

City of Chatsworth Water Works Commission

Sanitary Sewer Specifications

Table of Contents

SEWERS AND APPURTENANCES.....	8
1.01 Scope	8
1.02 Sewer	8
A. Quality and Inspection	8
B. Experience of Manufacturer	8
C. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.....	8
1. Markings	8
2. Certification	8
3. Joints.....	8
1.03 Iron Pipe and Fittings	9
A. Cast Iron Pipe, Ductile Iron Pipe, and Fittings:	9
B. Certification:	9
1.04 Polyvinyl Chloride Pipe for Force Main	9
A. Polyvinyl Chloride Pipe for Force Main	9
1. Polyvinyl Chloride Pipe.....	9
2. Markings	9
3. Certification	9
4. Locating Wire and Detector Tape.....	9
1.05 H.D.P.E. Pipe.....	10
A. Quality and Inspection	10
B. Experience of Manufacturer	10
C. Polyethylene Pipe	10
1. Joining Method	10
a. Fusion	10
b. Flange	10
c. Connections to Ductile Iron Pipe or Valves.....	10
2. Fittings.....	10
3. Markings	10
4. Locating Wire and Detector Tape.....	11
1.06 Precast Concrete Manholes	11
A. Precast Concrete Manholes	11
1. Base Sections.....	11
2. Riser Sections	11
3. Alteration to Manholes	11
4. Repaired and Patched Sections	11
5. Absorption	11
6. Testing and Stamping.....	11
1.07 Manhole Brick.....	12
1.08 Steel Pipe Casing	12
A. Steel Pipe Casing.....	12
1. Diameter and Wall Thickness	12

1.09 Concrete Work	12
A. Cement	12
B. Aggregate	12
C. Water	12
D. Mixing	12
E. Concrete from a Central Mix Plant	12
F. Concrete Mixed on Job Site	12
G. Concrete Cylinders	12
H. Placing of Concrete	13
I. Form Work	13
J. Removing Forms	13
K. Finishing	13
L. Payment	13
1.10 Reinforcing Steel and Miscellaneous Metal	13
A. Drawings	13
B. Reinforcing Steel	13
C. Miscellaneous Iron and Steel	14
D. Iron Castings	14
E. Painting	14
F. Payment	14
1.11 Unloading, Hauling, Distributing and Storing Pine and Related Materials	14
A. Unloading	14
B. Handling	14
C. Distributing	14
D. Storage	14
1. Ductile Iron Pipe	14
2. PVC Pipe	15
1.12 Location and Grades	15
1.13 Order of Work	15
1.14 Inspection	15
1.15 Organization of Work	15
1.16 Clearing and Grubbing	16
1.17 Removing and Resetting Fences	16
1.18 Protecting Trees	16
1.19 Protection of Other Utilities and Structures	16
1.20 Cutting and Removing Pavement	17
A. Marking	17
B. Machine Pulling	17
C. Damage to Adjacent Pavement	17
1.21 Excavation	17

1.22 Excavation in Solid Rock	17
A. Marking	17
B. Machine Pulling	18
C. Damage to Adjacent Pavement.....	18
1.21 Excavation	18
1.22 Excavation in Solid Rock	18
1.23 Blasting	18
1.24 Dewatering Trenches.....	19
1.25 Crushed Stone Stabilization.....	19
1.26 Bracing and Sheeting	19
A. Timber.....	19
B. Steel Sheeting	19
1.27 Bedding of PVC and Ductile Iron Pipe	19
A. PVC Pipe	19
1. Bedding Material.....	19
2. Depth of Bedding.....	19
3. Definition of Bedding Material	20
B. Ductile Iron Pipe.....	20
1. Type 1 - Flat Bottom Trench.....	20
2. Type 2 - Flat Bottom Trench.....	20
3. Type 3 - Loose Soil Bedding	20
4. Cover.....	20
C. PVC and HDPE Force Main.....	21
D. Payment	21
1.28 Trench Widths	21
A. PVC Pipe	21
1. Trench Width.....	21
2. Trench Depths.....	21
3. Compaction.....	21
4. Payment	21
1.29 Laying Gravity Sewer Pipe.....	22
A. PVC Pipe with Elastomeric Joints.....	22
1. Assembly of Gasketed Joint	22
2. Lubrication.....	22
3. Field Cut.....	22
4. Deflection Testing	22
B. Ductile Iron Pipe with Mechanical or Push-on Joints	23
1. Mechanical Joints.....	23
2. Push-On Joints	23
3. Mechanical Joint or Push-On Joint Pipe on Piers	23

1.30 Placing Precast Concrete Manholes or Constructing Brick Manholes	24
A. Precast Concrete Manholes.....	24
1. Connection of Pipe to Manhole	24
2. Adjustment	24
B. Brick Manholes	24
C. Precast Concrete and Brick Manholes.....	24
D. Drop Connections	24
E. Manhole Inverts.....	24
F. Manhole Steps.....	25
G. Future Sewer Connections	25
H. Manhole Frames and Covers.....	25
1.31 Selected Backfilling	25
1.32 General Backfilling	25
A. Street and Road Right-of-Way, Yards and Other Traveled Areas	25
1. Areas Requiring Pavement Replacement	25
2. Other Areas	25
1.33 Concrete Encasement of Pipe.....	26
1.34 Jointing Dissimilar Pipe	26
1.35 Assembling, Jointing, and Laying Pipe and Fittings for Force Main	26
A. Handling	26
B. Alignment and Gradient.....	26
C. Dewatering Trenches	26
D. Sequence of Work	26
E. Laying Pipe in Trenches	26
F. Assembling and Installing Ductile Iron Pipe and D.I. or C.I. Fittings.....	26
1. Pipe Lines in Earth Trenches.....	26
2. Pipe Line in Rock Trenches	27
3. Installing Ductile Iron Pipe with Mechanical Joints.....	27
4. Installing Ductile Iron Pipe with "Push-On" Type Joints.....	27
G. Assembling and Installing PVC Pipe with Elastomeric-Gasket Bell Ends D.I. Fittings.....	27
1. Cutting PVC Pipe.....	27
2. PVC Pipe, Trench, Bedding	27
3. Depth of Bedding and Marking Tape	27
1.36 Construction along Highways, Streets, and Roadways	28
A. Protection of Traffic	28
B. Construction Operations	28
1. Stripping	28
2. Trenching, Laying and Backfilling	28
3. Shaping.....	28
C. Excavated Material	28
D. Drainage Structures.....	28
E. Maintaining Highways, Streets, Roadways, and Driveways.....	28
1.37 Connections to Existing Manholes.....	29
1.38 Connections to Existing Sewers.....	29

1.39 House Service Lines	29
A. Service Line.....	29
1. Service Branch Connection for PVC Pipe	29
2. House Service Branches.....	29
B. Risers	29
C. Stoppers, Caps and Plugs	30
D. Marking Tape.....	30
1.40 Highway Crossing	30
1.41 Installation by Boring and Jacking	30
1.42 Location and Protection of Existing Underground Utilities	31
1.43 Rip-Rap	31
1.44 Street Maintenance	31
1.45 Surfacing of Trenches in Dirt Streets and Driveways	31
1.46 Surfacing of Trenches in Paved Streets and Driveways	31
1.47 Testing and Cleaning	31
1.48 Leakage Tests	32
A. Infiltration Test	32
B. Exfiltration Test.....	32
C. Low-Pressure Air Test	32
D. Repairs	33
1.49 Testing Force Main	33
1.50 Replacement Pavement	33
A. Pavement Replacement	34
1. Base	34
2. Asphaltic Concrete	34
3. Bituminous Surface Treatment Pavement	34
B. Sub-Grade Preparations	34
C. Pavement Preparation	34
1. Concrete Base	34
2. Soil Cement Base.....	35
3. Asphalt Surface	35
D. Replacement of Concrete Curb and Gutter, Street, Driveway and Sidewalk	35
E. Payment.....	35
1.51 Grassing	35
A. Materials	35
B. Preparation of Grade.....	35
1. Grading	35
2. Soil Improvement	35
C. Sowing of Seed	35
D. Protection	35
E. Grass Stabilization	35

F. Temporary Grassing and Mulching..... 35

1.52 Vegetation Cleanup, Maintenance and Inspection 36

 A. Cleanup 36

 B. Maintenance 36

 C. Inspection for Acceptance..... 36

1.53 Cleaning Up 36

1.54 Acceptance of Work..... 36

SEWERS AND APPURTENANCES

1.01 Scope

The Contractor shall furnish all materials and equipment and construct the sewers shown together with all clearing, grubbing, excavating, sheeting, backfilling, foundations, manholes and other appurtenances as shown and specified. The work shall include all ditching, diking, pumping, bailing, draining, flushing and all provisions necessary to protect and maintain buildings, fences, water and gas pipes, drain culverts, power and telephone lines and cables, and other structures; the furnishing and maintenance of suitable crossings for roadways; the cleaning away of all rubbish and surplus materials; and the furnishing of all materials, tools, implements and labor required to build and put in complete working order the specified sewers, and all structures appertaining.

1.02 Sewer

Pipe for sewers shall be furnished in accordance with the following requirements:

A. Quality and Inspection: Latitudes in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces; be first quality, be free from cracks, blisters and other imperfections and be true to theoretical shapes and forms throughout each length. Pipe shall be subject to inspection by the Owner at the pipe plant, trench and other points of delivery for the purpose of culling and rejecting pipe, independent of laboratory tests, which does not conform to the requirements of this Section. Pipe, which does not conform, will be so marked by the Owner, and shall not be used in the work. On-the-job repairing of rejected pipe will not be permitted.

B. Experience of Manufacturer: The pipe manufacturer shall submit evidence, if requested by the Owner, of having consistently produced pipe and joints of the quality specified herein and which have exhibited satisfactory performance results in service over a period of not fewer than two years. The pipe manufacturer and the pipe manufacturing process shall be subject to approval by the Owner.

C. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: Polyvinyl chloride (PVC) sewer pipe shall be bell and spigot pipe, shall be in lengths not exceeding 12-1/2 feet laying lengths and shall have minimum wall thickness conforming to ASTM D 3034 under the classification for DR 35 pipe, as amended to date.

Polyvinyl chloride (PVC) sewer pipe fittings shall be bell and spigot or bell and plain end and shall conform to ASTM D 3034, as amended to date.

1. Markings : PVC pipe shall be marked at intervals of 5 feet or less with the following information, manufacturer's name or trademark, plant code, date of manufacturer, nominal pipe size, PVC cell classification, the legend "Type PSM DR 35 PVC Sewer Pipe" and ASTM designation D 3034.

Fittings shall be marked with the following information: manufacturer's name or trademark, nominal size, designations PVC and PSM and ASTM designation D 3034.

All markings shall remain legible during normal handling, storage and installation.

2. Certification : The Contractor shall furnish the Owner with a written statement from the manufacturer that all pipe and fittings furnished have been sampled, tested and inspected in accordance with ASTM D 3034, as amended to date. Each certification so furnished shall be signed by an authorized agent of the manufacturer.

3. Joints : All pipes shall have elastomeric joints with an integral belled gasket coupler. Rubber gaskets shall comply with the physical requirements specified in the latest revision of ASTM F 477, as amended to date. Joints shall meet the requirements specified in ASTM D 3212, as amended to date.

