for the grounding of conduit systems and exposed structural steel. Copper grounding conductors shall be included in all non-metallic conduits. The sizes of copper grounding conductors shall be as shown on the Plans. Where no size is shown, copper grounding conductors shall be as required by the NEC. Copper grounding conductors may be buried in the floor finish and require no conduit enclosure except where exposed to severe mechanical injury. Exposed connections shall be made by means of approved pressure clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint, Grade A or approved equal. All buried connections shall be made by a welding process equal to Cadweld.

All control circuits shall be grounded on the non-fused side of the control transformer, where used.

Where permitted under these Specifications, galvanized steel conduit may be used as the grounding conductor and shall conform to the requirements of the NEC.

Where grounding conductors pass through the foundation walls, there shall be provided copper bars 2" x 3/8" passing through and welded to 1/2' x 6" square steel plate waterstops. Steel plate shall be welded to a horizontal and vertical reinforcing bar.

The Contractor shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, bonding jumpers shall be installed.

8.10 GROUND GRID

The Contractor shall furnish and install a system of ground conductors and driven electrodes which hereinafter is called the grounding grid. The grid is intended to connect together the various grounding systems.

Grounding electrodes shall be copper-weld or equal rods of not less than 5/8-inch diameter and not less than 16 feet long, except as otherwise shown or specified. They shall be driven as shown.

The grounding grid conductors shall be bare tin-plated copper conductors, not less than 250 MCM; they shall be embedded in backfill material around the structures.

All underground conductors shall be laid slack and where exposed to mechanical injury shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard to prevent the inductive choke effect. Connections shall be made as specified in the preceding paragraph.

WIRES AND CABLES

8.11 GENERAL

This section shall include the wires and cables as shown, specified or required for the complete power, lighting, control and other systems of the work of the Contract. Except as hereinafter modified, the materials and construction of the wires and cables shall be in accordance with the following standards and specifications:

Tin and Lead Copper Conductors: ASTM B33 and B189, respectively.

Stranded Copper: Class B, ASTM B8.

Rubber Insulations: I.P.C.E.A. "General Specifications for Wire and Cable with Rubber and Rubber-like Insulations".

Thermoplastic Insulations of the Polyvinyl Type: ASTM D734.

Neoprene Jackets: Heavy Duty, ASTM D752.

Wires and cables shall be as manufactured by General Cable, Southwire, Okonite, Pirelli, Anaconda, or approved equal. As far as possible, all wires and cables of like type shall be the product of one manufacturer.

The Contractor shall submit to the Engineer, in accordance with the provisions of General Conditions, detailed layout drawings showing all wires and cables to be installed. Such drawings shall identify the equipment and routes to be followed. Samples of wires and cables shall be furnished at the request of the Engineer.

8.12 GENERAL WIRING

Unless otherwise shown or specified, all power lighting and control circuits shall have conductors with 600 volt insulation, enclosed in conduit. Conductors larger than Number 8 AWG shall be stranded.

Insulated conductors shall be legibly marked along their entire length indicating size and insulation type. Insulation shall be Type THW for conductors

No. 8 AWG and larger and Type TW for conductors smaller than No. 8 AWG, except that connections to lighting fixtures shall be Type TW, THW, THWN, or AF as required to marking on fixtures; and conductors run through continuous rows of fluorescent fixtures shall be Type THW-MTW or THWN.

Lighting branch circuits shall be wires with conductors not smaller than Number 12 AWG, except that where runs exceed 50 feet from the panelboard to the first outlet, or where ratings of branch circuit protective devices exceed 20 amp conductors not smaller than Number 10 AWG or of the size shown on the Plans shall be used.

Conductors smaller than Number 14 AWG shall not be used except for control and signal circuits and then only when specifically permitted by the Engineer in writing.

Color code shall be as follows:

	208Y/120 Volt	480Y/277 Volts
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

Switch legs shall be the same color as the circuit conductor. Phase sequence shall be A-B-C from left to right, top to bottom and rear to front. Services and feeders shall be color coded as above, using Scotch tape of proper colors at terminations of the larger conductors. Final connections to unbalanced loads shall be made so as to obtain a load balance in the feeder, modifying conductor colors where necessary, with Scotch tape at termination.

All control circuit conductors connected to identified terminal boards shall be coded with the number or letter and number designation, which shall be the same as the coding of the terminal boards. Coding shall be by means of self adhesive printing plastic tape.

All conductors shall be carefully handled to avoid kinks or damage to insulation. Lubricants shall not be used to assist in pulling conductors into conduits, unless approved for this purpose as non-damaging to insulation. No splicing or connections shall be made except in junction boxes. Splices and connections shall be made with approved lugs and connectors and insulation of the connected conductors.

8.13 CONTROL CABLES

At the option of the Contractor, multi-conductor control cables may be used where separate control circuits, having a number of conductors greater than three, are shown on the Plans. Such control cables shall have PVC insulation and sheath.

CONDUITS

8.14 GENERAL

This section shall include standard weight and heavy wall metallic conduit, and heavy wall non-metallic conduit, and the support systems for conduits. The Contractor shall submit shop drawings showing the proposed layout of all conduits to be installed in the work and the details or hangers, sleeves, and inserts therefore.

8.15 CONDUIT MATERIAL AND INSTALLATION

Standard weight rigid metal conduit shall be zinc coated steel with threaded couplings and fittings. Termination at sheet metal enclosures shall consist of double locknuts and insulating bushings. Rigid steel standard weight conduit shall be used for all exposed and concealed work except where other raceways are indicated, specified, or permitted.

Electrical metallic tubing shall be zinc coated steel of 1 inch maximum size. All fittings shall be of steel or malleable iron, U.L. approved for concrete tight construction. Connectors to sheet metal enclosures shall be the insulated throat type. Electrical metallic tubing may be used for concealed work in lieu of rigid metal conduit only for 120 volt branch circuits run above suspended ceilings or within interior partitions.

Flexible metal conduit shall be zinc coated steel of 1/2 inch minimum size of minimum length; and shall be used for connections to moving or vibrating apparatus, recessed lighting fixtures, dry-type transformers, and motors. Flexible metal conduit may be used where rigid connections are impractical due to obstructions or space limitations. Connectors shall be the insulated throat type. Flexible metal conduit used in damp or corrosive locations, or for motor connections, shall be PVC jacketed liquid-tight complete with liquid-tight connectors.

Rigid Polyvinyl chloride conduit, U.L. approved as non-metallic conduit for use above or below ground shall be used in lieu of steel conduit underground, in gravel or earth under a concrete slab on grade, and in exposed corrosive locations indicated on the drawings. An equipment grounding conductor of TW insulated copper shall be included in all runs of non-metallic conduit.

Underground conduits shall be installed a minimum of 2 feet below grade except installed in contact with earth to connect to non-metallic conduit shall be protected from corrosion by encasement in concrete with a minimum cover of 3 inches in all directions.

Conduits shall be of a quality as made by Allied, Triangle Conduit and Cable Company, or approved equal. Condulets, couplings, boxes, hangers and similar devices shall be hot-dipped galvanized or protected against corrosion by other approved means. Condulets shall be Crouse-Hinds cast ferrous or approved equal. Sufficient condulets shall be used to permit ready fishing and withdrawing the wires.

Except as otherwise shown and specified, all conduit work shall be installed exposed, runs shall be parallel to walls, beams, columns and horizontal planes and shall be neatly aligned. Elbows and offsets shall be used wherever possible. For bends made in the field, an approved conduit bending machine shall be used. Field bends shall be symmetrical and carefully made so as to prevent damage or deformation of conduit. Any conduit which has been crushed or deformed in any way shall not be installed. Routing of conduits shall be the shortest possible and compatible with good layout. The number of bends, offsets and crossovers shall be kept to a minimum. The Contractor shall exercise the necessary precautions to prevent lodgement of dirt or plaster in conduits, boxes and fittings during installation. A run of conduit which has become clogged shall be swabbed to remove all foreign matter or shall be replaced.

All conduit threads shall be given a coat of zinc dust in oil or other approved compound and shall be made up watertight.

Where practicable, conduit runs shall be slightly pitched to facilitate draining the condensate or shall be otherwise installed to prevent trapping of condensation. At low points in trapped conduits, except where buried below grade, Appleton Type EDC or equal drain valves shall be installed.

Pull boxes of an approved type shall be provided on conduit systems where shown and where required to assist in pulling wires or cables into conduits.

Conduit sizes shall be as shown on the Contract Drawings.

8.16 CONDUIT HANGERS, SLEEVES, AND INSERTS

Conduit supports shall be spaced at intervals of 8 feet or less, as required to obtain rigid construction.

Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw clamp backs, to raise conduits from the surface.

Multiple runs of conduits shall be supported to trapeze hangers with steel or aluminum horizontal members and threaded hanger rods. The rods shall be not less than 3/8 inches in diameter.

Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type or the continuous slot type shall be provided.

Hangers and supports for conduits shall be of an approved design and shall be adequate to support conduit systems with a factor of safety of at least 10. All steel parts of the conduit support systems shall be galvanized or cadmium plated. Conduit supports shall be as manufactured by Appleton, Kindorf, or approved equal. Perforated strap hangers will not be accepted.

Where conduits pass through the walls or floors of structures, they shall be installed in suitable sleeves. Sleeves installed in the outside walls of structures or elsewhere where water-tightness is required, shall be cast iron and shall be caulked at both ends. All other sleeves shall be galvanized steel pipe.

MOTOR CONTROL CENTERS

8.17 GENERAL

This section shall include standard prefabricated motor control and distribution assemblies, designed for operation at voltages not exceeding 600 volts.

All control centers furnished under one Contract shall be the product of one manufacturer. Control centers shall be in accordance with the applicable NEMA Standards, except as modified herein.

8.18 MECHANICAL CONSTRUCTION

Control centers shall consist of the required number of standard vertical sections, each 90 inches high and 20 inches deep, unless otherwise specified. Each vertical section shall comprise a rigid steel enclosure, fabricated from formed sheet steel of not less than 14 gauge thickness, adequately reinforced.

Control centers shall be furnished by the manufacturer as completely assembled units where transportation and installation requirements permit. Each assembly shipped as a unit shall be joined together with a pair of mounting channels at the bottom and with a lifting angle at the top. Each installed assembly shall be joined together to form a rigid, free standing structure. Overall length of each installed assembly shall not exceed the dimensions shown on the Plans.

Each vertical section shall be provided with horizontal bus and wire spaces, separate from each other. Bus and wire spaces shall line up with the similar spaces in adjacent sections. A vertical wire space with suitable wiring clamps shall extend the full height of each section and shall connect with the horizontal wire spaces. The horizontal wire spaces shall be located at top or bottom as required to suit the layout. of the connected conduits and cables. All wiring shall be accessible from the front.

Each individual control or distribution unit shall be contained in a separate compartment which shall be fully isolated from the adjacent sections and compartments by means of horizontal and vertical baffles. Each compartment shall be provided with a hinged door on the front and a door opening of sufficient size to permit removal intact, of the unit in the compartment. Units shall have guide rails for accurate horizontal and vertical alignment within the structure, to eliminate possibility of damage to busses or stabs.

All units except circuit breakers larger than 225 amperes and motor starters NEMA Size 4 and larger shall be of draw-out design, having all components mounted on a removable chassis, and stab-on pressure connectors to engage the vertical buses. Compartment doors shall be mechanically interlocked with the circuit breaker and disconnect switch mechanisms to prevent opening of the door when breakers or switches are in the closed position. Means of locking circuit breakers and switches in the "off" position shall be provided.

All sections shall have the same structural design with provisions for adding similar sections at either end. Units of similar size shall be interchangeable. Unless otherwise specified, motor control center enclosures shall be of NEMA Type I design indoors, NEMA Type 4X outdoors.

8.19 ELECTRICAL CONSTRUCTION

Except as otherwise indicated on the drawings, the main horizontal buses shall have the capacity of 600 amperes and shall be supported with insulating blocks to withstand mechanical stresses that can be set up by short circuit currents. Bus bars shall extend across all sections of the assembly with provisions for connections to similar bus bars in additional sections at both ends. Short circuit rating shall be as shown on the drawings.

A vertical bus having the capacity of 300 amperes shall extend the full height of each vertical sections. A ground bus shall be provided across the assembly. Neutral transformer taps and control circuits having individual control transformers shall be grounded.

The service entrance compartments shall be provided with lugs capable of accommodating the incoming service cable of a size shown on the Plans.

Electrical construction shall be of the NEMA Class and Type as shown on the Plans. Where no Class and Type are shown, motor control centers shall be furnished in Class I, Type "B" construction.

8.20 SHOP DRAWINGS

In addition to the descriptive material required to demonstrate detail compliance with the Plans and Specifications, shop drawings and data shall include the following for all NEMA Classes and Types of motor control centers:

- Elementary Control Diagrams
- Unit Wiring Diagrams
- Assembly Outline Drawings
- Summary Sheets

Where a control center assembly is shipped in more than one section, shop drawings shall clearly show all field interwiring required to maintain circuit continuity upon reassembly.

At the option of the manufacturer, the first submittal may include only the property identified elementary control diagrams, outline drawings, and summary sheets. Following approval of this material, a full submittal shall be prepared for final approval.

8.21 COMPONENTS

Control centers shall provide equipment of the type and capacity and trip ratings shown or otherwise specified. The arrangement of the equipment in the control center shown on the drawings is diagrammatic only and is shown for the purpose of indicating the service requirements at the control center.

Control center components shall meet the detail provisions of the applicable Technical Specification Sections.

8.22 IDENTIFICATION OF COMPONENTS

Control centers shall be provided with engraved nameplates on the door of each compartment.

Each compartment containing a motor controller, relay panel or similar equipment, shall have an approved elementary diagram pasted inside the compartment door. Other compartments shall have approved unit wiring diagrams pasted inside the door. Compartments containing panelboards shall have a circuit directory mounted inside the door. In addition, each compartment containing a motor controller shall have an overload heater selection table pasted inside the door.