1.03 Iron Pipe and Fittings

The Contractor shall furnish iron pipe and fittings as follows:

A. Cast Iron Pipe, Ductile Iron Pipe, and Fittings: Cast iron or ductile iron pipe shall be used in sizes 3-inch through 8-inch, and ductile iron pipe shall be used in sizes 10- inch through 64-inch where shown or indicated on the Drawings; all cast and ductile iron pipe shall be designed for a minimum 150 psi working pressure, 100 psi surge - allowance; a 2 to 1 factor of safety on the sum of working pressure plus surge pressure; single AASHO H-20 truck loading; laying condition 2 and cover required. Each pipe shall be subjected to a hydrostatic pressure test of at least 500 psi at the point of manufacture. Cast iron pipe shall be of the thickness according to ANSI A21.1 Cast iron pipe shall conform to ANSI A221.6 or ANSI A21.8. Ductile iron pipe shall conform to ANSI A21.51. The class or nominal thickness, net weight without lining and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, year in which the pipe was produced and the letters "D.I."/ "C.I." or "Ductile"/ "Gray Iron" shall be cast or stamped on the pipe. Fittings shall be cast from gray or ductile iron. Ductile iron fittings shall conform to AWWAC 110 (ANSI A 21.10), or ANSI/AWWA C153/A21.53 gray iron fittings shall conform to ANSI/ A WW A C 110/A21.10, or latest revision. All fittings shall have standard mechanical joints. Exterior joints for cast iron and ductile iron shall be push-on type unless otherwise shown. Interior joints shall be flanged in accordance with ANSI A21.15 and A21.10. Pipe and fittings shall be cement lined in accordance with ANSI A21.4, standard thickness lining. All pipe and fittings shall be coated inside and out with an approved coal-tar coating. River crossing pipe shall be flexible joint pipe meeting all requirements of A WWA C 151. Each joint shall provide variable deflection up to 15 degrees with the joint capable of being deflected to metal binding position at maximum deflection without harm to the pipe or joint components.

B. Certification: The manufacturer of iron pipe and fittings shall furnish both the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI Specifications for each.

1.04 Polyvinyl Chloride Pipe for Force Main

The Contractor shall furnish polyvinyl chloride pipe for force main as follows:

A. Polyvinyl Chloride Pipe for Force Main

1. Polyvinyl Chloride Pipe: Polyvinyl chloride pipe shall conform to requirements of A WW A C900, as amended to date; with standard dimension ration DR 18 (Class 150) for PVC 1120 pipe with cast iron pipe equivalent Ods. Integral wall-thickened and sleeve-reinforced bell-type pipe ends designed for joint assembly using elastomeric seals shall be measured in accordance to ASTM D 2122 as amended to date. Pipe shall be furnished in standard 20 ft. laying lengths.

2. Markings: Pipe and couplings shall bear identification markings in accordance with A WW A C900, as amended to date, that will remain legible during normal handling, storage and installation and which have been applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage them.

3. Certification: The manufacturer shall furnish the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable A WW A and ANSI Specifications.

4. Locating Wire and Detector Tape: The Contractor shall install locator wire along the entire section of pipeline. The locator wire shall be installed simultaneously with the polyethylene piping.

1.05 H.D.P.E. Pipe

As an alternate the Contractor can provide H.D.P.E. pipe in lieu of P. V .C. pipe. Alternate pipe for force main installation shall meet the following:

A. Quality and Inspection: All pipe shall be smooth on both the interior and exterior surface; be free of noticeable imperfections such as cracks, blisters or kinks in the pipe. The Owner shall have the right to reject any and all piping not conforming to these stated requirements. Field repair of any damaged piping shall not be permitted. The Owner reserves the right to require the removal of fused connections for destructive testing to verify the integrity of fused joints, etc.

B. Experience of Manufacturer: The pipe manufacturer shall provide evidence of having provided quality pipe and joints which have shown satisfactory results in service for a period of no less than two years.

C. Polyethylene Pipe: Polyethylene pipe shall conform to ANSI/A WW A Standard C 906- 90. The pipe shall be PE 3408 with an SDR of 11 and be rated for a pressure of 150 p.s.i. The carbon black content shall measure 2% to 3% by weight when tested according to ANSI! ASTM D 1603 or ASTM D 4211. The pipe shall be provided in ductile iron pipe sizes. The pipe shall be produced by Plexco, Driscopipe or equal.

1. Joining Method: The pipe and fittings shall be joined by fusion, mechanical joint or by flange connections. All joints shall be fused, not including connections to existing utilities, unless otherwise shown on Drawings.

a. Fusion: The pipe shall be joined by heat fusion of the ends. Prior to fusion the pipe shall be clean and the ends shall be cut square. Fusion system operators shall be trained in the use of the equipment by the pipe supplier or manufacturer of the fusing machine and be experienced in the operation of the equipment.

b. Flange: A flange assembly consists of a metal back-up flange or ring and a polyethylene stub-end or flange adapter. The back-up flange is - slipped over the pipe profile and the stub-end or flange adapter is then fused into the plain end pipe.

c. Connections to Ductile Iron Pipe or Valves: Connections to ductile iron pipe and valves shall be mechanical joints or flanges.

1) Mechanical Joint: Mechanical joints are to be made with stiffeners which are inserted into the H.D.P .E. pipe. Stiffener manufacture's directions shall be followed when installing stiffeners and mechanical joints. Stiffeners shall be Romac Industries 501-H & RC501-H or equal.

2) Restrained Mechanical Joints: Restrained mechanical joints shall be made using mechanical joint adapters manufactured by Driscopipe or equal.

3) Flange: Flange connections shall be as described above in "b" above.

2. Fittings: The fittings shall meet all of the requirements of the pipe to which they are to be fused. They shall be homogeneous throughout and essentially uniform in color, opacity, density and other properties. Fittings should also be free of such defects as cuts, cracks or holes.

3. Markings: Markings shall be legible during usual handling of the pipe and be applied in a manner that will not damage the pipe. The following markings shall be provided as shown below:

- Nominal size and OD base
- Standard material code designation
- Dimension ratio .Pressure class

- AWWA designation for this standard (A WW A C 906-90)
- Manufacturer's production code
- Material test category of pipe
- NSF 61 approved

4. Locating Wire and Detector Tape: The Contractor shall install locator wire along the entire section of pipeline. The locator wire shall be installed simultaneously with the polyethylene piping.

1.06 Precast Concrete Manholes

The Contractor shall furnish precast concrete manholes as follows:

A. Precast Concrete Manholes: Precast concrete manholes shall consist of precast reinforced concrete riser sections, concentric top section and a base section conforming to Typical Details shown on Detail Drawings. Precast manhole sections shall be manufactured in accordance with ASTM C 478, as amended to date, and these specifications. Concrete shall have a minimum compressive strength of 4,000 psi when tested in accordance with ASTM C 478, as amended to date. Wall and bottom section shall have a minimum thickness of five inches (5").

1. Base Sections: Base sections for precast concrete manholes shall have a bottom poured monolithic ally with the walls. Base sections shall be furnished with inside diameters of 4, 5, and 6 feet as required. Base sections shall be furnished with a minimum height of 24 inches for pipes having a diameter of 8, 10, or 12 inches and a minimum height of 36 inches for pipes having a diameter of 15 or 18 inches. Minimum height for 5 or 6 foot diameter base sections shall be 48 inches regardless of pipe size. Base sections with 5 or 6 foot inside diameters shall be reduced to 4 foot inside diameter by means of an adapter ring or transition top.

The opening in the base section for the accommodation of the pipe shall be cast to closely conform to job conditions and shall provide a minimum clearance of three inches (3") between the inside bottom of the base and outside bottom of the pipe barrel.

2. Riser Sections: The riser sections shall be furnished in a minimum of six inch (6") increments and shall be four feet (4') in diameter with: (a) tongue and groove joint to be sealed with approved butyl rubber or bitumastic material, similar to "E-Z Stik" as manufactured by Concrete Supply Company or (b) O- ring gasket type joint conforming to ASTM C 443, as amended to date. The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an approved epoxy to give a smooth surface free of any honeycomb.

3. Alteration to Manholes: In the event that the manhole has to be altered after delivery to job site the Contractor may, with permission of the Owner, connect the pipe to the manhole with a collar of mortar and brick. The opening between the pipe and manhole shall have a minimum clearance of one inch (1") and shall be filled from the inside of the manhole with a non-shrink grout.

4. Repaired and Patched Sections: Repaired and patched sections will not be acceptable unless each individual section so repaired or patched shall have first been inspected and approved by the Owner, for repair and patching at the - manhole plant. Repairs to and patching of "O"- ring grooves and shoulders **will not be** permitted.

5. Absorption: Absorption shall not exceed 9 per cent when determined in accordance with ASTM C 497, as amended to date.

6. Testing and Stamping: An inspection, by an independent testing laboratory approved by the Owner, of the manufacturer's plant and product will be required to assure conformity of the precast manholes to these Specifications, and the minimum requirements of ASTM C 478, as amended to date. Each section of precast concrete manhole shall be stamped with the laboratory's stamp. Each stamped section shall

indicate the laboratory's configuration that it was accepted in accordance with applicable ASTM Specifications. A copy of such report will be furnished the Owner with submittal of shop drawings for approval. Job site inspection shall be visual for shape, uniformity, and density.

1.07 Manhole Brick

Brick for manhole construction or grade adjustment shall be whole, hard burned, common brick conforming to ASTM C 32 Grade MS, as amended to date.

1.08 Steel Pipe Casing

The Contractor shall furnish steel pipe casing and related materials as follows:

A. Steel Pipe Casing: Steel pipe casing shall be manufactured from steel conforming to ASTM A 252 Grade 2, as amended to date, with a minimum yield strength of 35,000 psi before cold forming. Pipe may be straight seam or spiral weld. A protective coating will not be required.

1. Diameter and Wall Thickness: The diameter and wall thickness of steel pipe casing shall be as shown on the Drawings.

1.09 Concrete Work

Concrete of the respective classes for bedding, blocking, walks, roads, headwalls, piers and other miscellaneous structures shall be as called for in the work to which they pertain.

A. Cement: Cement shall satisfy the requirements of ASTM C 150, Type I or Type n, as amended to date.

B. Aggregate: Aggregate shall satisfy the requirements of ASTM C 33, as amended to date.

C. Water: Water shall be fresh, clean and free from injurious amounts of oil, acid, alkali, and organic materials.

D. Mixing: Mixing shall be accomplished at a central mix plant unless prior approval is given by the Owner for mixing on the job site.

E. Concrete from a Central Mix Plant: Concrete supplied from a central mix plant shall have 28-day compressive strengths not less than those listed below:

Class "A" - 3,000psi
Class "B" - 2,200psi
Class "C" - 1,500psi

F. Concrete Mixed on Job Site: Concrete mixed on the job site shall have 28-day compressive strengths as above and shall contain not less than the following quantities of cement per cubic yard.

Class "A" - 5,641bs. (6 bags)
Class "B" - 479 lbs. (5 bags)
Class "C" - 3,761bs. (4 bags)

G. Concrete Cylinders: Concrete cylinders for testing purposes shall be made in accordance with the procedure described in ASTM C 31, as amended to date. Compression tests shall be made at the age of 7 days and 28 days by the testing laboratory as per ASTM C 39, as amended to date. Testing shall be done by a laboratory approved by the Owner. Each test shall consist of at least four (4) specimens; two (2) for field control and two (2) for laboratory control. One (1) initial test will be required and then one (1) for each one hundred (100) yards thereafter.