All control components such as relays, timers, etc., shall be identified by means of durable tags or painted symbols which shall bear the same code letters or numbers which appear on the shop drawings as device identification code.

All terminal boards shall bear numbers which shall be the same as the wire numbers used on the shop drawings. All shop and field wires shall be tagged to show clearly the number designation of each end of each wire.

8.23 SHOP PAINTING

Control centers shall be given rust-resisting treatment by the manufacturer before the shop coats of paint are applied. Shop painting shall consist of a primer coat of paint followed by a finish coat of enamel.

At least one pint of tough-up enamel, matching the finish coat of the control center, shall be furnished with each assembly. Where the assembly exceeds 4 vertical sections, one quart of tough-up enamel shall be furnished.

8.24 INSTALLATION

Connections to external equipment and connections of the incoming services shall be as shown on the Contract Drawings. Any adjustment due to selected equipment shall be made to the shop drawings by the Owner's coordinator. After installation, performance shall be checked and any additional adjustments shall be made by the manufacturer's representative before placing control centers in service. The supplier shall include one day (8 hours) plus travel time and expense in his bid for his qualified representative to check this equipment and make any necessary adjustments.

CIRCUIT PROTECTIVE DEVICES

8.25 GENERAL

This section includes branch circuit protective devices intended for service at 600 volts or less.

8.26 MOLDED CASE CIRCUIT BREAKERS

The circuit breakers shall be of the air-break type and shall be designed for 240 or 460 volt service as applicable. They shall be provided with thermal time-limit tripping elements and with instantaneous magnetic tripping elements. Circuit breaker mechanism shall be so designed that an overload or a fault on any one pole shall trip all poles simultaneously. All poles shall be effectively isolated from one another. Circuit breaker handles shall be trip-free and shall be so interlocked with the door-latching mechanism that the door of the circuit breaker enclosure cannot be opened unless the circuit breaker therein contained is in the open position. Number of poles and trip ratings of circuit breakers shall be as shown or specified.

Where shown on the Plans, circuit breakers shall have interchangeable thermal and adjustable magnetic tripping elements; where furnished for separate mounting, circuit breakers shall be NEMA type enclosures as shown for each location.

All circuit breakers where included as part of panelboards shall have ratings of 20 amperes and interrupting rating of 10,000 amperes unless otherwise shown. Branch circuit breakers shall be General Electric or approved equal.

8.27 DISCONNECT SWITCHES

Disconnect switches shall be heavy duty, visible blade type, single throw, horsepower rated in accordance with NEMA Standards. Switches shall be General Electric Type HCI or approved equal with quick-make and quick-break mechanism.

Where required, or where furnished, as a part of combination motor starters, disconnect switches shall be provided with NEC dual-element fuses having the current ratings as shown or as specified for the motor horsepower shown, except that where connected to the main bus of control centers, disconnect switches shall be provided with current-limiting fuses.

Where required for the running protection of small motors which are not equipped with magnetic starters, disconnect means shall be manual starting switches with integral overload relays.

Disconnect switches installed outdoors shall have NEMA 3R or 4 enclosures.

MOTOR CONTROLLERS

8.28 GENERAL

This section shall include motor controllers for three-phase and single-phase induction motors operating at voltages not in excess of 600 volts.

8.29 MAGNETIC MOTOR CONTROLLERS

Controllers shall be of the combination type, consisting of a circuit protective device and a motor starter, assembled and wired into a self-contained unit.

Circuit Protective Devices shall be molded case circuit breakers or fusible disconnect switches, as shown on the Plans. In general, circuit breakers shall be provided where the motor full load current is 6 amperes or more and fusible switches shall be provided for motors having lower values of full load current

Motors starters shall be 3-pole, 60 cycle magnetic starters and shall be of NEMA size appropriate for the motor horsepower and voltage shown.

Unless otherwise specifically shown or specified, all motor starters shall be provided with:

The operating coil rated for 115 volts.

An overload relay in each of the three legs of the starter. Overload relays shall be so selected that their thermal characteristics shall parallel closely the motor thermal characteristics. Overload relays shall be hand reset.

Individual motor starters shall be provided with any or all of the following modifications required to perform the control requirements as shown or specified:

Single phase control transformers of ratings suitable for the VA burden of the control circuit as actually installed and with fused secondary rated 120 volts.

Pushbutton stations or selector switches with suitable legend plates.

Indicating lights and interchangeable covers.

Control circuit fuse where a separate control circuit is shown.

Extra electrical interlocks or special control relays.

Motor starter shall in each case be of a type suitable to perform the control function shown, and 6/921 be in accordance with one of the following:

Constant speed, full voltage, non-reversing starters shall be General Electric Type CR-28log or approved equal.

Constant speed, full voltage, reversing starters shall provide basic contactors for the forward and reverse speed. Mechanical and electrical interlocks shall be provided to preclude the possibility of both contactors being closed at the same time.

Constant speed, reduced voltage starters shall be of the closed transition, auto transformer type and shall include the required 3-pole and 5-pole contactors, auto transformers, timing relays and appurtenances. Starting circuit inrush shall not exceed the value shown on the Plans.

Multi-speed motor starters shall provide the basic contactors for each speed, suitably interlocked. Where shown, sequence compelling relays shall be provided which shall require the lowest speed pushbutton to be operated first, followed by each succeeding higher speed button until the top speed is reached. Other starter modification shall be as specified under "Magnetic Motor Controllers" above, except that separate overload relays for each speed shall be provided.

Overload relays shall be bimetallic, isothermic type, General Electric Type CR-2824 or approved equal. Starters for single phase motors shall be similar to 3-phase starters except that only one overload relay will be required.

8.30 MANUAL STARTING SWITCHES

Manual starting switches shall be provided for the control and protection of single phase motors where shown; they shall provide thermal overload protection including trip-free operation and a manual reset on overload. Overload relays shall be selected for the motor characteristics as actually installed, and shall be of melt-alloy type. Integral on-off toggle switches shall be provided. Manual starting switches shall be Square D Class 2510 or approved equal. Where single phase motors are provided with integral overload protectors, toggle switches will be acceptable in lieu of manual starting switches.

8.31 ENCLOSURES

Where included as a part of control centers, motor controllers shall be open type. Where mounted indoors, separately from control centers, motor controllers shall be in NEMA Type I enclosures unless otherwise shown or specified. Enclosures shall be rust-proofed and painted with the manufacturer's standard finish. Where mounted outdoors, motor controllers shall be in NEMA 3R or 4 enclosures.

LIGHTING AND DISTRIBUTION EQUIPMENT

8.32 GENERAL

This section shall include lighting transformers, panelboards, switches, receptacles, fixtures, and accessories required for a complete installation as shown and as specified.

8.33 LIGHTING TRANSFORMERS

Lighting transformers shall be two-winding, dry type, air cooled of KVA and voltage ratings as shown, designed for indoor service. Except where ratings are less than 3 KVA, two 5% FCBN taps shall be provided in the primary windings. Transformers shall be General Electric type QHT or approved equal.

8.34 PANEL BOARDS

Panelboards shall be furnished and installed as shown. In general, circuit schedules shall be as shown. Subject to the Engineer's approval, such schedules may be revised to obtain more convenient grouping or a better balance of the actual connected load.

Panelboards shall be 3-wire, 125/250 volts AC or 4-wire, 120/208 volts, AC circuit breaker type panelboards, as shown with solid neutral and lugs in the main, suitable for control and protection of lighting and small power circuits.

Panelboards shall have single or double pole branch circuit breakers as required. Branch circuit breakers shall be quick-made, quick-break, trip free, trip indicating with thermal-magnetic tripping elements and shall be rated 20 amperes unless other ratings are shown.

Boxes shall be provided with ample wiring space and with a single door having steel hinges, cylinder lock and a card holder on the inside of the door. Cards with a clear circuit identification shall be provided.

Outlets for lighting circuits shall be of the type required for the fixture or outlet shown. Surface mounted switch and convenience outlets shall be in Crouse-Hinds FS or FD Series condulets or other approved equivalent with sheet steel covers. Where weatherproof or vapor-tight work is specified or shown, suitable gasketed covers shall be provided for all outlets, and gasketed covers with hinged or threaded caps shall be provided for convenience outlets. When two or more switches and/or convenience outlets are located adjacently, they shall be installed in gang condulets with one cover plate.

The Contractor shall submit to the Engineer, manufacturer's illustrations and other data showing lighting fixtures which he proposes to use. The engineer will not approve any fixtures which do not provide distribution curves equivalent to those specified and which are, in the opinion of the Engineer, not as desirable architecturally as those specified.

Mounting height for fixtures shall be as shown. Where no mounting height is shown, fixtures shall be mounted so as to give the minimum of shading from pipes, beams, and other obstructions, but in no case less than approximately 7 feet, 6 inches above the finished floor. Where pendant type fixtures are required, they shall be suspended by means of 1/2 inch galvanized conduit stems and ball hangers from outlet boxes.

8.35 SWITCHES AND RECEPTACLES

Lighting switches shall be rated 20 amperes at 277 volts, toggle operated, plastic enclosed, single pole, double pole, or three way as shown. Switches shall be Hubbell Catalog Number 1201, 1202 and 1203 for single and double pole, and three way respectively.

Plug receptacles shall be of the two wire, three-pole type. They shall be suitable for use with a three-pole polarized plug having two parallel blades and shall have the third leg grounded to the conduit system. All plug receptacles shall be duplex, Hubbell Catalog Number 5262 or approved equal.

Cover plates shall be provided for all devices, including wall switches and wall receptacles. Cover plates shall be standard size with ivory color. Cover plates shall be Hubbell, Pass & Seymour, or Leviton. Cover plates for conduit boxes shall be galvanized steel with same dimensions as boxes.

8.36 FIXTURES

Lighting fixtures shall be provided as shown and lamps shall be placed in all fixtures. Incandescent lamps shall be frosted and equal to General Electric Type A or Type PS. Fluorescent lamps shall be as specified. The Contractor shall be responsible for all lamps broken or stolen up to the date of acceptance of the work. Lamp wattage shall be as shown.

The Contractor shall submit to the Engineer, manufacturer's Illustrations and other data showing lighting fixtures which he proposes to use. The engineer will not approve any fixtures which do not provide distribution curves equivalent to those specified and which are, in the opinion of the Engineer, not as desirable architecturally as those specified.

Mounting height for fixtures shall be as shown. Where no mounting height is shown, fixtures shall be mounted so as to give the minimum of shading from pipes, beams, and other obstructions, but in no case less than approximately 7 feet, 6 inches above the finished floor. Where pendant type fixtures are required, they shall be suspended by means of 1/2 inch galvanized conduit stems and ball hangers from outlet boxes.

CONTROL STATIONS

8.37 GENERAL

Control stations shall include the pushbuttons, selector switches, indicating lights and similar devices. Control stations shall be heavy duty oil-tight, General Electric CR 2940, Westinghouse Type OT2, Square D Class 99001 or approved equal, having the continuous contact rating of not less than 6 amps at 115 volts, 60 cycles.

8.38 PUSHBUTTONS

Unless otherwise shown or required, pushbuttons shall be of the momentary contact type. Number and arrangement of buttons and contacts shall be as shown or indicated by control requirements.

Stop lockout pushbuttons shall be provided for all motors located out of sight of the controller or at a distance in excess of 50 feet from the controller. Such pushbuttons shall be located within reach of the equipment which they control and shall be so connected that while in the engaged position, it shall not be possible to start the equipment from any other control station or any automatic device. Stop-lockout pushbuttons shall be equipped with locking bars, which shall maintain contacts in the open position and shall be designed to accommodate padlocks.

8.39 SELECTOR SWITCHES

Selector switches shall be control stations of the maintained contact type having the number of contacts and the arrangement of contact as shown.

8.40 INDICATING LIGHTS

Indicating lights installed in motor control centers, switchgear, meter and control panels and similar panel installations shall be of the push-to-test transformer type, General Electric Type UX 224 or approved equal. Indicating lights furnished as part of remotely mounted control stations shall be of the transformer type, General Electric Type UE 212 or approved equal.

Indicating lights shall be suitable for 115 volt, single phase, 60 cycle power supply. Color caps shall be provided for the lamps shown.

8.41 ENCLOSURES

Enclosures for the control stations shall be of the type appropriate for each location as specified under the Materials and Performance Section headed "Electrical, General". Where installed in motor control centers, panels, or other major control assemblies, the control stations may be of the open type, installed in suitable cutouts.

MISCELLANEOUS CONTROLS

8.42 GENERAL

Miscellaneous controls shall include electric indicating instruments, instrument transformers, elapsed time meters, automatic alternators and the control switches and appurtenances as shown or specified. Control switch contacts shall be rated not less than 5 amp at 115 volts, 60 cycles.

8.43 ELECTRIC INSTRUMENTS

Where shown, electric indicating instruments of the required type shall be provided. All instruments furnished shall be the product of one manufacturer, similar in size, performance and appearance. They shall be General Electric type AB-18 or approved equal, having an accuracy of 1% of full scale deflection.

Instruments and instrument transformer ratios shall be selected to provide a full load reading of approximately 75% of full scale deflection.

Instrument transformers shall be of the dry type, rated and insulated as shown or required. Current transformers shall be capable of carrying continuously the rated primary current without damage to the insulation. Terminals of instrument transformers shall be properly identified.

Three phase selector switches for instruments shall be provided where shown. Such switches shall be General Electric Type SB-1 or approved equal.

Westinghouse "Teleductors" or approved equal shall be provided where ammeters are shown at a remote location from the current transformers. Teleductors shall each consist of a two-winding toroidal transformer, a full wave bridge rectifier, and loading and calibrating resistors. Input current of 0-5 amperes AC shall produce outputs of 0-3 MA DC into a 10,000 ohm load. The indicating instruments shall be DC millimeters calibrated in AC amperes.

8.44 ELAPSED TIME METERS

Elapsed time meters shall be provided where shown on the Plans. The time meters shall have synchronous clock motor movements for service at 115 volts, 60 cycles, and 3-1/2 inch dials with 6 digits, calibrated in hours and tenths of an hour.

8.45 PRESSURE SWITCHES

Pressure switches shall be of the tilting mercury switch type with Bourdon tube power elements, having outside adjustments for both the "on" and "off" operating points.

Switch contacts shall be rated not less than 5 amperes at 115 volts, 60 cycles. Pressure switches shall be Mercoid Series D-20 or D-30 or approved equal having pressure ranges, enclosures, operating differentials, and contact arrangements as shown or specified.

8.46 LIMIT SWITCHES

Limit switches shall be provided where specified and where it is required to convert a mechanical motion into the control or an electric circuit. Contacts shall be silver-to-silver snap-acting where practicable and in all cases where the motion is slow. Limit switches shall be operated by levers, plungers or pushrods, depending on the application. Rollers shall be provided where excessive wear due to a sliding action would result. Limit switches shall be General Electric Class CR 9440 or approved equal. Enclosures shall be as specified for each location.

8.47 CONTROL RELAYS

Control relays shall be of the heavy duty, 600 volt, machine-tool type, designed for rapid cycling duty or for continuous operation.

Number and arrangement of contacts shall be as shown on the Plans; all contacts shall be rated not less than 10 amperes at 115 volts, 60 cycles. Unless otherwise shown, relay coils shall be for operation at 115 volts, 60 cycles plus or minus 10%.

Control relays shall be of a type shown in accordance with the following:

General Purpose Relays (CR) shall have contacts convertible in the field from normally open to normally closed and vice versa, without additional parts. Relay armatures shall be operable manually without power for testing.

Pneumatic Timing Relays (TR) shall have the timing range of up to 3 minutes and repetitive accuracy of plus or minus 20%. Timing mechanism shall be convertible in the field from on-delay to of delay and vice versa without additional parts. Instantaneous contacts shall be furnished as required.

Design of pneumatic timing relays shall be such that relays shall be operable manually without power for testing.

Motor Driven Timing Relays (MTR) shall be driven by synchronous motors and shall provide a calibrated dial adjustment of time setting, as well as an indication of the unexpired time during the entire time cycle. Each relay shall consist of the motor, clutch and appurtenances and shall provide one normally open and one normally closed time contact with a common wire (SPDT). At least one normally open instantaneous contact shall also be provided. Timing ranges shall be as shown.

SECTION NO. 9

REMOVAL AND REPLACEMENT OF PAVEMENT

9.01 DESCRIPTION

This item shall govern for the removal, salvaging, disposal of excess materials and replacement of base and surface paving removed in connection with the construction pipe lines and appurtenances.

9.02 TYPES OF PAVEMENT AND SIDEWALKS

There are several types of pavement and sidewalks which are cut and replaced; Asphalt Pavement, Concrete Pavement and Concrete Sidewalks.

9.03 CONSTRUCTION METHODS

- A. Asphalt Pavement – Class “A”:** Where the installation of pipe involves the cutting of a street or driveway, such cutting shall be within the limits shown on the detailed drawings. All cutting of streets or driveways shall be done by a pavement saw. Backfill shall be thoroughly compacted prior to concrete placement. Concrete shall be eight inch (8”) Class “A” Portland Cement concrete with twelve inch (12”) minimum support on undisturbed earth. Asphalt topping shall then be applied. The asphalt paving shall be two inch (2”) Type “F” and shall be equal or better than the original pavement. Asphalt patches shall be thoroughly rolled or tamped with a mechanical roller or tamper. Rolling of patches with truck tires will not be permitted.
- B. Concrete Pavement:** Concrete pavement shall be eight inches (8”) on all roads and driveways and four inches (4”) on all sidewalks. All cutting concrete pavement shall be done by a pavement saw. Backfill shall be thoroughly compacted and all broken concrete disposed of by the Contractor. Where the installation of pipe involves the cutting of concrete curb and gutter, the material removed shall be disposed of properly and the section replaced shall be equal to or better than that which was removed. Concrete shall have a minimum compressive strength of 3,000 psi in 28 days.

SECTION NO. 10

WATER AND SANITARY SEWER TAPPING GUIDELINES

10.01 BACKFLOW PREVENTION

- A. Backflow Prevention Devices:** Effective January 5, 1999 the City of Perry began implementing a *Backflow Prevention Program* as required by the *Clean Water Act* passed by the Georgia Legislature. This law requires the installation of backflow prevention devices on all connections to the City of Perry Water System. As mandated, the **City of Perry will install** and maintain backchecks (equal to a Watts No. 7-10-U-2) on all new 1" services immediately past the water meter. **The customer shall install** and maintain all other backflow prevention devices which include isolation valves on the inlet and outlet of the device. All costs associated with the installation shall be the responsibility of the customer.

In those instances where it is determined by the City of Perry Utilities Director that a reduced pressure zone (RPZ) type backflow preventer is required, the customer shall be responsible for installation and maintenance. This applies to all sizes of water taps.

Customers planning backflow prevention installations greater than 1" shall meet with the City of Perry Utilities to discuss the proper design and installation of the backflow preventer assembly before work can begin.

Customers shall contact the City of Perry Utilities Director to inspect the installation of the backflow prevention device before water service can be activated. *If the assembly does not meet required specifications, water usage cannot begin.*

- B. Thermal Expansion:** As mandated by Section 613.2 of the *State of Georgia Plumbing Code (1994 Standard Plumbing Code)*, a thermal expansion control device is required in addition to the backflow device due to the system now being a closed system. **The customer is responsible for installation and maintenance of the thermal expansion device.** The logical location for this device is at the water heater.

Failure to install the required thermal expansion device will result in denial of permanent power and delay in issuing a Certificate of Occupancy to the location. Any questions you have regarding the City of Perry Backflow Program should be directed to the Utilities Director at 478-988-2732.

10.02 CUSTOMER WATER SERVICE VALVE

In accordance with the *City of Perry Water and Sewer Specifications* all water service lines up to 1" in size must have an **American made bronze gate valve** installed immediately past the backflow preventer on the customer's side. **The City is responsible for installation and maintenance of the gate valve installed in a standard plastic valve box.** This valve will serve as the customer's water service isolation valve as required by Section 610.1 of the aforementioned code. The valve and all piping downstream of the backflow preventer shall become the property of the customer. The customer will be responsible for maintenance of these materials. *Water Service will not be established until the gate valve and valve box have been permanently installed as outlined above.*

10.03 WATER METERS

The City of Perry will be responsible for all water meter installations in sizes from 1" to 2". The customer shall be responsible for the installation of all water meters above 2". All costs associated with the installation shall be the responsibility of the customer.

Customers planning water meter installations greater than 2" shall meet with the City of Perry Utilities Director to discuss the proper design and installation of the meter assembly before work can begin. **The City of Perry will provide the water meter and strainer only on these installations.**

The customer shall use an experienced contractor to make any water tap. The tapping contractor shall provide evidence of his competency to perform the work and have pre-approval from the City of Perry Utilities Director before any tap on a City main can begin.

The customer shall provide 24 hours advance notice to the City of Perry Utilities Director prior to any installation. A City of Perry representative shall inspect all materials and tapping equipment prior to commencement of work to verify compliance with specifications and be present during the installation procedure.

The City of Perry periodically contracts with a certified testing company to test all water meters 2" and larger for accuracy. The water supply is turned off for a period of thirty (30) minutes or more to test and/or repair the meters. **If in the opinion of the Utilities Director this procedure will create a hardship for the customer, a locking by pass of adequate size shall be required.**

Inspection of the complete water meter assembly and pit by the City of Perry Utilities Director is required before water service can be activated. *If the assembly does not meet specifications, water usage cannot begin.*

In accordance with City of Perry Specifications, the customer is responsible for the repair of all pavement cuts.

10.04 OWNERSHIP OF FACILITIES

A. ¾” to 1” Installations:

The **City of Perry owns** all material and equipment from the water main up to and including the backflow preventer. **The customer owns** all material on the customer’s side of the backflow preventer. Testing and maintenance is the responsibility of the **respective owner**. In the event an RPZ is required, **the customer shall own** the RPZ and be responsible for testing and maintenance. **The customer also owns** all piping on the customer’s side of the RPZ.

B. 1 ½” and Larger Installations:

The **City of Perry owns** all material and equipment from the water main up to the outlet side of the water meter including the meter box. **The customer owns** all material and equipment on the customer’s side of the water meter including the backflow preventer and backflow preventer vault/cabinet. Testing and maintenance is the responsibility of the **respective owner**.

10.05 SANITARY SEWER TAPS

The City of Perry is responsible for sanitary sewer connections to City sewer mains involving **single family residences only**.

The customer is responsible for sanitary sewer connections to City sewer mains involving **commercial sewer connections**. All costs associated with the connection shall be the responsibility of the customer.

Customers planning commercial sewer connections shall meet with the City of Perry Utilities Director to discuss the proper design and installation of the connection before work can begin.

The customer shall use an experienced contractor to make any sewer tap. The tapping contractor shall provide evidence of his competency to perform the work and have pre-approval from the City of Perry Utilities Director before any tap on a City main can begin.

The customer shall provide 24 hours advance notice to the City of Perry Utilities Director prior to any installation. A City of Perry representative shall inspect all materials and tapping equipment prior to commencement of work to verify compliance with specifications and be present during the installation procedure.

All sewer connections into existing manholes must be made by **core drilling** the wall of the manhole and installing the appropriate neoprene boot.

In accordance with City of Perry Specifications, the customer is responsible for the repair of all pavement cuts.

A Certificate of Occupancy for any residential or commercial location will not be issued until all work associated with the sewer connection is completed.

In all references above, the word “customer” shall refer to the owner, contractor, developer or other responsible party associated with the project requesting utility services from the City of Perry.

SECTION NO. 11

FENCING

11.01 GENERAL

The work under this Section of the Specifications covers chain link type fencing, complete in place, as shown on the drawings and hereinafter specified.

11.02 FENCE STRUCTURE

Corner and swing gate posts shall be hot-dip galvanized, basic open hearth copper bearing steel pipe 3 inches O.D., weighing not less than 5.79 pounds per foot. Posts shall be set full 3 feet in concrete footings, crowned to shed water. Tops of posts shall be fitted with galvanized malleable iron fittings designed to exclude water from the post interior.

Line posts shall not be less than 2-1/4" O.D. standard pipe or 2 1/4" x 1.78" H-beams of high carbon steel, hot galvanized. Posts shall be spaced not more than 10 feet apart and be a full 3 feet in bell shaped concrete footings, crowned at the top to shed water. Concrete for footings shall be as specified under Section 3. Line post tops shall be heavy malleable iron, designed to fit over the post top and shall include provisions for accommodating a top rail or wire.

- (A) Top rail: Fence top rail shall be 1-5/8" O.C. standard steel pipe, hot galvanized and shall be furnished in lengths not less than 18 feet, except where shorter lengths are necessary. Lengths of pipe shall be joined, using extra long, hot galvanized pressed steel sleeves.
- (B) Coil tension wire: A number 7 gauge coiled spring tension wire having a zinc coating of 1.6 oz. of zinc per square foot of surface area shall be provided along bottom of fence. Fabric shall be fastened to tension wire at intervals of 2'0" with pig rings.

11.03 BRACING AND TENSIONING

To prevent climbing, bands shall be beveled edge type, secured with 3/8" diameter, square shouldered aluminum carriage bolts, non-removable from outside of fence enclosure. Bracing: All terminal posts shall be braced by means of 1-5/8" O.D. horizontal compressive member, securely attached to terminal and first line posts with malleable iron fittings and bevel edge bands, truss braced from first line post to bottom of terminal with 3/8" diameter rod and turnbuckle. Corner posts shall be braced in each direction.

Tension bars for attaching fence fabric to terminal posts shall be 1/4" x 3/4", high carbon steel, and shall be attached to terminal posts by means of beveled edge bands.

Barbed wire extension arms: Intermediate and corner posts shall be equipped with extension arms for the support of barbed wire. The arm base shall be malleable iron and the extension shall be pressed steel, the complete units being hot galvanized after fabrication. Intermediate post arms shall have provision for accommodating the top rail and the corner post arms shall have a set screw. Ants shall slope to the outside at a 45-degree angle.

11.04 FABRIC

Fencing fabric shall consist of individual wire pickets, helically wound, and interwoven from No. 11W&M gauge copper bearing steel wire to form a continuous chain link fabric in 2" mesh. Top and bottom edges of fabric shall have a twisted and barbed finish and fabric shall be 6 feet in height between top and bottom edges, exclusive of barbed wire brackets. Fabric shall comply with ASTM A239.

- (A) Finish: Fabric shall be hot dip galvanized after weaving and the zinc coating shall not be less than Class I, ASX A392. The coating shall withstand six one-minute dips by the Preece Test, ASTM A239.
- (B) Tensile Strength: The wire in the completed fabric, after galvanizing, shall have a tensile strength of not less than 80,000 pounds per square inch.
- (C) Fabric Ties: Fabric shall be attached to line posts and top rail with aluminum strip or wire of an approved gauge or design, at intervals of not more than 14 inches on line posts, and 24 inches on top rails.
- (D) Barbed wire: Barbed wire shall be of 2 strands of galvanized No. 12 gauge wire conforming to ASTM A121 for copper bearing wire with zinc coating, Class 3. Barbs shall be of 14 gauge full round wire with 4 points, wound at 4" intervals.

11.05 GATES

Swing gate frames shall be minimum 2 inches, O.D. standard weight steel pipe with interval bracing of 1-5/8" O.D. standard weight steel pipe. Frame members shall be welded at all joints to insure a watertight construction.