H. Placing of Concrete: Placing concrete shall be in daylight hours. Concrete mixed at a central plant shall be transported to the job site as per ASTM C 94, as amended to date. Concrete when placed shall be compacted with mechanical, internal vibrating equipment and/or with hand spading with a slicing rod. No concrete shall be placed when the atmospheric temperature is below 35 degrees Fahrenheit. If the temperature drops below 35 degrees after concrete is placed the Contractor shall enclose, heat and protect the concrete. Earth fill shall not be placed on concrete until concrete has been allowed to set for 24 hours.

I. Form Work: Form work, where required, shall be built to conform to the shape, lines and dimensions of the concrete work as shown.

Forms shall be set to line and grade, and shall be braced, tied, and secured in a manner which will withstand placing of the concrete, and which will maintain shape and position. Forms shall be tight, and be substantially assembled to prevent bulging and the leaking of concrete. Joints shall be arranged vertically or horizontally. Temporary openings shall be arranged, where required, at the bottoms of wall forms and elsewhere, to facilitate cleaning and inspecting. Lumber used once in forms shall have nails removed and surfaces in contact with concrete work thoroughly cleaned before reuse. Wall sleeves, inserts and openings required in concrete work shall be properly set in form work. Chamfer strips shall be placed in forms for all exterior comers.

J. Removing Forms: Under normal conditions, the time elapsing before the forms may be stripped shall not be less than the following:

Slabs	14 days
Piers	7 days
Walls	2 days

K. Finishing: All exposed concrete work shall be kept wetted with water, and shall be fineness, or other equally as good abrasive, to bring the surface to a smooth texture and to remove all form and other marks. The paste formed by the rubbing may be rubbed down by floating with a canvas, carpet-faced, or cork float, or may be rubbed down with dry burlap.

L. Payment: Payment for concrete work, placing of concrete and form work will be paid for under various items specifically set forth in the Proposal, to which this work pertains.

1.10 Reinforcing Steel and Miscellaneous Metal

Reinforcing steel, miscellaneous iron and steel and iron castings shall conform to these Specifications and shall be as called for in the work to which they pertain.

A. Drawings: The Contractor shall furnish to the Owner for review six (6) copies of bending and spacing details for steel bar reinforcing which show bar size, spacing, bending, and tagging identification.

B. Reinforcing Steel: Bar reinforcement and wire mesh shall be furnished by domestic steel mills. Steel bar reinforcement shall conform to the requirements of ASTM.A 615, (Grade 60), as amended to date, and shall be of an approved deformed type. Bars shall be cold bent to shapes indicated on the Drawings. Bending shall be done in the shop unless otherwise specified and shall conform to the requirements of the ACI Building Code (ACI-318), as amended to date. Bars shall be furnished full length unless otherwise indicated on the Drawings, or approved by the Owner. Bars shall be placed in the locations shown on the Drawings and held securely in place during the placing - of concrete. Bars shall be spaced the proper distance from the face of the wall by the use of approved precast concrete mortar blocks and/or steel chairs with plastic coated legs or plastic tips or stainless steel chairs.

Wire mesh reinforcement shall conform to the requirements of ASTM A 185, as amended to date, and unless otherwise indicated on the Drawings, shall be 4-inch by 4-inch mesh, of 6 gauge wire. Wire mesh shall be secured in position by space bars and chairs or pre-cast concrete mortar blocks.

C. Miscellaneous Iron and Steel: Miscellaneous iron and steel for straps, brackets and related items shall be as shown and called for on the Drawings.

Bolts and nuts shall be of the best quality high strength steel, unless otherwise shown on the Drawings. Bolts and nuts in general shall be United States standard dimension. All anchor bolts exposed to the weather shall be of stainless steel, Type 316, unless otherwise specified. Anchor bolts in general shall be placed in forms prior to pouring concrete. When concrete anchors must be used, they shall be Phillips "Red Head" or Raw1 "Saber Tooth" self-drilling anchors, or equal.

Welding under these Specifications may be done by the MIG, TIG or "Electrode" method in accordance with A WS-ASTM E 6012, as amended to date, (Electrode Method only).

D. Iron Castings: Castings shall be gray-iron conforming to ASTM A 48, as amended to date. Castings shall be tough, close-grained and smooth, free from blow holes, blisters, shrinkage stains, cracks, cold shots and like defects. No plugging of defective castings will be permitted. Castings shall be made accurately to dimensions shown on the Drawings or ordered and shall be planed or ground where necessary, whether marked or not, to secure perfectly flat bearing surfaces. Allowance shall be made in the patterns so that the specified thickness of metal will not be reduced. No casting will be accepted, the weight of which is less than the theoretical weight, based on required dimensions, by more than five percent (5%).

E. Painting: Straps, brackets and related items shall receive pretreatment in the shop of one (1) coat of KOP-COAT "40 passivator", allowing 24 hours to dry, then apply prime coat of KOP-COA T "622 LCF primer", 1.5 min. dry mil thickness applied at the rate of 425 square feet per gallon, allowing 48 hours to dry. Coating in the field will be two (2) coats Bitumastic 300M, 10.0 min. dry mil thickness/coat, applied at the rate of 100 square feet per gallon.

F. Payment: No separate payment will be made for the above work. the cost of such work, and all cost incidental thereto, shall be included in the unit prices bid for the item to which the work pertains.

1.11 Unloading, Hauling, Distributing and Storing Pine and Related Materials

The Contractor shall unload, haul, distribute and store pipe and related materials as follows.

A. Unloading: Equipment and facilities for unloading, hauling, distributing and storing materials shall be furnished by the Contractor and shall at all times, be available for use in unloading materials. Delays in unloading railroad cars, unloading trucks, or hauling from freight terminal which incur demurrage, truck waiting charges or terminal charges shall be at the expense of the Contractor.

B. Handling: Pipe, fittings and other material shall be carefully handled so as to prevent breaking and/or damage. Pipe may be unloaded individually by hand but **shall not** be unloaded by rolling or dropping off of trucks or cars. Preferred unloading is in units using mechanical equipment, such as fork lifts, cherry pickers or front end loaders with forks. If fork lift equipment is not available units may be unloaded with use of spreader bar on top and nylon strips or cables (cushioned with rubber hose sleeve) looped under the unit.

C. Distributing: Materials shall be distributed and placed so as to least interfere with traffic. No street or roadway may be closed without first obtaining permission of the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, street and roadways upon which material is distributed. No distributed materials shall be placed in drainage ditches.

D. Storage: All pipe, fittings and other materials which cannot be distributed along the route of the work shall be stored for subsequent use when needed. The Contractor shall make his own arrangements for the use of storage areas; except that, with permission, he may make reasonable use of the Owner's storage yards.

1. Ductile Iron Pipe: Ductile iron pipe must be stockpiled on level ground. Timbers must be placed under the pipe for a base and to prevent dirt and debris from washing into the pipe.

2. PVC Pipe: PVC pipe must be stockpiled on level ground. If pipe is unloaded individually by hand, timbers must be used under the pipe for a base, spaced the same as factory load, with stop blocks nailed at either end. Stockpile must be built up the same manner as it was stocked for shipment, transferring dunnage and chock-blocks from load to stockpile. Individual lengths of pipe shall not be stacked in piles any higher than five feet (5'). If pipe is unloaded in units, the units must be placed on level ground and shall not be stacked more than two (2) units high. Units must be protected by dunnage in the same way they were protected while loaded on the truck or car. The dunnage must support the weight of all units so that pipe lengths do not carry the weight of the unit loaded above.

If pipe is to be stored outside and exposed to sunlight for a number of months, the pipe must be protected by covering with canvas or other opaque material. The cover shall be loose enough to allow for air circulation around the pipe. The use of clear plastic sheets will not be permitted.

1.12 Location and Grades

The line and grade of the sewer and drain, and the positions of all manholes and other structures, and other appurtenances, shall be laid out by the Contractor from controlling lines and bench marks furnished by the Owner, or from the measurements shown. All lines and grades shall be subject to checking by the Owner, but that checking shall in no way relieve the Contractor from responsibility for the correctness. The Contractor shall provide such field men and assistance as the Owner may request, and such hubs, stakes, spikes, nail, and other fastenings as may be required, in establishing and checking all controlling lines and grades.

1.13 Order of Work

The Owner reserves the right to accept and use portions of the work when it is considered to be in the public's best interest to do so; the Owner shall have the authority to establish the order in which the lines shall be worked.

1.14 Inspection

All work done and materials furnished shall be subject to inspection by the Owner; all improper work shall be reconstructed, and all materials which do not conform to the requirements of the specifications shall be removed from the work upon notice being received from the Owner of the rejection of those materials. The Owner shall have the right to mark rejected materials, and to distinguish them as such.

1.15 Organization of Work

The Contractor shall so organize his work that backfilling and cleanup shall closely follow pipe laying operations and manhole construction.

In general, not more than one block of a street or roadway shall be closed for construction at anyone time. Before proceeding with trenching operations in a succeeding block, the preceding section shall be backfilled, cleanup completed and the street opened to traffic.

For work outside the streets and roadways, backfilling and windrowing, in accordance with the provisions of "General Backfilling" paragraph shall be performed in such manner that not more than five hundred feet (500') of trench shall remain open at anyone time.

Failure on the part of the Contractor to comply with the above provisions in a reasonable manner, in the opinion of the Owner, shall be sufficient cause for the Owner to order a temporary shut-down of further trenching and pipe laying operations until the provisions have been met.

1.16 Clearing and Grubbing

The Contractor shall clear and grub only the areas for which a permanent sewer easement has been obtained which is a strip ten (10') feet on either side of the sewer centerline or as shown on the Drawings. Trees or loose objects between the permanent sewer easement and construction easement lines may be removed if necessary for construction purposes unless removal is specifically prohibited on the Drawings. Written approval by the Owner for removal of such noted trees or objects will be required. In no case is the Contractor to go outside the construction easement (twenty (20') feet on each side of the sewer line) with men, machinery, or material. No trees larger than 30 inches in diameter shall be removed without approval of the Owner.

All material and debris resulting from clearing and grubbing operations shall be disposed of in accordance with the rules and regulations of both the Air Quality and Solid Waste Management Sections of the Environmental Protection Division of the Georgia Department of Natural Resources. Burning shall be in accordance with local regulations and as approved by the Owner. The Contractor shall obtain any burning permits required and shall be responsible for any damage to surrounding property caused by his burning operation.

1.17 Removing and Resetting Fences

At all locations where existing fences must be removed to permit construction of the sewer, the Contractor shall remove the fences and, as the sewer construction progresses, reset the fences in their original location and to their original condition. During construction, the Contractor shall provide temporary fencing, or employ other safeguards, which will prevent livestock from wandering to other property.

1.18 Protecting Trees

Shrubbery and Lawns: Trees and shrubbery along trench lines crossing developed private property shall not be disturbed unless absolutely necessary, subject to approval by the Owner. Trees and shrubbery to be removed shall be properly heeled-in and replanted. Heeling-in and replanting shall be done under the direction of an experienced nurseryman. Where sewer trenches cross private property through established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replacement is approved by the Owner. Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials and shall be replaced at the surface of the trench in backfilling. In lieu of removing and replacing sod, the Contractor may! if approved by the Owner, re-grass lawns by seeding or sprigging with grass of the same type as the established lawn. Before planting, a fertilizer of 16:4:8 composition, or approved equal, shall be evenly applied at the rate of 20 pounds per 1,000 square feet and disked or harrowed into the dampened soil. An acceptable date for seeding shall be as recommended by the local Soil Conservation Agent. Areas sown with grass seed shall be mulched and kept watered until all growth is thoroughly established.