Fabric for gates shall be as specified for line fence.

Hinges shall be standard offset type which will allow gates to swing back parallel with line fence. Hinge material shall be malleable iron or steel forgings.

Double latches shall be drop-bar type, securely bolted to gate frames and designed to engage heavy malleable iron gate stops anchored in concrete footings.

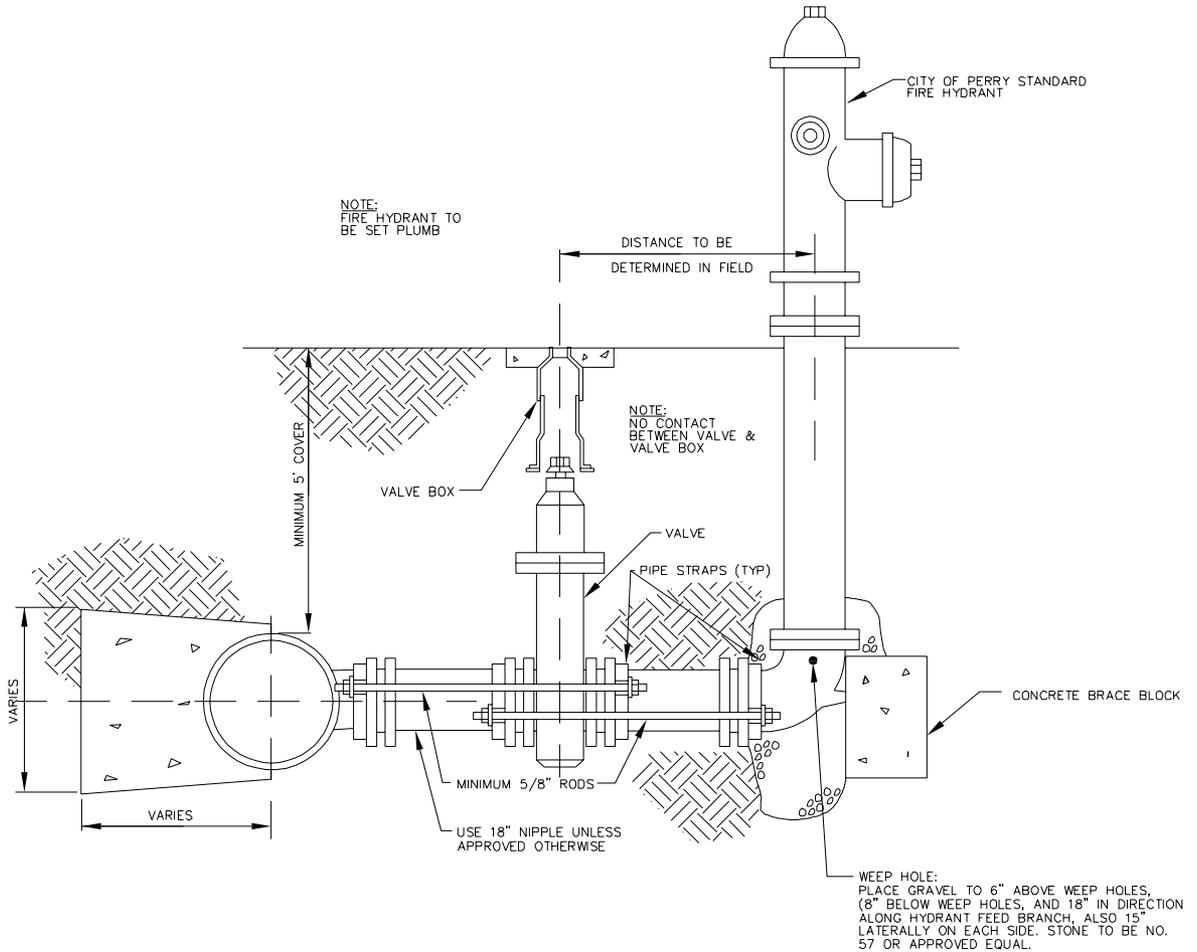
Single latches for gate frames up to and including 10 feet wide, shall be malleable iron, gravity type, designed to automatically engage in pin welded to the gate frame and to be secured with an approved type padlock.

Gate Keepers: Gate shall be equipped with a gate keeper designed to engage with the gates when opened wide to secure them in this position.

Each gate shall be furnished with a Yale and Town stainless steel cylinder padlock with two keys per lock and all locks keyed alike.

11.06 MISCELLANEOUS FITTINGS

All fence fittings as above or other wise necessary for complete installation shall be malleable iron, pressed steel, aluminum or forgings. All miscellaneous ferrous metals used in the work shall be hot-dip galvanized.



GENERAL NOTES:
 RODS TO BE HIGH TENSILE, HOT ROLLED STEEL WITH TENSILE STRENGTH OF 150,000 PSI AND A MINIMUM YIELD STRENGTH OF 130,000 PSI. RODS SHALL BE 5/8" MINIMUM. PIPE STRAPS SHALL BE FABRICATED FROM 5/8" X 2-1/2" FLAT IRON AND STANDARD PER GRINNEL OR APPROVED EQUAL.
 ALL HYDRANT AND HYDRANT VALVES AND HYDRANT TEES SHALL BE BOTH RODDED AND RESTRAINED BY CONCRETE BLOCKS.
 ALL RODS, BOLTS, AND OTHER METAL SURFACES SHALL BE COATED AFTER INSTALLATION WITH KOPPERS CO. BITUMASTIC SUPERBLACK OR APPROVED EQUAL.

FIRE HYDRANT DETAILS

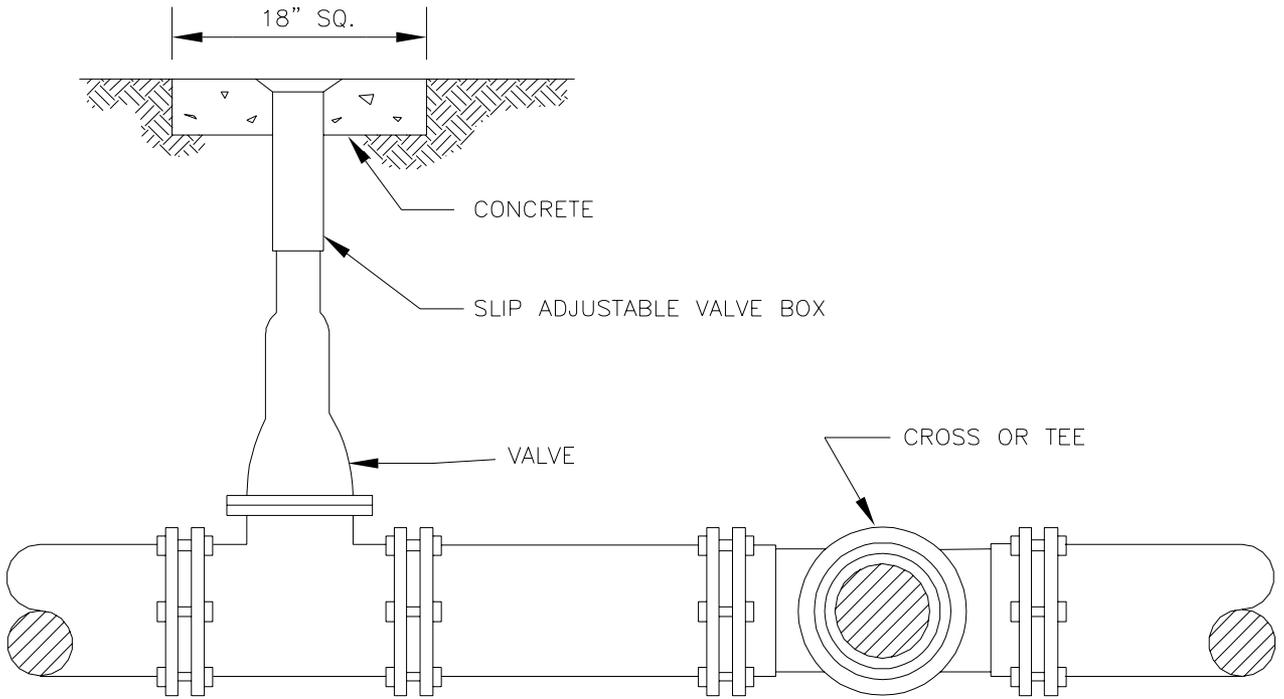
N.T.S.



Date: 09/09/04

CITY OF PERRY, GEORGIA
 UTILITY CONSTRUCTION DETAILS

FIRE HYDRANT DETAIL



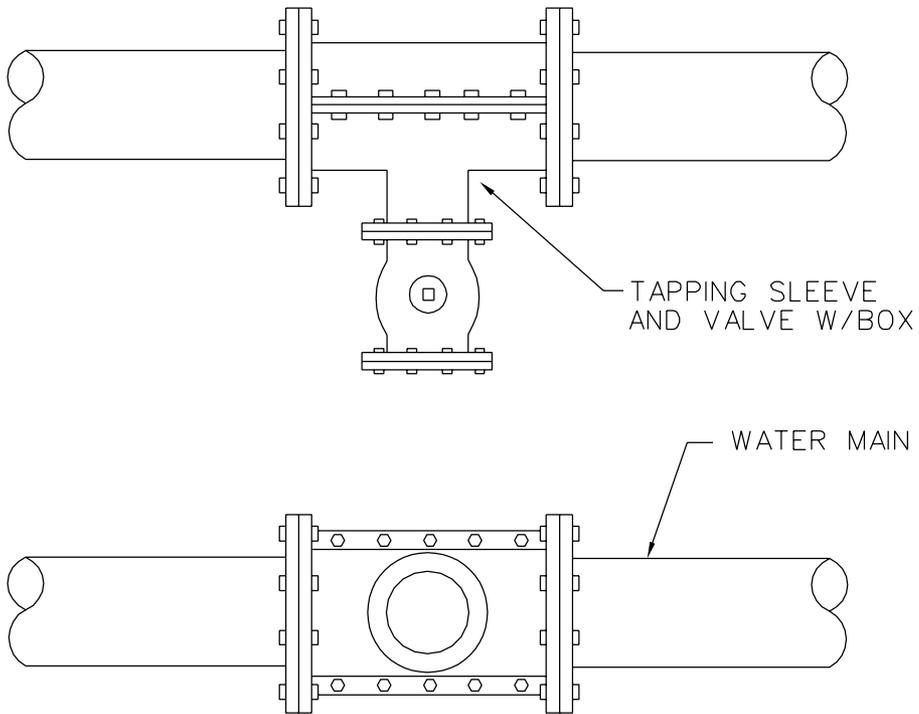
DETAIL – VALVE SETTING (TYPICAL)
N.T.S.



Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

WATER VALVE DETAIL



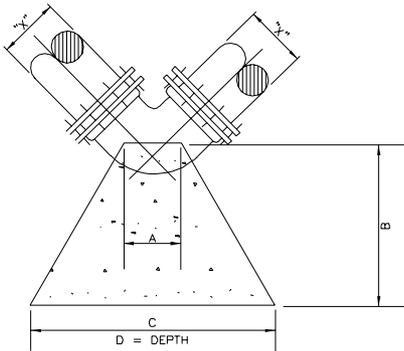
DETAIL - TAPPING SLEEVE AND VALVE W/BOX
N.T.S.



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CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

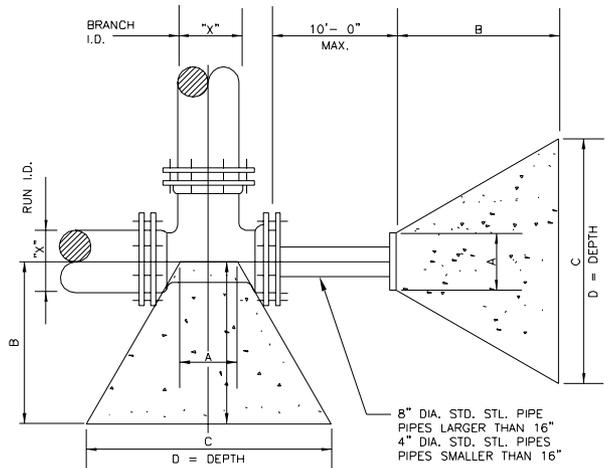
TAPPING SLEEVE DETAIL



BLOCKING DIMENSIONS

	BENDS				TEES & DEAD ENDS				
	X	A	B	C	X	A	B	C	D
30° BEND	2'-0"	11'-6"	15'-3"	6'-0"	30"	3'-0"	8'-9"	13'-0"	5'-0"
24° BEND	2'-0"	7'-9"	10'-9"	5'-6"	24"	2'-6"	7'-3"	10'-8"	3'-9"
20° BEND	1'-9"	6'-0"	8'-6"	5'-0"	20"	2'-0"	5'-3"	8'-0"	3'-6"
16° BEND	1'-3"	4'-0"	6'-0"	4'-6"	16"	1'-0"	4'-8"	6'-4"	3'-0"
12° BEND	10"	2'-9"	4'-0"	4'-0"	12"	10"	2'-9"	4'-6"	2'-6"
10° BEND	10"	2'-6"	3'-9"	3'-0"	10"	10"	2'-0"	3'-3"	2'-6"
30° BEND	1'-6"	7'-6"	10'-0"	5'-0"	8"	8"	1'-9"	2'-6"	2'-0"
24° BEND	1'-3"	5'-9"	8'-0"	4'-0"	6"	6"	1'-3"	2'-0"	1'-6"
20° BEND	1'-0"	4'-9"	6'-8"	3'-6"					
16° BEND	1'-3"	3'-3"	5'-0"	3'-3"					
12° BEND	10"	1'-9"	3'-0"	2'-9"					
10° BEND	10"	1'-9"	3'-0"	2'-0"					
30° BEND	1'-0"	4'-8"	6'-4"	4'-0"					
24° BEND	1'-0"	3'-0"	5'-0"	3'-6"					
20° BEND	1'-0"	2'-6"	4'-4"	3'-0"					
16° BEND	1'-0"	1'-9"	3'-0"	2'-6"					
12° BEND	10"	1'-3"	2'-3"	2'-0"					
10° BEND	10"	1'-0"	2'-0"	1'-6"					
30° BEND	1'-0"	2'-10"	4'-3"	3'-0"					
24° BEND	1'-0"	2'-6"	3'-8"	2'-6"					
20° BEND	10"	2'-0"	3'-0"	2'-0"					
16° BEND	0'-8"	1'-8"	2'-6"	1'-6"					
12° BEND	10"	1'-0"	1'-6"	1'-6"					
10° BEND	10"	1'-0"	1'-6"	1'-0"					

NOTE: 200 P.S.I. TEST PRESSURE
SOIL BEARING OF 2500 P.S.F.
2500 P.S.I. CONCRETE



8" DIA. STD. STL. PIPE
PIPES LARGER THAN 16"
4" DIA. STD. STL. PIPES
PIPES SMALLER THAN 16"

THRUST BLOCK DETAIL

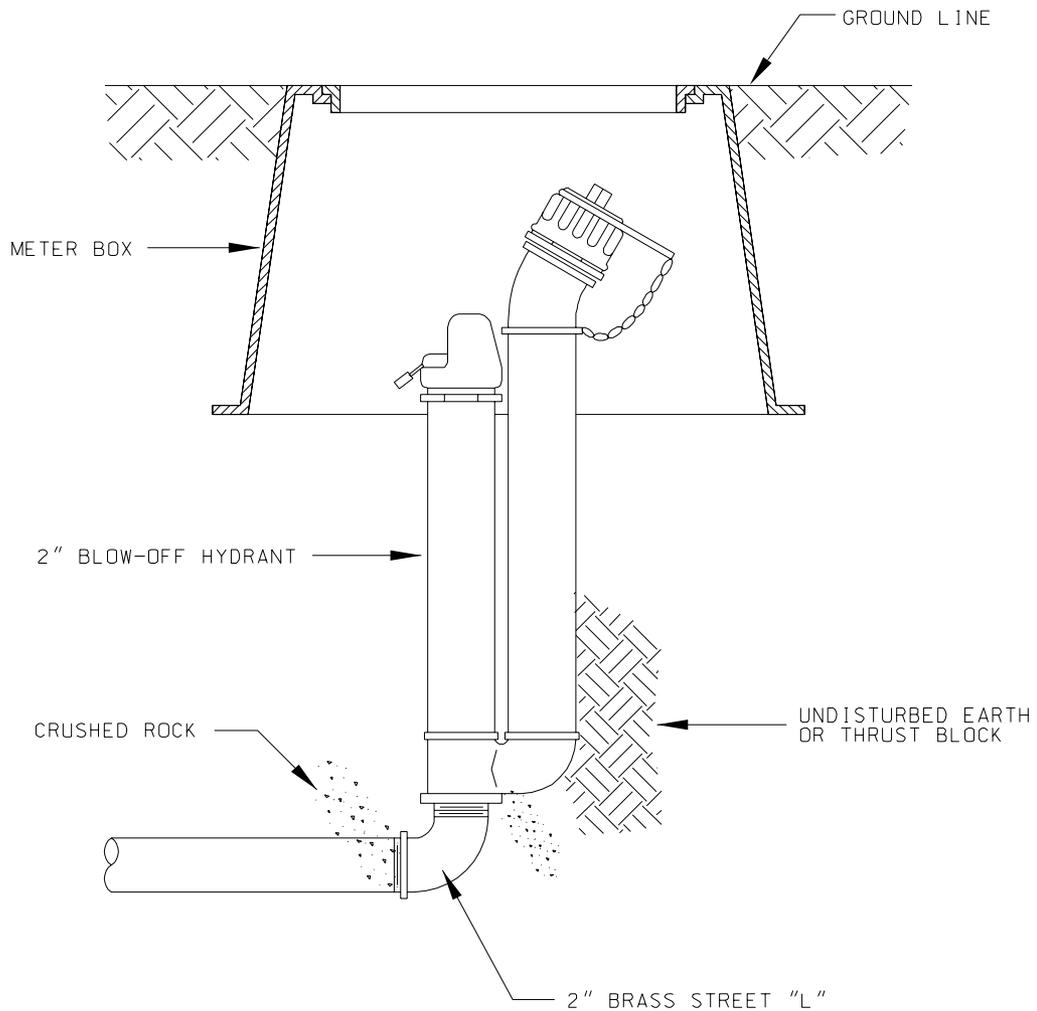
N.T.S.



Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

THRUST BLOCK DETAIL



BLOW-OFF HYDRANT DETAIL

N. T. S.

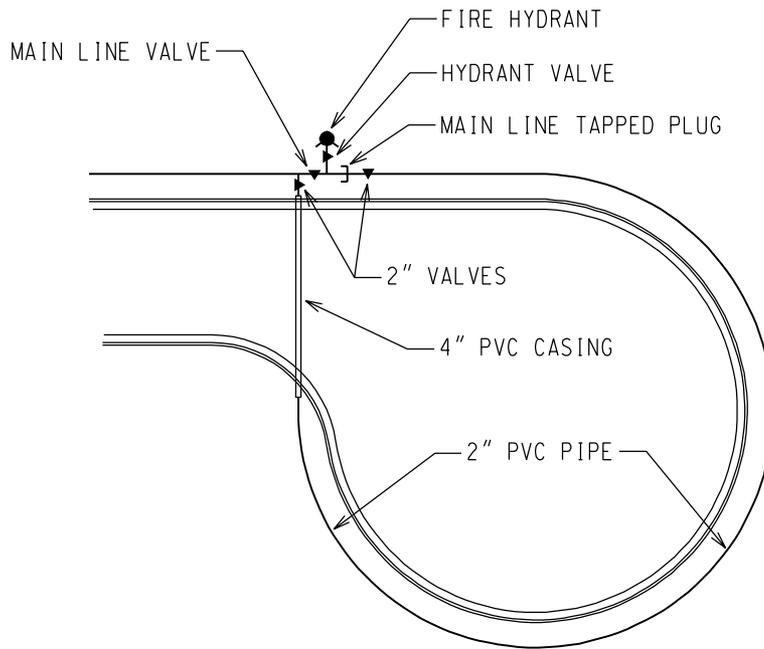


Date:

09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

BLOW-OFF HYDRANT DETAIL



NOTES:

1. ALL 2" GATE VALVES SHALL BE WHEEL OPERATED, MANUFACTURED OF BRASS AND MADE IN AMERICA.
2. TWO INCH DOUBLE STRAP TAPPING SADDLES SHALL BE USED WHEN TAPPING THE 2" LINE

CUL-DE-SAC WATER LINE DETAIL

N.T.S.

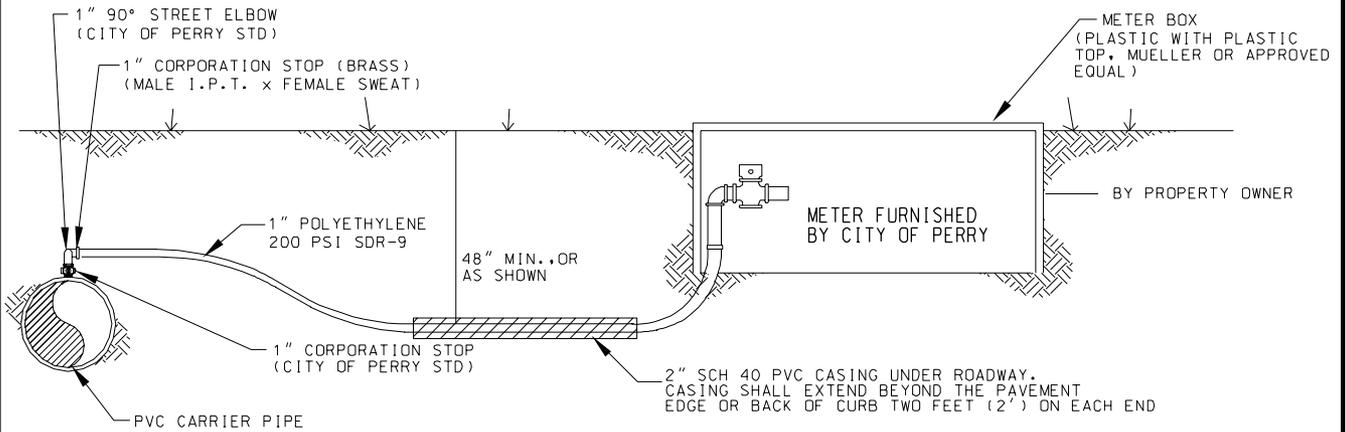


Date:

09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

CUL-DE-SAC
WATERLINE DETAIL



DETAIL - STANDARD SERVICE CONNECTION

N.T.S.

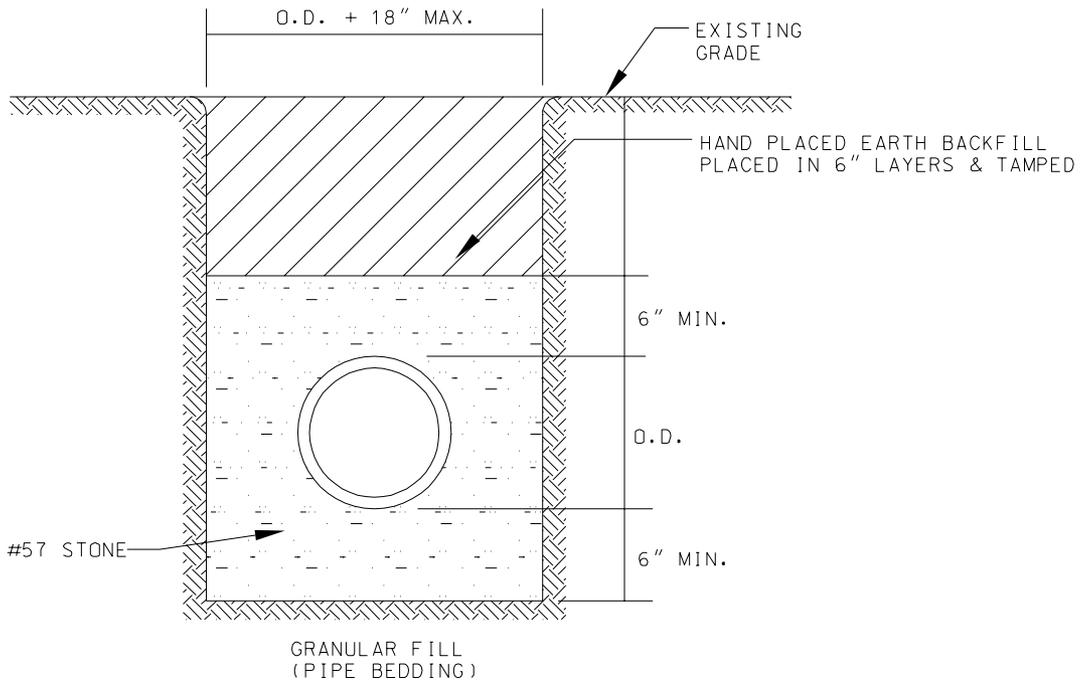


Date:

09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

WATER SERVICE
CONNECTION DETAIL



P.V.C. SANITARY SEWER
BEDDING DETAIL

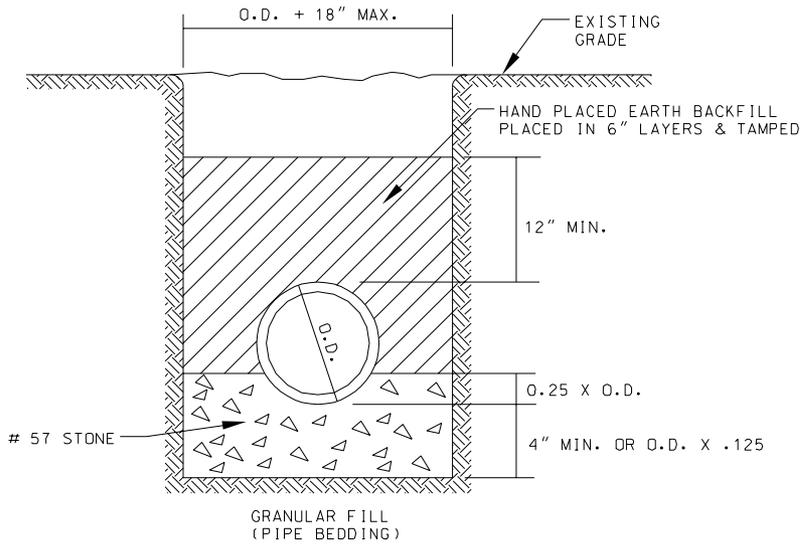
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Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