1.19 Protection of Other Utilities and Structures

Damage to existing utility lines, services, poles, and structures shall be repaired or replaced by the Contractor at his own expense. The approximate positions of certain known underground lines are shown for information. A minimum clearance of ten feet (10') horizontal and eighteen inches (18") vertical must be maintained between new sewer lines and existing water mains. Existing small lines are not shown. The Contractor shall locate existing small lines, and other possible existing unknown utility lines, with an electronic pipe finder and shall excavate and expose all existing underground lines in advance of trenching operations.

1.20 Cutting and Removing Pavement

The following specification for pavement cutting applies to concrete pavements, asphalt, surfaced pavements having a rigid base, concrete curb, walk, gutters and driveways. Brick, gravel, oil and chips, and asphalt mat (asphalt less than one and one-half inch 1-1/2" thick) pavements are excluded from the following requirements.

A. Marking: Pavement cuts for trench excavation in high-type pavements shall be made by means of a pavement sawing machine. All saw cuts shall be perpendicular to the pavement surface and shall be truly and accurately made along a predetermined and carefully marked chalk line. If necessary, a suitable stationary guide shall be used to prevent side swaying of the machine to insure that the cut will be straight. Asphalt pavement shall be broken along the marked cuts with a jack hammer or other suitable tool. Concrete pavement, and asphalt pavement on concrete base, shall be scored to a depth of approximately two inches (2") below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring with a jack hammer or other suitable tool.

B. Machine Pulling: Pavement shall not be machine pulled until completely broken and separated along the marked cuts.

C. Damage to Adjacent Pavement: The pavement adjacent to pipe line trenches shall be neither disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the Contractor shall remove the damaged pavement and shall replace with new pavement at his own expense.

1.21 Excavation

Excavation for sewer lines shall be by open cut, unless otherwise shown or specified. No tunneling shall be done without approval by the Owner to tunnel cross section and details of construction. The top portion of trenches may have sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, pavements, utilities, and private property. For un-timbered trenches and trenches held by stay bracing only, the width of the lower portion of the trench, to a height of two feet above the top of the pipe, shall not exceed the trench widths specified for the respective pipe size. The width of trenches, where skeleton or solid sheeting is used may be increased to dimensions approved by the Owner, but shall be not greater than that necessary to clear the wailers when lowering pipe into the trench. If trenches are excavated to widths in excess of the above limitations or if trenches collapse because of insufficient bracing and sheeting, the Contractor shall use special methods of constructing pipe foundations, as specified in "Bedding of Pipe" paragraph at his own expense. Excavation in excess of the depths required for manhole and other structures shall be corrected by pouring a sub foundation of Class "C" concrete, at the Contractor's expense.

1.22 Excavation in Solid Rock

Solid rock is defined as those materials in the original bed and in well-defined ledges which cannot be removed with pick, shovel, ditching machine, 5/8 cubic yard backhoe and other similar devices, and which requires jack hammering with bull point or, drilling and blasting. Concrete and masonry structures to be removed which require drilling and blasting for removal shall be considered rock unless otherwise provided for gutters and driveways. Brick, gravel, oil and chips, and asphalt mat (asphalt less than one and one-half inch 1-1/2" thick) pavements are excluded from the following requirements.

A. Marking: Pavement cuts for trench excavation in high-type pavements shall be made by means of a pavement sawing machine. All saw cuts shall be perpendicular to the pavement surface and shall be truly and accurately made along a predetermined and carefully marked chalk line. If necessary, a suitable stationary guide shall be used to prevent side swaying of the machine to insure that the cut will be straight. Asphalt pavement shall be broken along the marked cuts with a jack hammer or other suitable tool. Concrete pavement, and asphalt pavement on concrete base, shall be scored to a depth of approximately two inches (2") below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring with a jack hammer or other suitable tool.

B. Machine Pulling: Pavement shall not be machine pulled until completely broken and separated along the marked cuts.

C. Damage to Adjacent Pavement: The pavement adjacent to pipe line trenches shall be neither disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the Contractor shall remove the damaged pavement and shall replace with new pavement at his own expense.

1.21 Excavation

Excavation for sewer lines shall be by open-cut, unless otherwise shown or specified. No tunneling shall be done without approval by the Owner to tunnel cross section and details of construction. The top portion of trenches may have sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, pavements, utilities, and private property. For un-timbered trenches and trenches held by stay bracing only, the width of the lower portion of the trench, to a height of two feet above the top of the pipe, shall not exceed the trench widths specified for the respective pipe size. The width of trenches where skeleton or solid sheeting is used may be increased to dimensions approved by the Owner, but shall be not greater than that necessary to clear the wailers when lowering pipe into the trench. If trenches are excavated to widths in excess of the above limitations or if trenches collapse because of insufficient bracing and sheeting, the Contractor shall use special methods of constructing pipe foundations, as specified in "Bedding of Pipe" paragraph at his own expense. Excavation in excess of the depths required for manhole and other structures shall be corrected by pouring a sub foundation of Class "C" concrete, at the Contractor's expense.

1.22 Excavation in Solid Rock

Solid rock is defined as those materials in the original bed and in well-defined ledges which cannot be removed with pick, shovel, ditching machine, 5/8 cubic yard backhoe and other similar devices, and which requires jack hammering with bull point or, drilling and blasting. Concrete and masonry structures to be removed which require drilling and blasting for removal shall be considered rock unless otherwise provided for herein. Boulders, and detached pieces of rock, having volumes of more than 8 cubic feet, shall be considered as rock.

Where excavation of rock, boulders or large stones is required, a clearance of not less than six (6) inches in every direction from all parts of pipe and appurtenances shall be provided.

Where rock is encountered at grade in trenches, the trench shall be excavated not less than six inches (6") below the bottom of the pipe bell, refilled with crushed stone thoroughly tamped in-place, and shaped to the pipe.

Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe up to a level at least two feet above the pipe.

Where sewers are constructed across streets, pastures, and cultivated fields, excavated rock shall not be mixed with backfill material used to complete the final twelve inch (12") layer of backfill at the original ground surface. Surplus rock shall be removed and wasted at locations approved by the Owner.

1.23 Blasting

Blasting operations shall be conducted in accordance with existing ordinances and regulations, and shall be done subject to the Owner's approval of the method and quantity of explosive to be used. Exposed structures shall be protected from the effects of blasts; blasts shall be covered with suitable mats, and shall be restricted to the extent that no appreciable shock will be transmitted to existing structures, pipe lines, sewers, and other public or private facilities. All blasting supplies shall be stored in a manner approved by the Owner, and a watchman shall be stationed at all times at the place of storage.

1.24 Dewatering Trenches

Where groundwater is encountered, the Contractor shall make the effort necessary to secure a dry trench bottom before laying pipe. In sandy and in other suitable type soils, dewatering shall be done by well pointing. If in the opinion of the Owner, the Contractor has failed to obtain an absolutely dry trench bottom by insufficient use of all known methods of trench dewatering, the Owner may order the Contractor to excavate below grade and place not less than 6 inches of graded crushed stone fill material over the trench bottom to form trench drains to suitable located sumps and the water removed by bailing or pumping. The graded crushed stone fill material shall be placed at the Contractor's own expense and shall be of such depth that there shall be no water in bell holes at the time of coupling pipe.

1.25 Crushed Stone Stabilization

Wherever the sub grade is by nature too soft or mucky for the proper installation of the pipe, the Contractor shall undercut the trench and backfill with crusher run stone or crushed stone 3/4 inch in size and less. The stone shall be brought to the sub grade required by the class of bedding for the particular location and compacted.

1.26 Bracing and Sheeting

The sides of all trenches and excavations for sewer shall be securely held by stay bracing, or by skeleton or solid sheeting and bracing, as required by the soil conditions encountered.

A. Timber: Timber sheeting near the bottom of trenches over 10 feet deep, for pipe 15- inch size and larger, shall remain in place and shall be cut off no less than 2 feet above the top of the completed line. When sheeting and bracing cannot be safely removed above this level, it shall be left in place. Sheeting left in place shall be cut off at least 2 feet below the surface. Bracing and, sheeting may be removed in units when the level of the backfilling has reached the point necessary to protect the pipe and adjacent property.

B. Steel Sheeting: Continuous interlocking steel sheeting may be substituted for timber sheeting. Steel sheeting may be removed without cutting, provided the rate of removal is in pace with tamping and backfilling operations to assure complete filling of the void created by the withdrawal of the sheeting. Complete withdrawal of the sheeting in advance of tamping and backfilling will not be permitted.

1.27 Bedding of PVC and Ductile Iron Pipe

All pipe shall be laid on foundations prepared in accordance with the following specifications.

A. PVC Pipe: PVC pipe shall be laid as specified using the following classes of bedding required for the various type of soils and conditions encountered. Bedding for PVC pipe shall be in accordance with ASTM D 2321, as amended to date, the manufacturer's recommendations and these Specifications.

1. Bedding Material: Class I materials shall be used for bedding and haunching in all conditions. Class II, III, IV and V materials will not be permitted for bedding and haunching under any condition. "

2. Depth of Bedding: Bedding material shall be used to provide uniform longitudinal support for the pipe. Trench shall be undercut to allow for a maximum of six inches (6") of bedding material. Bell holes shall be excavated in the bedding material to allow for unobstructed assembly of the joint, but care shall be taken to assure that bell hole is no larger that necessary to accomplish proper joint assembly. After joint assembly, material shall be placed underground around the entire length of pipe and compacted. Compaction to the spring line of the pipe shall be of the same material used in the bedding. Backfill with Class I, II, III or N material shall then be carried to a point six inches (6") above the top of pipe, using hand tools for tamping, Class N material will not be allowed in a wet ditch. If the remaining backfill material contains large particles which could damage the pipe from impact during placement the initial backfill shall be increased to twelve inches (12") above the top of the pipe. Puddling will not be allowed as a method of compaction. The remaining backfill shall be as specified in "Selected Backfill" and "General

Backfill" paragraphs of these specifications. Pipe shall have at least thirty inches (30") of cover before wheel loading and at least forty-eight inches (48") of cover before using heavy-duty tamping equipment such as a hydro-hammer.

3. Definition of Bedding Material: Class I, II, III, IV and V materials are defined as follows:

Class I -Angular 1/4 to 3/4 inches graded stone. Latest revision of ASTM C 33 -Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable.

Class II -Coarse sands and gravels with maximum particle size of 3/4 inches including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.

Class III -Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures.

Class IV -Silt, silty clays and clays, a: including inorganic clays and silts of medium to high plasticity and liquid limits.

Class V -This class includes organic soils as well as soils containing frozen earth, debris, rocks larger than 1-1/2 inches in diameter, and other foreign materials.

B. Ductile Iron Pipe: Ductile iron pipe for gravity sewers and force mains shall be laid as specified using the following type of bedding required for the depth of cover for the various sizes of pipe to be installed. Type 4 and 5 bedding as shown and described in Ductile/Cast Iron Handbook -Fourth Addition Page 182-208 may be used for additional depths if approved by the Owner.

1. Type 1 - Flat Bottom Trench

Flat bottom trench on undisturbed earth with excavation for Bells. Loose backfill shall be as specified in the "Selected Backfilling" and "General Backfilling" paragraphs.

2. Type 2 - Flat Bottom Trench

Flat Bottom Trench on undisturbed earth with excavation for Bells. Lightly consolidated backfill to centerline of pipe, additional backfill shall be as specified in the "Select Backfilling" and "General Backfilling" Paragraphs.

3. Type 3 - Loose Soil Bedding

Pipe bedded in 4- in. minimum Loose Soil. Backfill lightly consolidated to top of pipe. Additional Backfill shall be as specified in the "Select Backfill" and "General Backfill" Paragraphs.

4. Cover

Maximum depth of cover for ductile iron pipe of the various classes and sizes to be installed are as follows:

Laying Condition
Maximum Depth of Cover (Ft)

Pipe Size In.	Pressure Class psi	Nominal Thick In.	Type 1	Type 2	Type 3
4	350	0.25	53	61	69
6	350	0.25	26	31	37
8	350	0.25	16	20	25
10	350	0.26	11	15	19
12	350	0.28	10	15	19

C. PVC and HDPE Force Main: PVC and HDPE pipe shall be bedded on clean earth or stone. Rock ditches shall be undercut not less than six (6) inches below the pipe and the trench shall be brought to grade with clean earth or stone. The pipeline shall be laid, backfilled with the same type material and compacted to a point at least six (6") inches above the pipeline. Where any part of the trench has been excavated below the grade of the trench, the part excavated below such grade shall be filled in with compacted Class I material.

D. Payment: No extra payment will be made for bedding, the cost therefore to be included in the prices bid for sewers.

1.28 Trench Widths

Trench widths and depths (where applicable), and PVC pipe.

A. PVC Pipe: The maximum trench widths and depths with the various classes of bedding and required compaction shall be as follows:

1. Trench Width: The maximum clear trench width at the top of the pipe shall not exceed a width equal to the nominal pipe diameter plus eighteen inches (18"). If this width is exceeded or the pipe is installed in a compacted embankment, pipe embedment shall be compacted to a point at least 2.5 pipe diameters from the pipe on both sides of the pipe or to the trench walls, whichever is less.

2. Trench Depths:

Pipe Sizes 6-Inch to 15-Inch, Inclusive

Class of Bedding	% of Proctor Density Range	Maximum Height Of Cover
I	95	30

3. Compaction: If the proper compaction cannot be obtained with materials from trench excavation, the Contractor will be required to obtain them elsewhere.

4. Payment: The cost of any extra work to obtain required compaction shall be included in the prices bid for sewers at various depths.

1.29 Laying Gravity Sewer Pipe

All sewer pipe shall be laid upgrade; the spigots shall point downgrade. The pipe and specials shall be laid in the trench so that, after the line is completed, the interior surface shall conform on the bottom accurately to the grades and alignment fixed. The interior of all pipes shall be carefully freed of all dirt and superfluous material of every description, as pipe laying proceeds.. Defective joints discovered after laying shall be repaired and made tight. Defective pipe shall be removed and proper replacement made.

A. PVC Pipe with Elastomeric Joints: Proper implements, tools and equipment shall be used for placement of the pipe in the trench to prevent damage. Under no - . circumstances may the pipe be dropped into the trench. In subfreezing temperatures, caution shall be exercised in handling pipe to prevent impact damage. All pipe shall be carefully examined for cracks, nicks, gouges, severe scratches, voids, inclusions and other defects before laying. If any pipe is discovered to be defective after having been laid, it shall be removed and replaced with sound material.

1. Assembly of Gasketed Joint: The assembly of the gasketed joint shall be .performed as recommended by the pipe manufacturer. The elastomeric gaskets may be supplied separately in cartons or pre-positioned in the bell joint or coupling at the factory. When gaskets are color coded, the Contractor shall consult the pipe manufacturer or his literature for the significance. In all cases, the gasket, the bell or coupling interior, especially the groove area (except when gasket is permanently installed) and the spigot area shall be cleaned with a rag, brush or paper towel to remove any dirt or foreign material before the assembling. The gasket pipe spigot bevel, gasket groove, and sealing surfaces shall be inspected for damage or deformation. When gaskets are separate, only gaskets which are designed for and supplied with the pipe shall be used. They shall be inserted as recommended by the manufacturer.

Lubricant used shall be supplied by the pipe manufacturer and shall be applied as specified by the pipe manufacturer.

2. Lubrication: After lubrication, the pipe is ready to be joined. Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or "stab" the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion.

If undue resistance to insertion of the pipe end is encountered, or the reference mark does not position properly, the joint shall be disassembled and the position of the gasket checked. If it is twisted or pushed out of its seat ("fishmouthed"), the Contractor shall inspect components, repair or replace damaged items, clean the components, and repeat the assembly steps. Both pipe lengths must be concentric alignment. If the gasket was not out of position, the Contractor shall verify proper location of the reference mark. The reference mark shall be relocated if it is out of position. .

3. Field Cut: Field cut pipe to be joined shall be square cut using a hacksaw, handsaw or power saw with a steel blade or abrasive disc. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. A factory-finished beveled end shall be used as a guide for proper bevel angle, and depth of bevel plus the distance to the insertion reference mark. The end may be beveled using a pipe beveling tool or a wood rasp which will cut the correct taper. A portable sander or abrasive disc may be used to bevel the pipe end. Any sharp edges on the leading edge of the bevel must be rounded off with a pocket knife or a file.

4. Deflection Testing: The maximum deflection in the installed PVC pipeline shall not exceed 5% of the pipes original internal diameter. Deflection testing will be required using either a deflectometer or a "GO-NO-GO" mandrel. The Owner shall randomly select portions of the project to be deflection tested. Such portions shall consist of not less than 5% of the total reaches (reach being length of pipe between two manholes) in the project (excluding house leads).

Where deflection is found to be in excess of 5% of the original pipe diameter, the Contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be retested for deflection. However, should after the initial testing the deflection pipe fails to return to the original size (inside diameter) the line shall be replaced.

In the event that deflection occurs beyond the 5% limit in any section of 5% or more of the reaches tested, the entire system shall be tested.

B. Ductile Iron Pipe with Mechanical or Push-on Joints: Proper and suitable tools and equipment shall be used for the safe and convenient handling and laying of ductile iron pipe. Care shall be taken to prevent damage to the exterior coating and interior cement lining. All pipe shall be carefully examined for cracks and other defects before laying. If any pipe or fitting is discovered to be defective after having been laid, it shall be removed and replaced with sound material at the expense of the Contractor. Whenever pipe is required to be cut, the cutting shall be done by skilled workmen using an abrasive wheel cutter. Use of a cold chisel or oxyacetylene torch will not be permitted.

1. Mechanical Joints: Mechanical joints shall be made only by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping the gland and gasket over the spigot end of the pipe. The spigot shall be inserted into the socket full depth, then backed off 1/4-inch to provide clearance for expansion. The gasket shall be brushed with soapy water and shall be pushed into position making sure that it is evenly seated in the socket. The gland shall then be moved into position for compressing the gasket. All bolts and nuts shall be made "finger-tight".

For joints made in trenches, the bolts shall be tightened to a uniform permanent tightness, using a torque wrench for tightening. Bolts shall be tightened alternately 180 degrees apart.

2. Push-On Joints: The groove and bell socket shall be thoroughly cleaned and lubricated before the gasket is inserted. Before inserting the gasket it shall be thoroughly lubricated and manufacturer's instructions shall be followed for proper facing and seating of gasket. After the gasket is in place and just prior to joint assembly a generous coating of lubricant shall be applied to the exposed gasket surface. The lubricant used shall be a lubricant supplied by the pipe manufacturer.

The plain end shall be inspected and any sharp edges which might damage the gasket shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly. Prior to inserting the plain end of the pipe into bell socket lubricant shall be applied to the beveled nose of the pipe.

Small pipe may be pushed home with a long bar but large pipe may require additional power such as a jack, lever or backhoe. A timber header shall be used between the bell and bar or other power to avoid damage to the pipe.

During assembly of the pipe the joint must be kept straight while pushing. Pipe may be deflected if desired but only after the assembly is completed.

3. Mechanical Joint or Push-On Joint Pipe on Piers: Mechanical or push-on joint pipe may be used on piers in gravity sewer lines. Pipe shall be laid with 1/4- inch clearance in each joint to provide for expansion. Jointing of pipe shall be as described above. On mechanical joint pipe the bolts shall be tightened alternately 180 degrees apart but be left "finger-tight" until the sewage is diverted into the sewers; then bolts shall be further tightened a sufficient amount which will prevent leakage of the joint, but which will not prevent slippage which may occur because of temperature stresses.

1.30 Placing Precast Concrete Manholes or Constructing Brick Manholes

Precast concrete manholes, brick manholes or a combination of precast concrete and brick manholes shall be placed or constructed where shown. Manholes shall be 4, 5 and 6 feet in diameter as determined from the schedule of pipe sizes and line deflections, or as shown.

The top of manholes outside of roads, streets, and highways shall be built to grades twelve inches (12") above ground surface unless otherwise shown on the Drawings. Manholes in roads, etc. shall be built to grade designated. Vented manholes shall be constructed to elevations as shown on the Drawings.

Manholes shall be placed and/or constructed as follows:

A. Precast Concrete Manholes: Precast concrete manholes shall be bedded on not less than six inches (6") of compacted crushed stone. The crushed stone shall extend not less than six inches (6") outside the walls of the manhole, and shall be compacted under entire length of pipe within manhole excavation.

1. Connection of Pipe to Manhole: Connections of pipe to manhole for 4-inch through 15-inch pipe shall be made with a flexible joint system. The joint system shall be a neoprene or synthetic rubber boot or sleeve, either cast or core drilled into the wall of manhole. The boot or sleeve shall be clamped and seated to the pipe with a stainless steel band. The boot or sleeve system shall be "LOCK JOINT FLEXIBLE MANHOLE SLEEVE" as manufactured by Interpace Corporation, Parsippany, New Jersey or "KOR-N-SEAL" as manufactured by National Pollution Control Systems, Inc., Nashua, New Hampshire or equal. Connections of pipe to manhole for 18 inch pipe and above shall be made with a collar of mortar. The opening between the pipe and the manhole shall have a minimum clearance of one inch (1") and shall be filled from the inside of the manhole with a non-shrink grout.

2. Adjustment: The top of the concentric top section shall have a minimum wall thickness of eight inches (8") to accommodate brick courses for height adjustment. A maximum of three (3) brick courses will be allowed for adjustment of manhole to required grade.

B. Brick Manholes: The bottom of each brick manhole shall be built of Class "B" concrete. The walls of the manholes shall be built of whole hard burned brick of good quality laid in cement mortar made of one part cement and two parts clean, sharp sand. The walls shall be thoroughly plastered on the outside with a smooth coat of 1:2 cement mortar. Mortar shall be not less than 3/4 inches in thickness. Immediately before laying, the brick shall be thoroughly saturated with water. Every brick shall be carefully embedded in mortar on its bottom and sides.

C. Precast Concrete and Brick Manholes: Manholes may be precast concrete or, may be a combination of precast concrete and brick if approved by the Owner.

D. Drop Connections: Drop connections will be required, where called for on the Drawings, or as determined by the dimensions shown in "Drop Manhole Schedule", shown on the Drawings. Drop pipe shall be not smaller than 8-inches. Generally, drop pipe shall be one size smaller than the sewer which they serve. Openings in walls of precast concrete manholes for drop connections shall not be made at joints. Drop connection fittings and riser pipe shall be encased in brick and mortar or formed Class "C" concrete. Drop connections for both brick and precast concrete manholes shall conform to typical details as shown on the Drawings. Drop connections shall be carefully backfilled to prevent dangerous side pressures.