PVC BEDDING DETAIL



DUCTILE IRON SANITARY SEWER
BEDDING DETAIL

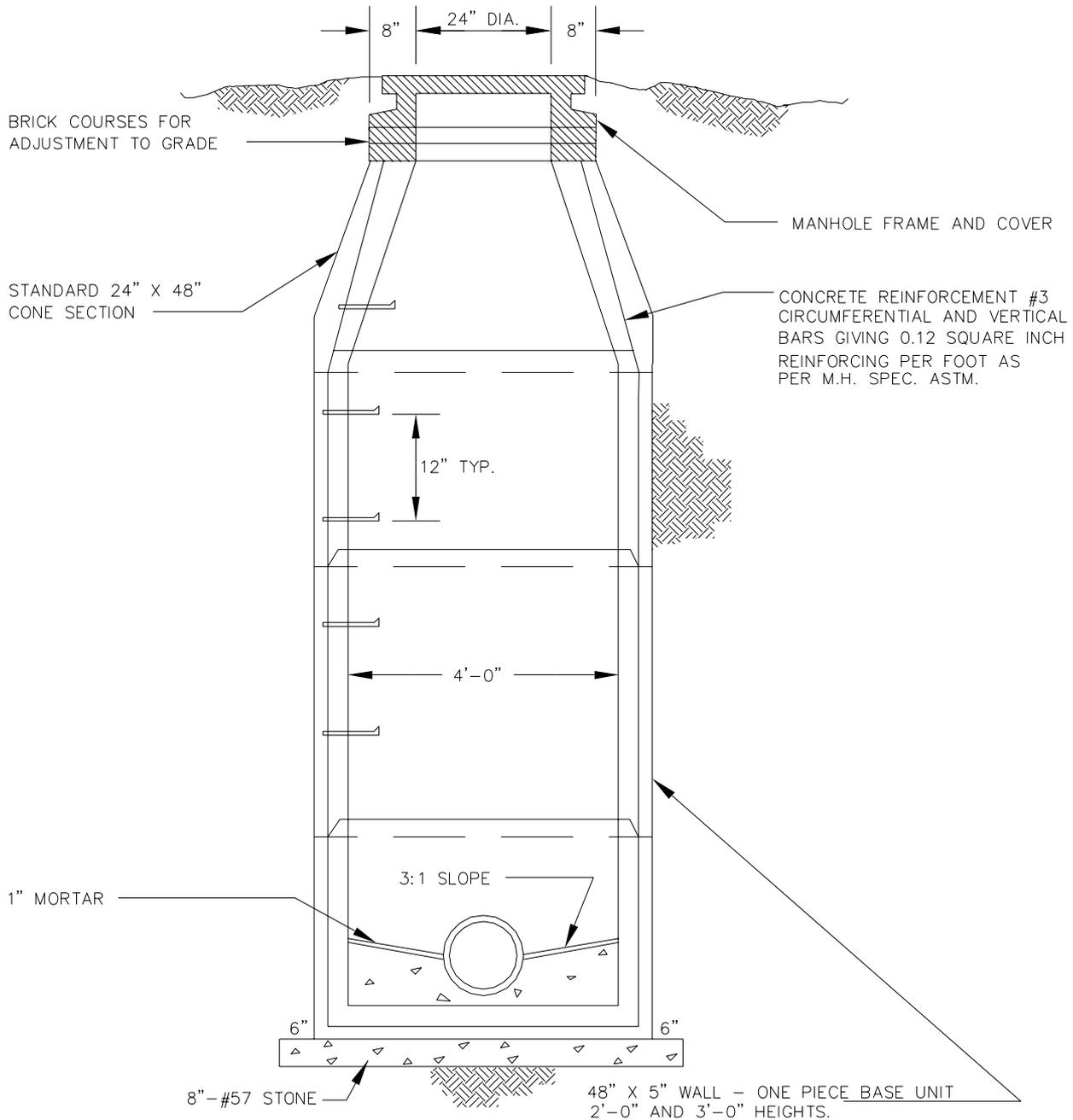
N.T.S.



Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

DUCTILE IRON
BEDDING DETAIL



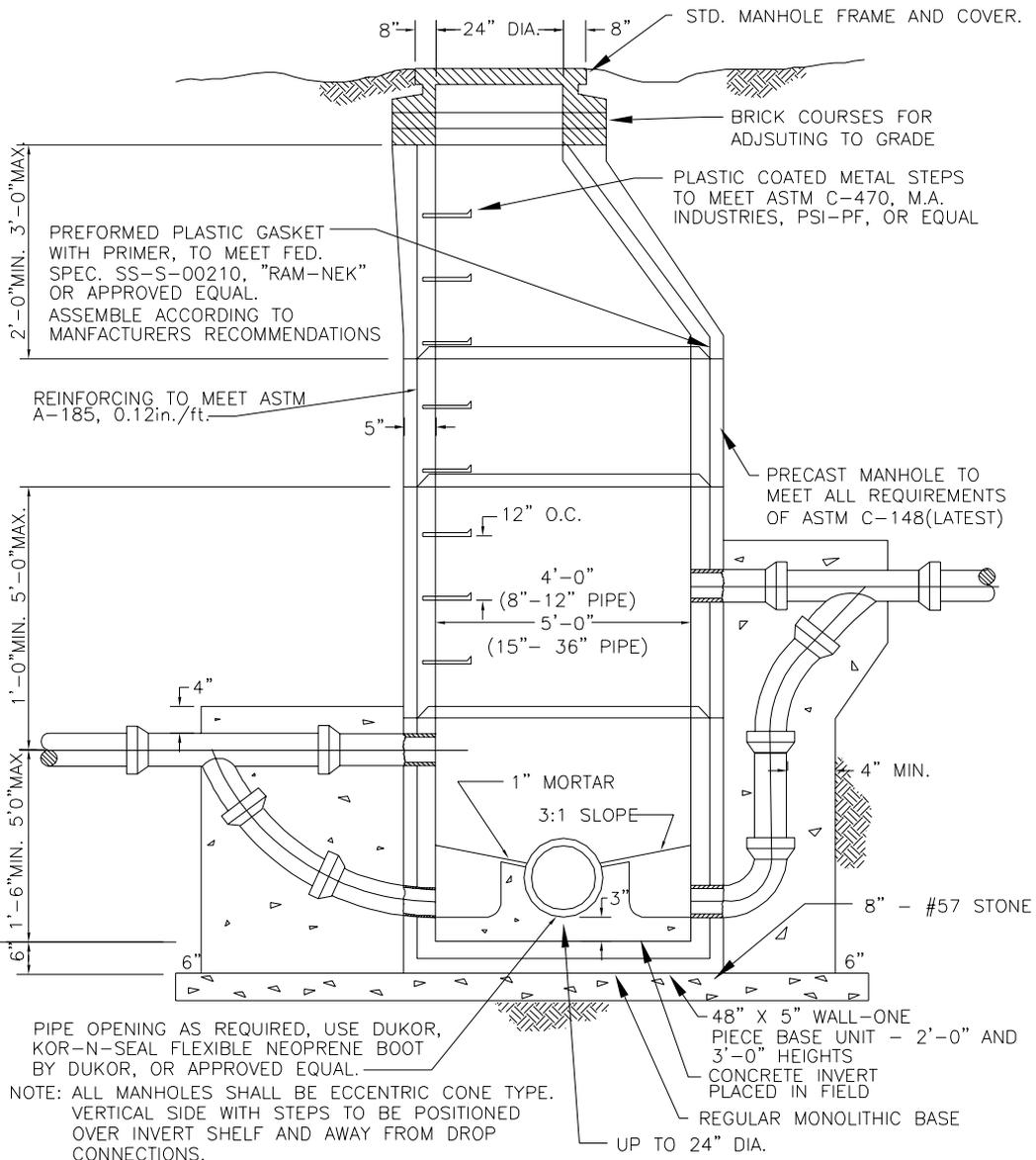
DETAIL – PRECAST CONCRETE MANHOLE
N.T.S.



Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

MANHOLE DETAIL



DETAIL - PRECAST DROP MANHOLE

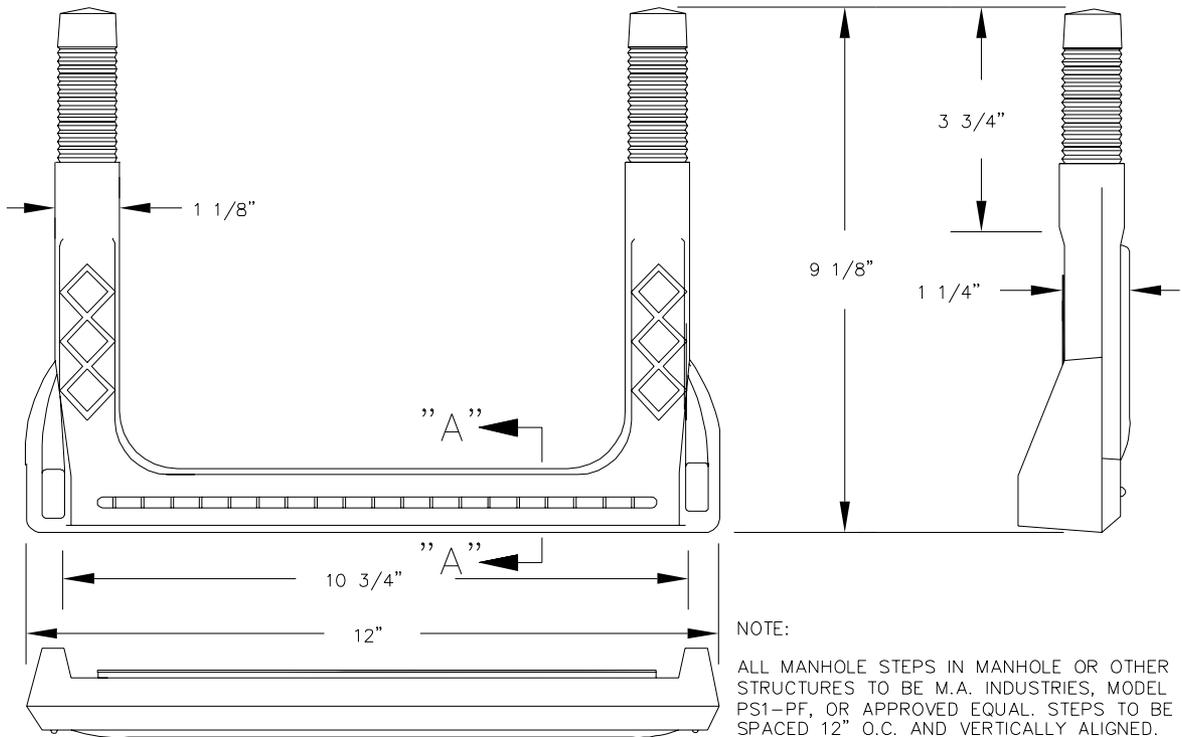
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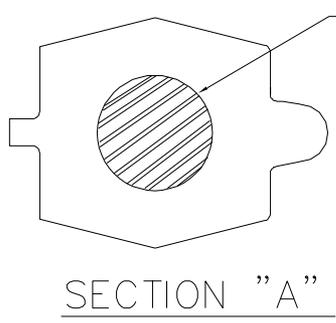
Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

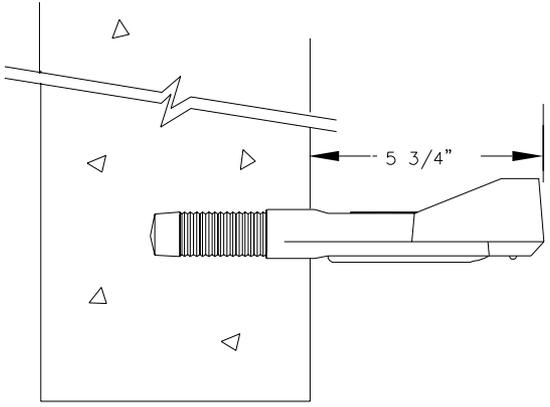
DROP MANHOLE DETAIL



NOTE:
 ALL MANHOLE STEPS IN MANHOLE OR OTHER STRUCTURES TO BE M.A. INDUSTRIES, MODEL PS1-PF, OR APPROVED EQUAL. STEPS TO BE SPACED 12" O.C. AND VERTICALLY ALIGNED.



1/2" G.R. 60 STEEL REINFORCEMENT



DETAIL - PVC MANHOLE STEPS
 N.T.S.

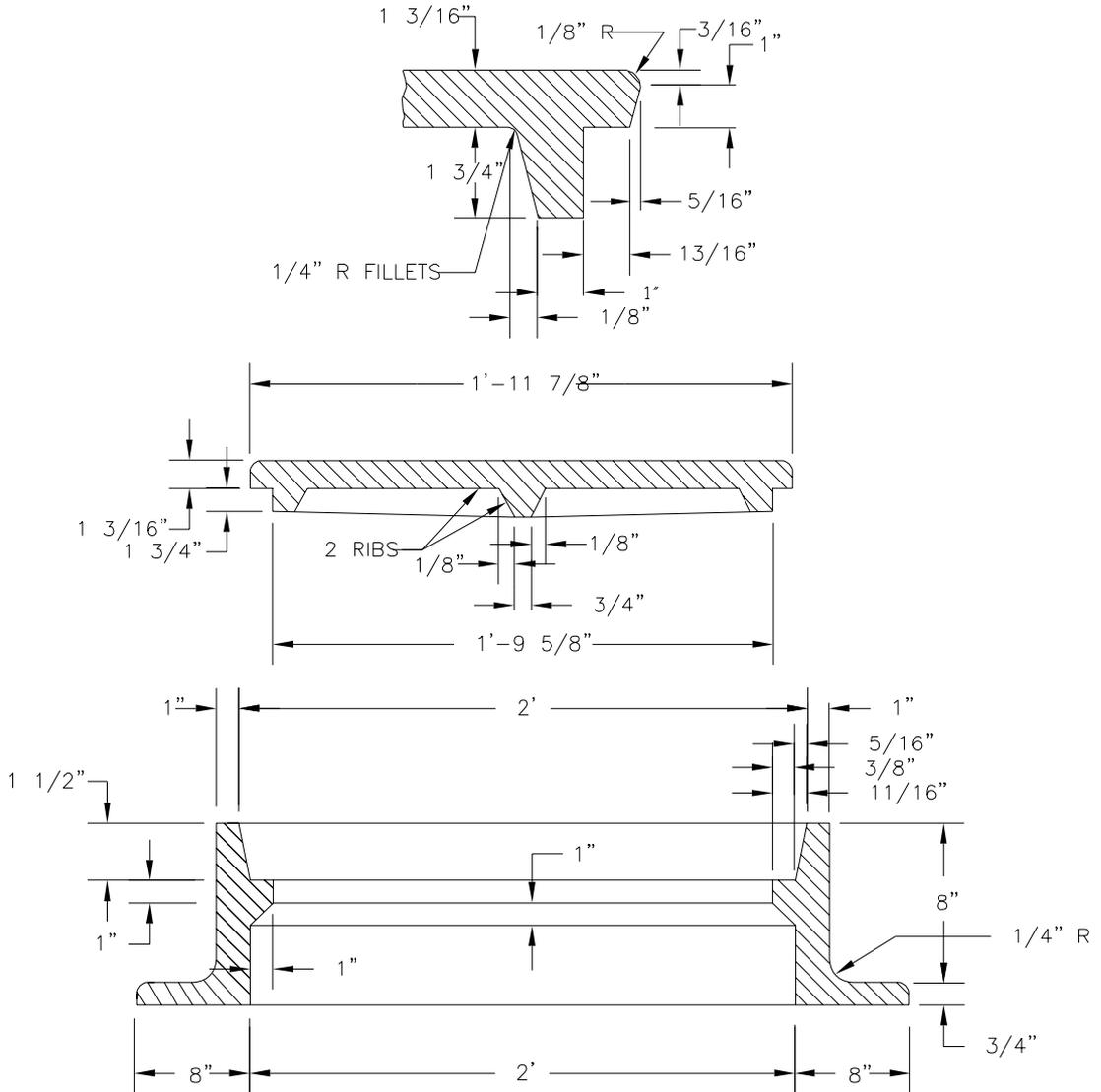


Date: 09/09/04

CITY OF PERRY, GEORGIA
 UTILITY CONSTRUCTION DETAILS

MANHOLE STEP DETAIL

NOTE: PICKHOLES SHALL BE NON-PENETRATING AND WATER TIGHT.
 CORRUGATION AND TWO PICKHOLES IN COVER, NO PERFORATION.
 SEATING SURFACE OF FRAMES AND COVERS TO BE MACHINED TO
 FIT.
 FRAME AND COVER SHALL WEIGH 300 POUNDS MINIMUM.