E. Manhole Inverts: Manhole inverts shall be carefully constructed with cement grout, Class "B" concrete, or cement mortar brickwork; special care shall be taken to lay the channel and adjacent pipes to grade. Cement mortar shall be made of one (1) part cement and two (2) parts clean sharp sand. Channels shall be properly formed, rounded, and troweled smooth. The connections of the sewer with the wall and channel of the manhole shall be tight and smooth.

F. Manhole Steps: Manhole steps shall conform to the details shown. Steps for brick manholes shall be installed along a vertical centerline, and approximately 15" centers steps shall be firmly and securely built into manhole walls as brickwork proceeds. Steps for precast concrete manholes shall be installed along a vertical centerline, on approximately 14" to 16" centers.

G. Future Sewer Connections: Where shown, a twelve inch (12") long pipe stub for future sewers, of such size as may be designated, shall be laid to proper grade and alignment and plugged with a factory plug with same type joint as used on the sewer pipe.

H. Manhole Frames and Covers: Manhole frames and covers shall be as detailed and shown on the Drawings and as called for in the Proposal and shall include setting to finished grade as required, and grouting in place.

1.31 Selected Backfilling

All trenches shall be backfilled immediately after pipes are laid therein, and joints have been inspected unless other protection of the pipeline is directed. Selected backfill material shall consist of finely divided earth, stone dust, sand, crushed stone, or other approved material carefully placed about the pipe and up to a height of at least twelve inches (12") above the top of the pipe barrel, and in uniform layers not exceeding six inches (6") in thickness, each layer thoroughly compacted with proper hand tools in a manner which will not disturb and/or injure the pipe. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner which will prevent injurious side pressures. If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select materials elsewhere.

1.32 General Backfilling

After selected backfill material has been placed and tamped, the remainder of the trench may be backfilled with general excavated material, except that no rock, unless in small shattered fragments, will be permitted to be mixed with other back-fill material.

A. Street and Road Right-of-Way, Yards and Other Traveled Areas: In streets and road right-of -ways, yards and other traveled areas open to vehicular or pedestrian travel the ditch shall be backfilled and each layer shall be tamped to a density equivalent to at least 95% of the Standard Proctor maximum dry density in accordance with ASTM D 698, as amended to date.

Backfill material shall be placed in uniform layers not exceeding six inches (6") in thickness, with each layer thoroughly compacted with heavy duty tampers ("Whacker" or equal) to a height of at least thirty six inches (36") or forty-eight inches (48") above the top of the pipe barrel.

The remainder of the ditch may be backfilled and tamped in the same manner or if the Contractor so elects he may place backfill in layers not exceeding twelve inches (12") and use wheel loading or heavy duty power tamping equipment ("Hydro-Hammer" or equal). Pipe shall have at least thirty-six inches (36") of cover before wheel loading and at least forty-eight inches (48") of cover before using heavy duty tamping equipment ("Hydro-Hammer" or equal).

1. Areas Requiring Pavement Replacement: Mechanical tamping will be required of all backfilling of excavated portions. After backfilling and tamping as described above is completed the top six inches (6") of the ditch shall be backfilled with compacted crushed stone, ASTM C 33, as amended to date, gradation #67 or #57, with sufficient fines for compaction. Further compaction shall be accomplished by leaving the backfilled trench opens to traffic while maintaining the surface with stone. Settlement in trenches shall be refilled with stone and such maintenance shall continue until replacement of pavement is completed.

2. Other Areas: Other areas, including woodland, fields, pastures and areas not open to vehicular travel; the remainder of the ditch may be backfilled by placing fill in ditch and "walking-in" with wheel loaded equipment. After sufficient settlement has been obtained the Contractor shall complete surface dressing, remove surplus material and clean up in accordance with these Specifications. Wherever trenches have

not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored as specified herein. Surplus material shall be disposed of by the Contractor.

1.33 Concrete Encasement of Pipe

Where shown the pipe shall be completely encased with Class "C" concrete. The trench shall first be excavated not less than 6 inches (6") below the bell of ". the pipe and the pipe laid to line and grade on concrete blocking. Concrete shall then be poured to the full width of the trench, but in no case less than 6 inches (6") from the pipe bell on either side of the pipe, and to a height of not less than 6 inches (6") above the top of the pipe bell. No backfill material shall be placed in the trench for a period of at least 24 hours after the concrete encasement has been poured.

1.34 Jointing Dissimilar Pipe

Dissimilar pipes shall be joined together using flexible couplings as manufactured by "Femco" or "Mission". Concrete collars will be permitted only if flexible couplings are not available in sizes needed. Concrete collar shall be constructed of Class "A" concrete and shall be poured so as to completely and securely encase the entire joint. The collar shall be formed as shown on the Drawings. The inside of the pipe shall be free of foreign material to the satisfaction of the Owner.

1.35 Assembling, Jointing, and Laving Pipe and Fittings for Force Main

The Contractor shall assemble, joint and lay all pipe and fittings to accurately conform to the lines and grades shown:

A. Handling: Proper and suitable tools and equipment, for the safe and convenient handling and laying of pipe shall be used. Care shall be taken to prevent ductile iron pipe or fittings coating from being damaged, particularly the cement lining on the interior of the ductile iron pipe. All pipe shall be carefully examined for cracks, broken lining or other defects. PVC pipe shall be carefully examined for cracks, nicks, gouges, severe scratches, voids, inclusions, and other defects before laying. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be defective, after being laid, it shall be removed and replaced with sound material, without further charge.

B. Alignment and Gradient: In general, pipe line alignment and gradient shall be straight; however, pipe line may be laid on a curve but must be within the limits of curvature as recommended by the pipe manufacturer. All force mains shall be laid on a minimum rising grade of 0.1 0% unless otherwise shown on the Drawings.

C. Dewatering Trenches: All excavation shall be dewatered properly before laying pipe. Where running sand is encountered, dewatering shall be done by well pointing whenever possible. Where soil conditions are not favorable for use of well point, French drains of graded stone shall be constructed to suitably located sumps and the water removed by bailing or pumping.

D. Sequence of Work: Excavation, laying, jointing and backfilling shall be kept up as closely as is possible so as to progress in a uniform, workmanlike manner. The Contractor will be required to backfill and compact the trench as soon as is possible after laying and jointing is completed.

E. Laving Pipe in Trenches: When laying pipe in trenches, care shall be taken to give the pipe solid bearing throughout its entire length. Bell holes shall be excavated in a manner which will relieve pipe bells of all load.

F. Assembling and Installing Ductile Iron Pipe and D.I. or C.I. Fittings: Proper care shall be exercised in the assembly and installation of Ductile Iron Pipe and D.I. fittings.

1. Pipe Lines in Earth Trenches: Where pipes are laid in earth excavated trenches, the bottom of such trenches shall be fine graded by skilled workmen to a true line and shall not be laid on loose rock or other hard materials, but be bedded on fine, clean undisturbed earth. Over excavation in the bottom of trenches shall be filled to grade with granular material and compacted. Backfill shall be performed as specified herein.

2. Pipe Line in Rock Trenches: Where pipe is laid in rock trenches the bottom of such trenches shall be undercut and the pipe shall be bedded in at least six inches (6") of crushed stone conforming to ASTM C 33, as amended to date, gradation #67 and the trench shall be backfilled with earth, rock dust, clay or sand as specified herein.

3. Installing Ductile Iron Pipe with Mechanical Joints: Pipe and fittings with mechanical joints shall be installed by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping gland and gasket over spigot. The spigot shall be inserted in the socket full depth. The gasket shall be brushed with soapy water and shall be pushed into position, making sure the gasket is evenly seated in the socket. The gland shall be slid into position for compressive gasket. All bolts and nuts shall be tightened "finger tight", after which bolts shall be tightened to a uniform permanent tightness, using a torque wrench for tightening. Bolts shall be tightened alternately 180 degrees apart. Sockets, spigots, glands and bolts shall be kept wet with soapy water until each joint is completed. Any joints which leak shall be remade.

4. Installing Ductile Iron Pipe with "Push-On" Type Joints: The groove and bell socket shall be thoroughly cleaned and lubricated before the gasket is inserted. Before inserting the gasket it shall be thoroughly lubricated and manufacturer's instructions shall be followed for proper facing and seating of gasket. After the gasket is in place and just prior to joint assembly a generous coating of lubricant shall be applied to the exposed gasket surface. The lubricant used shall be a lubricant supplied by the pipe manufacturer.

The plain end shall be beveled and inspected, any sharp edges which might damage the gasket shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly. Prior to inserting the plain end of the pipe into bell socket, lubricant shall be applied to the beveled nose of the pipe.

Small pipe may be pushed home with a long bar but large pipe will require additional power such as a jack, lever or backhoe. A timber header shall be used between the bell and bar or other power to avoid damage to the pipe.

During assembly of the pipe the joint must be kept straight while pushing. Pipe may be deflected if necessary but only after the assembly is completed.

G. Assembling and Installing PVC Pipe with Elastomeric-Gasket Bell Ends D.I. Fittings: All dirt or foreign material must be removed from the groove of pipe. If necessary, groove shall be wiped with a clean, dry cloth. Care shall be taken to insure that the proper ring is used. The rubber ring shall be wiped clean before it is inserted into the groove. The GROOVE OR RUBBER RING MUST NOT BE LUBRICATED. Apply lubricant to beveled spigot and push lubricated end past the gasket into the bell housing. Manufacturer's recommendations must be strictly adhered to in assembling rubber ring in groove and installing pipe into the bell.

The assembling of D.I. or C.I. mechanical joint fittings must be done by experienced mechanics. The gasket shall be brushed with soapy water before slipping the gasket and gland into place. Bolts shall be tightened "finger tight" and then tightened alternately 180 degrees apart to a uniform tightness, using a torque wrench.

1. Cutting PVC Pipe: Wherever pipe or special castings are required to be cut, the cutting shall be done by skilled workmen using hacksaw, handsaw or a power saw with a steel blade or abrasive disc. The end may be beveled using a beveling tool or wood rasp which will cut the correct taper.

2. PVC Pipe, Trench, Bedding: The trench bottom must be free of large stones, large dirt clods or frozen earth. Place 4-inches of select material on trench bottom to provide smooth cushion for pipe. Excavation for pipe bells shall be provided so that the pipe is uniformly supported along its length. When an unstable trench bottom is encountered and, in the opinion of the Owner, will not support the pipe, the Contractor shall remove the bad material and replace with a minimum depth of one foot of No. 67 stone.

3. Depth of Bedding and Marking Tape: Minimum depth of bedding shall be six inches (6"). Compaction to the centerline of the pipe shall be of the same material used in the bedding. Backfill shall then be carried

to a point eighteen inches (18") above the top of pipe, using hand tools for tamping. Puddling will not be allowed as a method of compaction. Before replacing the remaining backfill, detectable marking tape shall be placed in the ditch for the entire length of force main. Tape shall be two inches (2 ") in width, imprinted with the words "BURIED SEWER", and shall be as manufactured by Griffolyn Company, Inc., Allen Systems, Inc. or equal. The remaining backfill shall be as specified in the "Selected Backfill" and "General Backfill" paragraphs of these specifications. Pipe shall have at least thirty-six inches (36") of cover before wheel loading and at least forty-eight inches (48") of cover before using heavy-duty tamping equipment such as a hydro hammer.

1.36 Construction along Highways, Streets, and Roadways

The Contractor shall install pipe lines and appurtenances along highways, streets, and roadways in accordance with the applicable regulations of the State Department of Transportation and the Owner with reference to construction operations, safety, traffic control, road maintenance, and repair.

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

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

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

2. Trenching, Laying and Backfilling: The Contractor shall open trenches, install pipe line, and backfill. The trench shall not be opened ahead of pipe laying operations any further than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated; excess material shall be removed immediately behind laying operations.

3. Shaping: The Contractor, immediately after completing backfilling operations, shall re-shape damaged cut and fill slopes, side ditches and ditch lines, and shall replace topsoil, sod, and other materials removed from shoulders in accordance with the requirements, and to the full and complete satisfaction, of the proper highway personnel and the Owner. The Contractor, when installing pipe lines and appurtenances, shall provide sufficient personnel and equipment so as to simultaneously carry out all of the above operations.

C. Excavated Material: Excavated material shall not be placed along highways, streets, and roadways in a manner which would cut off traffic. No scattered excavated material shall be allowed to remain on the pavement; all such material shall be kept swept away.

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

E. Maintaining Highways, Streets, Roadways, and Driveways: The Contractor shall furnish proper construction equipment, which shall be available for use at all times, for maintaining highways, streets, and roadways upon which work is being performed. All such highways, streets, and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work.

1.37 Connections to Existing Manholes

At locations where new sewers are shown to be connected to existing manholes the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. The work shall consist of making the opening in the manhole wall, inserting the new pipe to the elevation shown, filling the space in the wall around the pipe with mortar, and constructing and remodeling manhole inverts.

High-early strength cement shall be used for mortar in order that proper channels may be formed in manhole bottoms with a minimum interruption of service to the existing sewer.

1.38 Connections to Existing Sewers

At locations where new sewers are shown to be connected to existing sewers at a new manhole, the Contractor shall first expose the existing sewer, install a supporting timber beam, strap the pipe with suitable straps, and attach the straps to the beam; all in a manner which will bridge the excavation for the new manhole. The manhole shall then be constructed, and be complete with invert, frame, and cover. Under special conditions, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. Actual physical connection of the sewers will be made at a later date, as directed by the Owner.

1.39 House Service Lines

On all sewer lines laid in streets, and at all other locations 6-inch house service lines shall be provided at all buildings and dwellings and at such other locations.

A. Service Line: Service lines shall extend from the main sewer in the street to the property line unless otherwise directed by the Owner.

1. Service Branch Connection for PVC Pipe: Service branch connection for PVC pipe shall consist of molded or fabricated "T-Y" (in-line) branch fitting with all gasketed connections. Taps will be permitted only by special permission of the Owner and shall be a gasketed fitting in conjunction with a repair sleeve coupling or a gasketed saddle tee with all stainless steel clamps. Saddles may be mounted on pipe with solvent cement or gasket but shall be secured by metal banding. Saddles shall be installed in accordance with manufacturer's recommendations. Holes for saddle connections shall be made by mechanical hole cutters or by keyhole saw or saber saw. Holes to tee saddles shall be laid out with a template and shall be de-burred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting. Fittings which are prefabricated using pipe sections, molded saddles and PVC solvent cement may be used, provided the solvent cement used in fabrication has cured at least 24 hours prior to installation. Cemented mitered connections without socket reinforcement shall not be used. PVC primer and solvent cement shall be used in accordance with the manufacturer's current recommendations and ASTM D 2855, as amended to date. After solvent cementing saddles, temporary band clamps must be quickly placed both upstream and downstream of the saddle and tightened.

2. House Service Branches: In general, house service branches shall incline upward at approximately 45 degrees above a horizontal line normal to the direction of flow in the street main. Service lines shall be laid on a straight line and grade from the sewer or riser to the property line, and in no event shall service lines be less than three and one-half feet (3-1/2') deep to invert of the pipe at the property line.

Where required, short radius bends shall be used to connect the service branch to the house service line. Pipe service branches, together with bends, shall be placed on a compacted bed of crushed stone in such a manner as to be self-supporting and to relieve the strain on branches and bends.

B. Risers: Where trench depths are such that risers are required for the pipe, service lines shall be installed by excavating into ditch bank and installing riser in a vertical position against undisturbed earth, and the entire length of the pipe containing the riser encased in concrete in conformance with the details shown on the Drawings.

Risers shall extend to the heights directed by the Owner and shall be encased in a Sonotube fibre form as manufactured by Sonoco Products Company or a brick masonry stack as shown on the Detail Drawings. Bends shall be used to connect the riser to the house service lines.

C. Stoppers, Caps and Plugs: All house service connections shall be closed with factory manufactured pipe stopper of such design and secured in such a manner as to not leak under a maximum hydrostatic head often feet (10') or five (5) psi air pressure. The pipe stopper shall be able to be removed without special tools, excessive force or breakage of the pipe bell.

D. Marking Tape: Detectable marking tape shall be installed at the end of all house service lines. The tape shall be two inches (2") in width imprinted with the words "BURIED SEWER", and shall be as manufactured by Reef Industries, Inc. , Allen Systems, Inc. or equal. The tape shall extend from the invert of the service line to the ground surface and shall be firmly secured at the invert, but shall not be tied to house services lines.

1.40 Highway Crossing

The Contractor shall install pipe lines across highways in accordance with the applicable regulations of the State Department of Transportation and as shown on the Drawings. All work shall conform to the "Construction along Highways, Streets and Roadways" section of these Specifications. Permits for highway crossings will be obtained by the Owner.

1.41 Installation by Boring and Jacking

Where called for on the Drawings, casing, sewer line or force mains shall be installed by the boring and jacking method.

A. This section pertains to the boring and jacking of casing for short lengths of sewers or force mains under railroads and private right-of-way, highway, streets and similar features to the limits shown on the Drawings and as herein specified, including the installation of sewers (carrier pipes) generally twenty-four inches (24") or less in diameter inside said casing pipe.

B. The work is herein defined as the operations in which both the boring auger and the jacking of the casing or carrier pipe are done mechanically, and in which the diameter of the casing pipe is too small to permit hand working at the heading of the casing pipe. Two basic methods are (1) pushing the casing into the fill or earth simultaneously as the boring auger drills out the ground; and (2) drilling the hole through the fill or earth and pushing the casing into the hole after the drill auger has completed the bore.

C. A suitable boring pit shall be opened adjacent to the slope of the embankment, or adjacent to point of bored and jacked section as shown on the Drawings. The boring pit shall be long enough to accommodate the selected working room. The boring pit shall be solid sheeted, braced and shored as necessary to provide a safe operation. The Contractor shall take all precautions, and shall comply with all requirements as may be necessary to protect private or public property. Guide timbers or rails for keeping the casing pipe on line and grade shall be accurately set and maintained in the bottom of the pit, and with heavy timber back-stop supports installed at the rear of the pit to adequately take thrust of the jacks without any movement or distortion. It is paramount to the securing of acceptable tolerance limits of workmanship in the boring and jacking operation that extreme care be taken in the setting of all guides, rails and jacks to the end that the casing pipe in final position be within the limits of acceptability for the placing and laying of the carrier pipe. Except as otherwise limited on the plans, for variations in grade elevation of not exceeding four inches (4") from the established line and grade will be considered as acceptable within these Specifications, subject to the Owner's approval.

D. In general, the diameter, thickness, style, joints and materials selected for casing pipe shall be as shown on the Drawings and shall be considered as "minimum" requirements. In all cases, the approval for construction by agreement with the private company and/or construction permit issued by the State, County or municipal agency will be required before construction starts.

E. In general, carrier pipe will be P.V.C. or cast iron/ductile iron with mechanical or push-on joints. Joints shall be assembled adjacent to the casing pipe and the assembly pushed through the casing pipe so that the carrier pipe will be on a uniform grade as shown on the Drawings. For 12-inch or smaller carrier pipe a minimum of four (4) skids placed at 90 degrees will be required. For carrier pipe larger than 12-inch a minimum of six (6) skids placed at 60 degrees will be required. Skids shall be pressure treated lumber strapped to pipe. Thickness of skids must prevent bell of pipe from touching casing. Skids for ductile iron pipe shall be a minimum of 12-inches long, strapped behind the bell. Skids for PVC shall be full length of pipe with sufficient straps to prevent skids from moving during placement. Where necessary to maintain the grades as shown, adequate blocking shall be placed as required. Sand backfilling of the annular space between the carrier pipe and the casing shall be mechanically placed by an acceptable method approved by the Owner.

1.42 Location and Protection of Existing Underground Utilities

Underground utilities shown on the Drawings are for the Contractor's information only and it is not the intention of the Owner to convey the opinion that all utilities are shown. It is the responsibility of the Contractor to locate the underground utilities and to protect same. Utility lines or services damaged by the construction shall be repaired by the Contractor at his own expense.

1.43 Rip-Rap

The Contractor shall furnish and place rip-rap as required, and where shown. Rip-rap shall consist of stone or bagged sand-cement to a thickness of approximately twelve inches (12"). Stone shall be hard quarry or field stone of such quality that it will not disintegrate on exposure to water or weathering. Stone shall range in weight from a minimum of 25 pounds to a maximum of 150 pounds with at least 50 percent of the pieces weighing more than 30 pounds. Bagged sand-cement rip-rap shall consist of one part cement and five parts of sand in clean cloth bags, approximately one cubic foot in size. Sand and cement shall be as specified for concrete work herein.

1.44 Street Maintenance

All street and roads on which the Contractor is performing work shall be maintained for traffic. Proper construction equipment shall be available for this maintenance.

No more than one block of a street shall be closed for construction at anyone time. Before proceeding with trenching operations in a succeeding block the preceding section shall be completely backfilled, cleanup completed, and the street opened to traffic. When work is halted for the day, the Contractor shall completely backfill all excavations and remove all equipment to allow an uninterrupted flow of traffic.

1.45 Surfacing of Trenches in Dirt Streets and Driveways

Where trenches are along dirt streets and across dirt driveways open to vehicular traffic, the top two inches (2") of backfill up to the traveled surface shall be of crusher run or of a good grade, all-weather soil approved by the Owner.

1.46 Surfacing of Trenches in Paved Streets and Driveways

Where trenches are in paved streets and driveways, the remaining six inches (6") of backfill up to the traveled surface shall be made with crushed stone, ASTM C 33, as amended to date, Gradation #67 or #57, with sufficient fines for compaction. Trenches shall be compacted and maintained until pavement is replaced.

1.47 Testing and Cleaning

Before acceptance of any sewer or systems of sewers, lines shall be cleaned and tested in accordance with these Specifications. Where any obstruction is met, the Contractor will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be clean before final inspection. Pipe lines shall be straight and shown a uniform grade between manholes. The Contractor shall be required to correct any variations there from which may be disclosed during the inspection.

1.48 Leakage Tests

All sewer lines, including house service lines, shall be tested for leakage, in the presence of the Owner or his representative before being placed into service. Tests shall be conducted by one or a combination of the following three methods:

A. Infiltration Test: Where natural ground water levels stand a minimum of two feet (2') above the top of the pipe, the amount of leakage may be determined from measurements made at the lower end of the sewer section under test. Sewers above the test section shall be closed before testing by the installation of suitable watertight bulkheads. The average of six readings at five minute intervals will be used to determine the rate of infiltration for anyone test section.

The rate of infiltration of ground water into any test section of sewer, including manholes, shall not exceed the following:

Size of Sewer	Gallons Per 24 Hours Per Foot of Sewer
6"	0.06
8"	0.08
10"	0.09
12"	0.11
16"	0.15
18"	0.17
21"	0.20

B. Exfiltration Test: Where natural ground water levels do not stand two feet (2') above the top of the pipe, an exfiltration test shall be conducted on each section of sewer. The test shall be performed up to an average maximum hydrostatic head of ten feet (10'). The test shall be conducted in the following manner.