DETAIL – STANDARD MANHOLE FRAME AND COVER

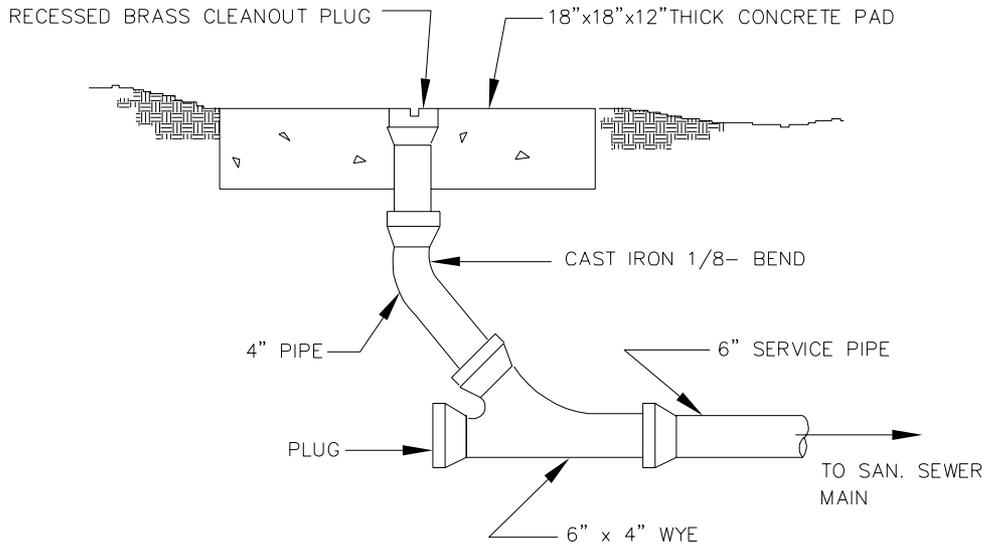
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Date: 09/09/04

CITY OF PERRY, GEORGIA
 UTILITY CONSTRUCTION DETAILS

MANHOLE FRAME AND
 COVER DETAIL



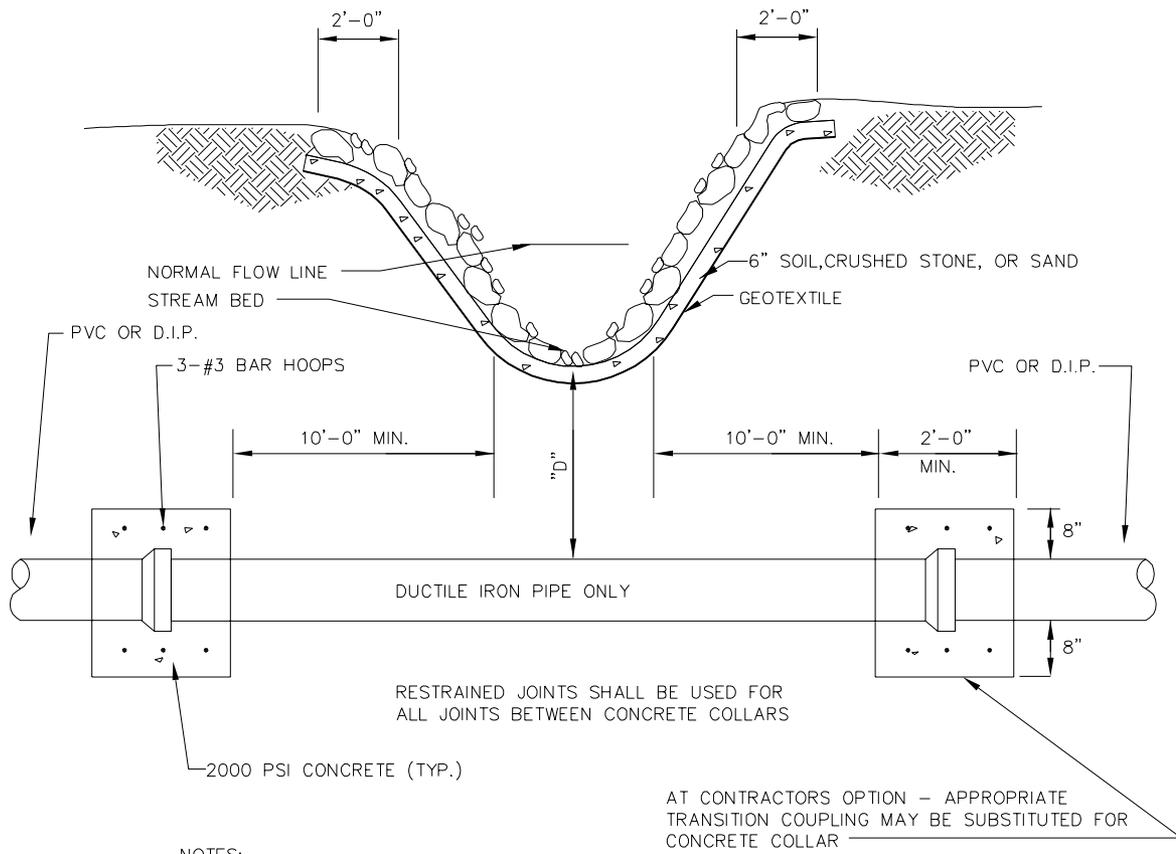
DETAIL – CLEANOUT TO GRADE



Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

**CLEANOUT TO
GRADE DETAIL**



NOTES:

1. RIP RAP SHALL BE PLACED ACROSS ENTIRE STREAM CROSSING - 2'-0" MIN. BEYOND TOPS OF BANKS.
2. 10'-0" MIN. WIDTH OF ROCK RIP RAP TO EXTEND MIN. OF 5'-0" EACH SIDE OF CENTERLINE OF TRENCH.
3. RIP RAP SHALL BE GA. DOT CLASS I RIP RAP.
4. USE D.I.P. ONLY IF "D" IS LESS THAN 3 FT. OR SHOWN ON PLANS.

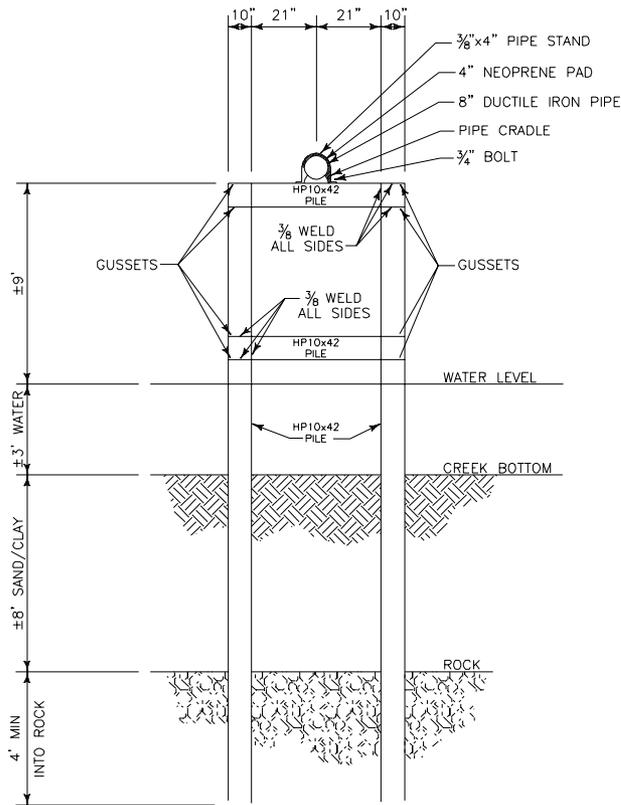
DETAIL - TYPICAL BELOW GRADE STREAM CROSSING
NTS



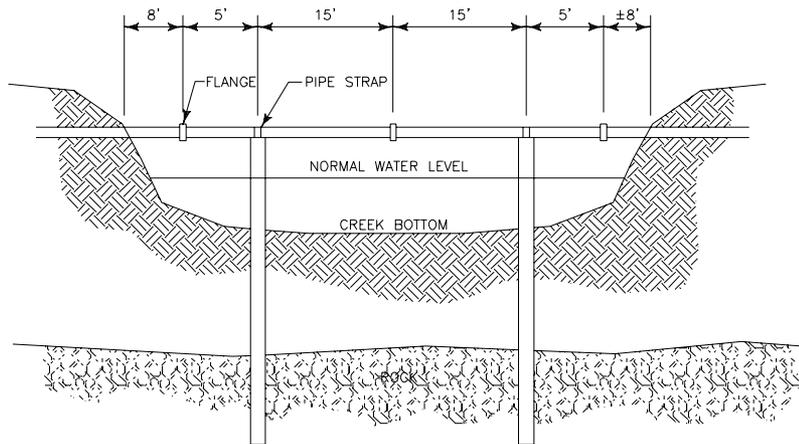
Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

**BELOW GRADE STREAM
CROSSING DETAIL**



SECTION VIEW



PROFILE VIEW

AERIAL CREEK CROSSING DETAIL

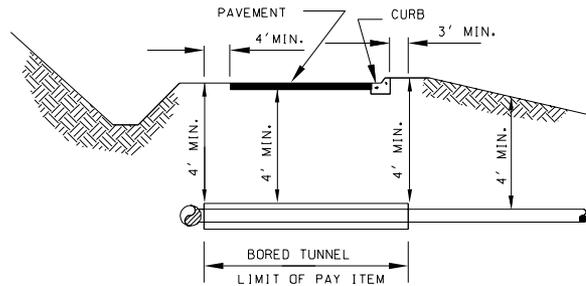
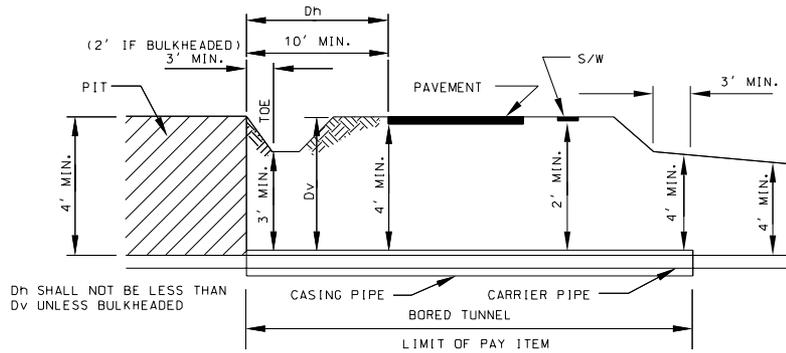
SCALE: N.T.S.



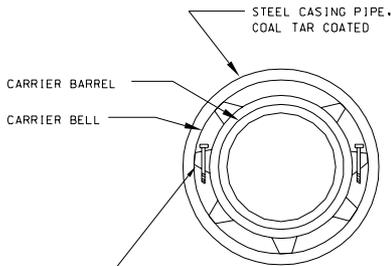
Date: 09/09/04

CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

**AERIAL CREEK
CROSSING DETAIL**



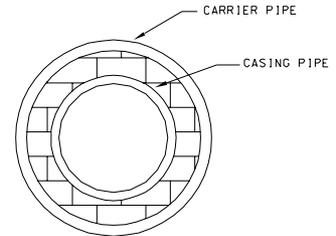
UTILITY CROSSING SECTIONS



PSI MODEL PE, PLASTIC CASING INSULATORS, SUFFICIENT TO ACCOMMODATE SPECIFIED CARRIER AND CASING PIPES - AS AVAILABLE FROM HARCO TECHNOLOGIES CORP. OR EQUAL.

PIPE CARRIER DETAIL

N.T.S.



SEAL BOTH ENDS OF STEEL ENCASUREMENT WITH BRICK AND/OR MORTAR, LEAVING WEEP HOLE FOR DRAINAGE. CARRIER PIPE TO BE WRAPPED WITH NON-ABRASIVE MATERIAL AT POINTS OF CONTACT TO PREVENT WEARING ON OUTSIDE WALL OF PIPE.

SEAL DETAIL

NOTES: CONSTRUCTION WITHIN THE GA. DOT RIGHT-OF-WAY SHALL CONFORM TO GEORGIA DEPARTMENT OF TRANSPORTATION SPECIFICATIONS.
 PRIOR TO BORING EXCAVATION EFFORT CONTRACTOR SHALL FIELD LOCATE AND EXPOSE ANY EXISTING UTILITIES BY HAND EXCAVATION AND SUBMIT EXISTING UTILITY ELEVATIONS TO ENGINEER FOR BORING ELEVATION APPROVAL.
 INSULATOR/SUPPORTS FOR CARRIER PIPE TO BE SPACED 4' EACH SIDE OF PIPE JOINT WITH A MAXIMUM OF 4' BETWEEN EACH SUPPORT AND MINIMUM OF 3' SUPPORTS PER PIPE LENGTH.
 CONTRACTOR SHALL PROVIDE NECESSARY TRAFFIC CONTROL PER DOT REQUIREMENTS

DETAIL - HIGHWAY UTILITY CROSSING

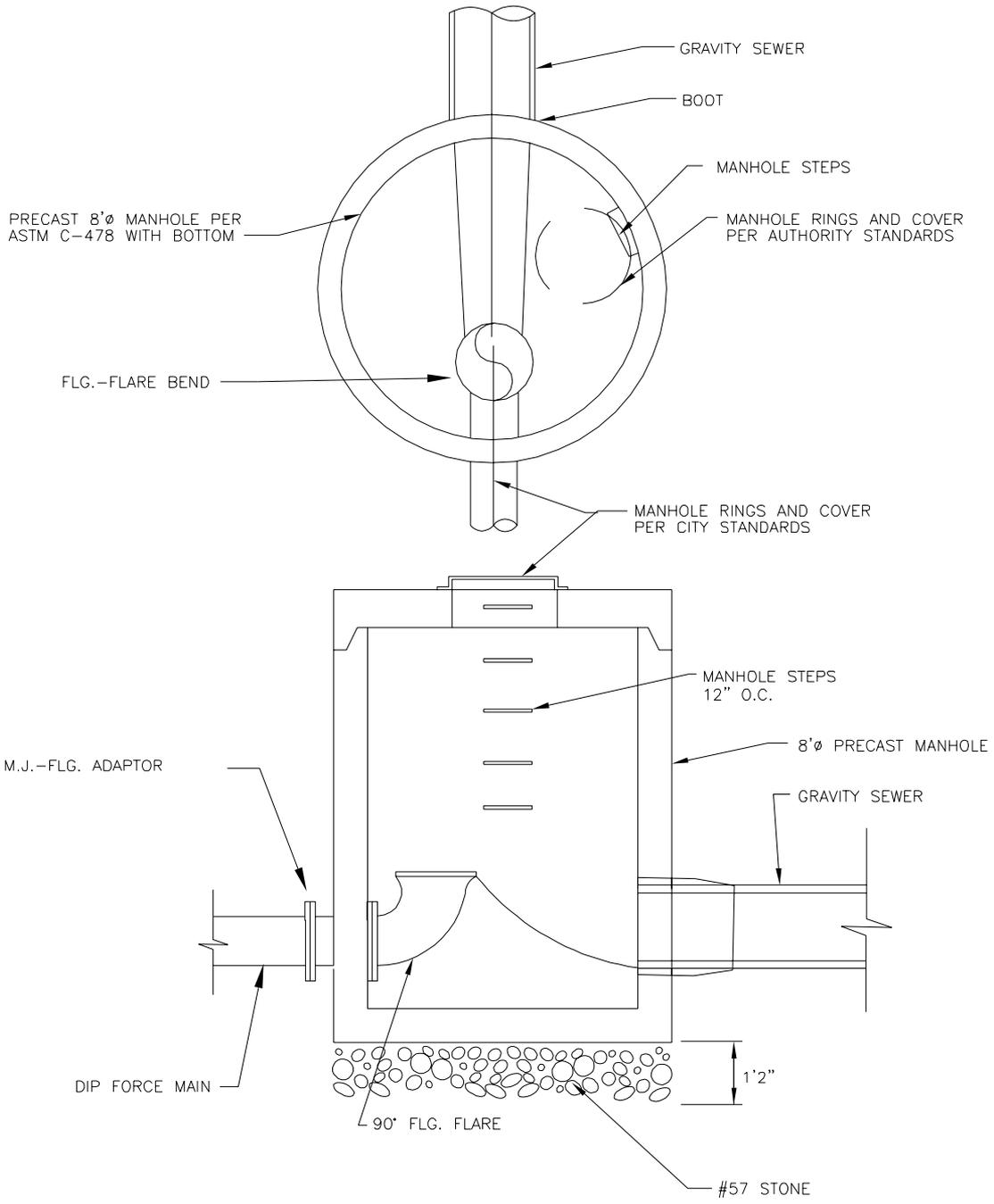
N.T.S.



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CITY OF PERRY, GEORGIA
 UTILITY CONSTRUCTION DETAILS

JACK & BORE DETAIL



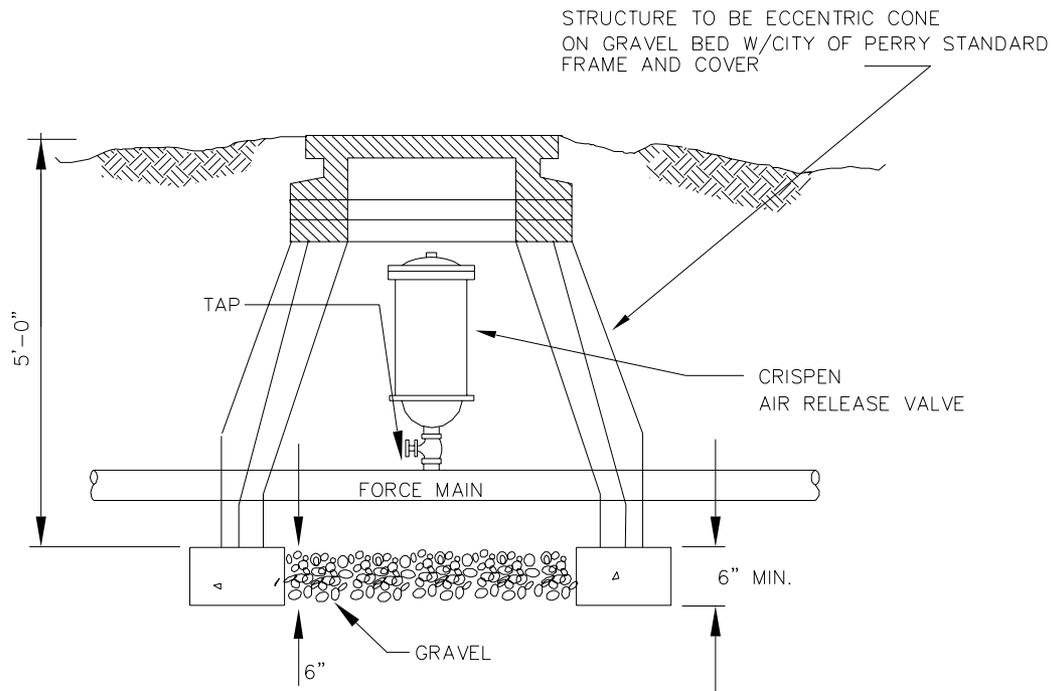
DETAIL – FORCE MAIN TERMINATION MANHOLE
N.T.S.



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**FORCE MAIN TERMINATION
MAHNOLE DETAIL**



DETAIL — AIR RELIEF VALVE

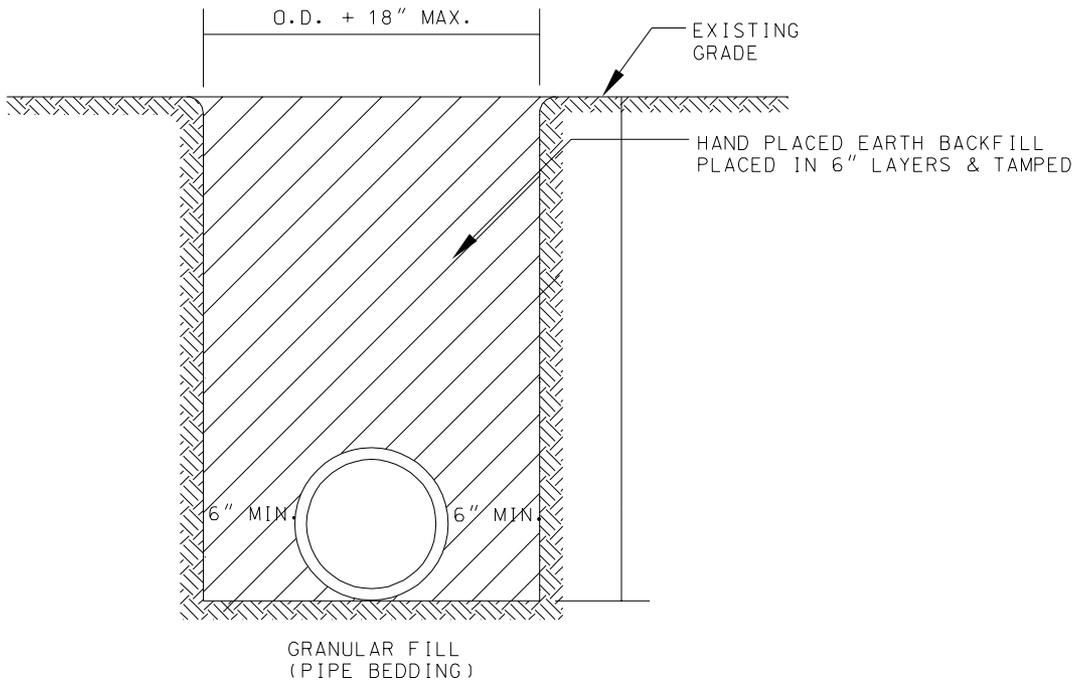
N.T.S



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CITY OF PERRY, GEORGIA
UTILITY CONSTRUCTION DETAILS

AIR RELEASE VALVE



FORCE MAIN
BEDDING DETAIL

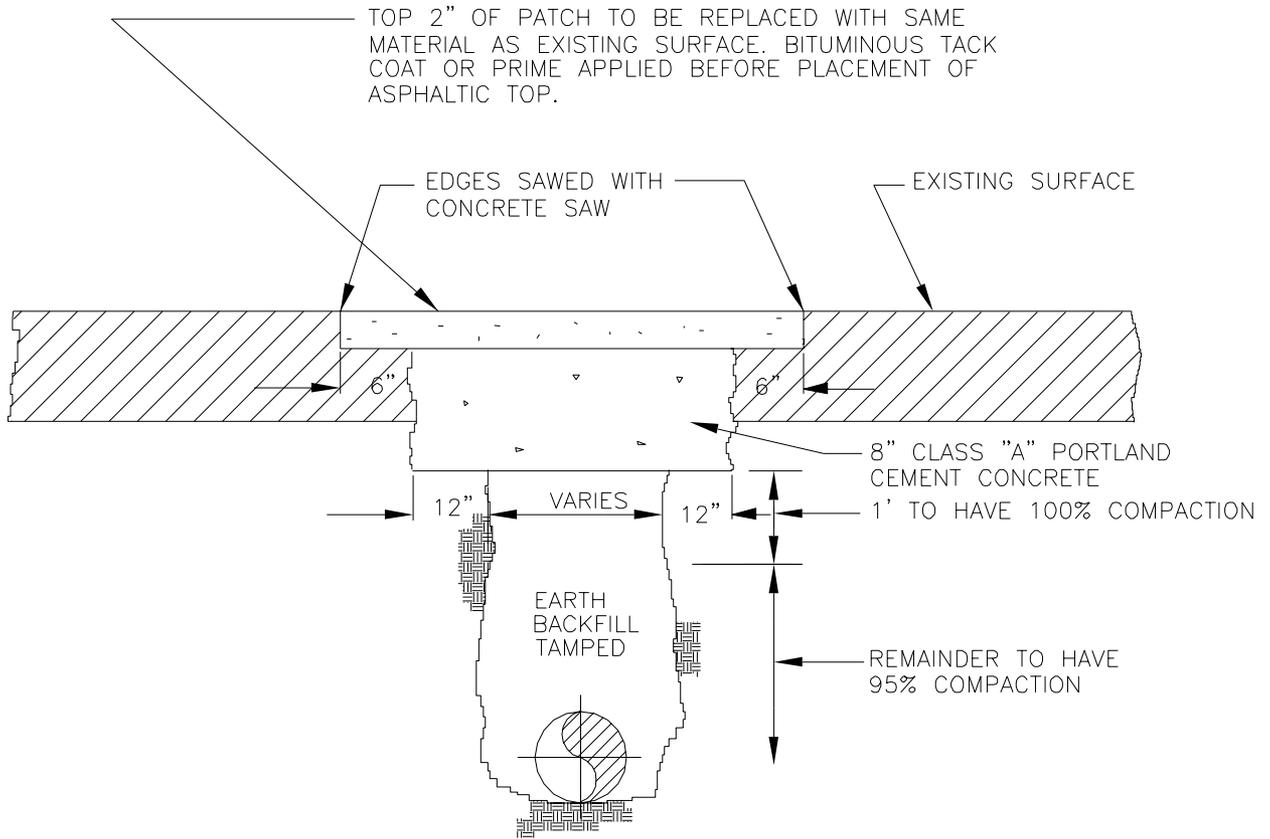
N.T.S.



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CITY OF PERRY, GEORGIA
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FORCE MAIN
BEDDING DETAIL



DETAIL – CLASS "A" – PAVEMENT REPLACEMENT

N.T.S.



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CITY OF PERRY, GEORGIA
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PAVEMENT PATCH DETAIL