The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into each bulkhead at the top of the sewer pipe shall be 2-inch pipe nipple with an elbow. At the upper end of the test section a riser pipe shall be installed. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a tight valve, until all air is exhausted and until water overflows the riser pipe at the upper end. Water may be introduced into the pipe twenty-four (24) hours prior to the test period to allow complete saturation. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water.

During the test period, which shall extend over a period of thirty (30) minutes, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the thirty (30) minute test period shall not exceed that shown for infiltration in (A) above.

C. Low-Pressure Air Test: Where sewer grades are such that preclude performance of the exfiltration test or at the Contractor's option, a low-pressure air test shall be conducted on each section of sewer after completion and before acceptance.

Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low- pressure air. At the Contractor's option sewers may be tested in lengths between manholes or in short sections (25 ft. or less) using air-lock balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this section is reached and the pressure allowed to stabilize (approximately 2 to 5 minutes), the pressure maybe reduced to 3.5 psi before starting the tests. If a 1.0 psi drop does not occur within the test time, and then the line has passed the test. If the pressure drops more than 1.0 psi during the test time the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs and retest the line. Minimum test time for various pipe sizes, in accordance with ASTM F 1417, as amended to date, is as follows:

Nominal Pipe size Inches	T(time) Min/100 Feet	Nominal Pipe Size Inches	T(time) Min/100 Feet
4	3.46	12	11.20
6	5.40	15	14.20
8	7.34	18	17.00
10	9.26	24	19.50

Required test equipment includes air-lock balls, braces, air hose, air source, timer, rotometer as applicable, cut-off valves, pressure reducing valve, 0-15 pressure gauge, 0-5 pressure gauge with gradations in 0.1 psi and accuracy of + 2%.

The Contractor shall keep records of all test made. Copy of such records will be given to the Owner. Such records shall show date, line number and stations, operator and such other pertinent information as required.

The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over pressurizing the sewer line.

D. Repairs: All visible leaks shall be repaired regardless of whether infiltration, exfiltration or air test is within allowable limits. No sewer will be accepted until leakage tests demonstrate compliance with one of the above leakage test methods.

1.49 Testing Force Main

When a section of force main of a length deemed adequate is ready for testing, the line shall be filled with water, air completely exhausted and a leakage test made. The Contractor shall furnish all labor, materials and equipment for carrying out these tests. Wherever conditions will permit, in the opinion of the Owner, pipe lines shall be tested before the trench is backfilled. All joints then shall be examined during open trench test and all leaks entirely stopped. The Contractor shall furnish a test pump, and means for accurate measurement of water introduced into a line during testing, and shall furnish and install corporation stops in the line as required for blowing lines free from air and at the test pump location.

The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure tests, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material.

Test pressures shall be 100 lbs. per square inch. Allowable leakage in gallons per hour per 1000 feet of pipeline shall not exceed 0.045 D (D is the nominal pipe diameter in inches). Minimum test period shall be two (2) hours; however, if additional testing is required, such additional testing shall be performed by the Contractor.

Any cracked or broken material shall be removed and replaced with sound pieces, at the expense of the Contractor. Joints which leak shall be carefully remade. Remade joints and replace material shall be carefully re- tested under the same conditions of operation. If joints or materials are then found to be defective, they shall be remade and replace until the line passes the required test.

1.50 Replacement Pavement

Upon completion of backfilling and consolidation of the backfill, the Contractor shall furnish all materials and labor and shall replace all pavement removed for construction of the pipelines and appurtenances; and shall also remove and replace, at his own expense, any and all pavements adjacent to pipe trenches which may have been disturbed or damaged as the result of construction operations.

In the event weather conditions do not permit the permanent replacement of pavement immediately subsequent to the completion of pipe line construction, the Contractor will be required to maintain temporary surfacing until such time as the weather is suitable for paving operations. Any such delay will not be counted against the contract time for completion, provided, that all other work to be performed under the Contract is completed within the specified time.

The various types of pavement removed shall be replaced as follows:

A. Pavement Replacement: Street pavement shall be replaced in accordance with the applicable provisions of the Department of Transportation, State of Georgia, Standard Specifications Construction of Roads and Bridges, 1983 Edition, and with the details shown on the Drawings and/or as specified herein.

1. Base: On Highways the base for the asphaltic concrete pavement shall be eight inches (8") of concrete, or as shown. On all other streets, driveways, etc., the base for the asphalt concrete or bituminous surface treatment pavement shall be six inches (6") of crushed stone as specified in this section.

2. Asphaltic Concrete: The crushed stone base shall be thoroughly compacted to the proper level after which it shall be primed and sealed in accordance with the aforesaid standard specification. The wearing course shall consist of 1- 1/2" of Type "E" plant-mixed asphaltic concrete, conforming to the provisions of "Hot Mix Asphaltic Construction" Section 400 of the aforesaid Standard Highway Specifications.

3. Bituminous Surface Treatment Pavement: The surface of the previously placed crushed stone in sewer trenches and any holes in existing pavement shall be leveled at the proper grade and thoroughly compacted by rolling. The roadway surface shall then be thoroughly cleaned, sealed and primed, after " which there shall be applied a double surface bituminous penetration course, one inch (1") in thickness, conforming to the provisions of "Bituminous Surface Treatment", Section 424, of the aforesaid Standard Highway Specifications.

B. Sub-Grade Preparations: Under trench paving the sub- grade shall be thoroughly compacted by approved mechanical compaction equipment to 95 percent as determined by Modified Proctor Test. At least two (2) compaction tests shall be made between manhole reaches equal to or less than 200 feet long. At least three (3) compaction tests shall be provided for manhole reaches greater than 200 feet long. These tests shall be conducted by an approved soils testing company and shall be performed by an experienced soils technician.

C. Pavement Preparation: Before replacement of pavement, the pavement should be cut at least 12" back on each side of the trench or to visible over breaks, whichever is greater, to a depth of 2" with a concrete saw. No cutback will be required on bituminous surface treatment pavement. This will insure a straight vertical edge for the patch. After making the saw cut, the pavement to be removed should be broken into small pieces and removed. The broken edge below the saw cut is left fairly rough and irregular, but is approximately a vertical plane to provide an aggregate interlock between the patch and the existing pavement. The sub-base material should be carefully placed and shaped. Water should be added to provide a damp but not wet sub-base before the concrete base or soil cement base is placed. The Vertical face of the existing pavement should be sprayed with a fine mist of water to moisten the vertical surface. To further improve the probability of obtaining a bond between the old pavement and the concrete base to be poured, the vertical face of the old pavement should be painted with a solution of Portland Cement and water mixed to the consistency of heavy paint. The new concrete base should then be poured or soil cement base placed before this surface dries out. The base should be placed with care, making sure it is worked back into all comers and into the rough surface of the existing pavement assuring a locking bond between the old pavement and the new base being placed.

1. Concrete Base: After the concrete base has cured, the concrete surface and vertical edges of the existing paving must be clean and dry before the tack coat is applied. The tack coat should be applied to the surface of the new concrete base and brushed into the comers and on to the vertical edges of the old pavement to provide a bond and seal out water. The asphalt surface material should be immediately placed after the surface of the tack coat has dried to the point it is sticky to the touch.

2. Soil Cement Base: In lieu of the concrete base as described above, a soil cement base material consisting of approximately twelve (12) percent Portland Cement by volume and a friable local material must be used. The local material and mixture must be approved by the Owner. The minimum depth for the soil cement should be 12". This material should be placed in at least two (2) layers with no layers to exceed 6" in depth and compacted to 100% compaction. In lieu of the bituminous tack coat, a bituminous prime should be lightly sprayed or mopped onto the soil cement base as soon as it is completed.

3. Asphalt Surface: The asphalt surface material should be immediately placed after the surface of the bituminous prime has cured. A short period of time is required for the prime to penetrate into the base material.

D. Replacement of Concrete Curb and Gutter, Street, Driveway and Sidewalk: Concrete curb and gutter, street, driveway and sidewalk shall be replaced with Class "A", 3000 psi concrete of the same thickness and dimensions as was removed.

E. Payment: Payment for pavement replacement will be made as a separate item, based on the measure and quantity of paving replaced at the unit prices bid in the Proposal. Measurement for payment for concrete curb and gutter, street, driveway, and sidewalk shall be by linear foot measured along center line of pipeline. No payment will be made for extra widths not anticipated.

1.51 Grassing

The Contractor shall establish and maintain, until Owner acceptance, grassing in all disturbed areas, grassing in all finish grade areas, including cut and fill slopes and other areas as indicated on the Drawings. All pipe lines shall be grassed.

A. Materials: (See Erosion and Sediment Control Plan)

B. Preparation of Grade:

1. Grading: (See Erosion and Sediment Control Plan)

2. Soil Improvement

a. The Contractor shall request the County Agent to check the pH, and liming is recommended, shall apply lime of the type and in prorating recommended by the County Agent.

b. The lime and fertilizer shall be uniformly mixed into the top 4" of soil. All surface areas distorted by ground preparation or mixing shall be restored to finish grade as shown on Drawings. On cut slopes steeper than 3:1 the mixing may be omitted.

C. Sowing of Seed: (See Erosion and Sediment Control Plan)

D. Protection: All disturbed areas shall be covered with clean wheat or oat straw at a rate of one bale per 1000 square feet. Adequate protection shall be provided for all areas against damage of any kind, until inspection and acceptance. Damaged areas shall be promptly repaired.

E. Grass Stabilization: (See Erosion and Sediment Control Plan)

F. Temporary Grassing and Mulching: (See Erosion and Sediment Control Plan)

1.52 Vegetation Cleanup, Maintenance and Inspection

A. Cleanup: Any soil, mulch or similar material which has been brought onto paved areas by hauling operations or otherwise shall be removed promptly, keeping these areas clean at all times. Upon completion of the planting, all excess soil, stones and debris which have not previously been cleaned up shall be removed from the site or disposed of. All grassed areas shall be prepared for final inspection.

B. Maintenance: Maintenance shall begin immediately after installation and continue until final inspection and acceptance. Grassing shall be protected and maintained by watering and mowing. Replanting may be necessary to produce a uniform stand of grass. Weeding, fertilizing, liming, disease and insect pest control, aerating and all other procedures consistent with good horticultural practice may be necessary to insure normal, vigorous and healthy grass.

C. Inspection for Acceptance: Upon the complete installation of grassing, the Contractor shall request an inspection to determine that all required areas have been satisfactorily grassed according to the plans and specifications. Grassing shall be noted as to condition and coverage and shall be free from erosion and other damage prior to being accepted. Upon acceptance, the Owner shall assume the responsibility for maintenance.

1.53 Cleaning Up

Before the work is considered complete, all material not used, and rubbish of every character must be removed from the project. All streets, sidewalks, curbs, fences and other private or public facilities and structures disturbed must be in essentially as good condition as existed before the work was done. Any subsequent settlement of backfill or pavement over trenches shall be replaced by the Contractor and the surfaces brought to grade.

1.54 Acceptance of Work

Sewer lines and appurtenances will not be considered ready for acceptance until all provisions of these Specifications have been complied with, until all tests have been satisfactorily completed, and until inspection of the work has been made. Sewage flows shall not be diverted into new sewers until after such time as final inspection of the lines has been made and permission granted therefore.