

WATER MAIN CONSTRUCTION

01. SCOPE: This section shall include the furnishing of all labor, tools, materials, and all other incidentals required for a complete system as shown on the drawings and specified herein.

02. MATERIALS:

A. General: All materials used on this project shall conform, as a minimum, to the specifications contained in this section. Should the contractor desire to use other materials not listed in these specifications, written permission must be obtained from the Owner's engineer. Specific types of pipe shall be specified in the Schedule of Bid Items and/or the Special Provisions.

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purposes specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

B. Pipe:

1. Ductile Iron: ASTM Specification A339-55, latest revision, Gr. 60-42-10, and in conformance with ANSI Stand. A21.51-1991 (AWWA C151-91), as approved by Sect. Comm. A21, American National Standards Association. Pipe dimensions shall conform to Federal Specifications WW-P-421c, Type II, push-on joints; Type III, mechanical joints. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from cast iron. Pressure class shall be as required by ANSI A21.50-1991 latest revision, assuming Type 1 laying conditions. The minimum pressure class for each size pipe shall be Pressure Class 200.

a. Joints:

(1) Push-On Joints: Shall be a single rubber gasket joint and comply with ANSI/AWWA C11/A21.11.

(2) Mechanical Joint: Shall be a bolted joint of the stuffing-box type and shall comply with ANSI/AWWA C11/A21.11.

(3) Restrained Push-On Joints and Restrained:

Mechanical Joints: Shall comply with the applicable sections of ANSI/AWWA C11/A21.11 and shall be TR Flex or equivalent. Restrained joint ductile iron pipe shall be provided at fittings and bends in the lengths and sizes as indicated on the contract drawings. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.

b. Lining and Coating: Shall be a cement mortar lining of standard thickness with a seal coat of asphaltic material and shall comply with ANSI/AWWA C104/A21.4-80.

c. Exterior Coating: Shall be an asphaltic coating in accordance with ANSI/AWWA C151/A21.51-81.

2. Flanged Ductile Iron Pipe with Threaded Flanges: Shall be ductile iron with a maximum working pressure of at least 250 psi and shall meet the requirements of ANSI/AWWA C115/A21.15-83. Flanges shall be ANSI B16.1 Class 125 or Class 250 as necessary to match the flanges of the attached valve or fitting, or adaptors may be used to mate the Class 125 flange to a Class 250 flanged fitting or valve.

3. Steel: Galvanized, standard weight, screwed pipe, ASTM Standard A120-62T. Galvanized steel pipe shall not be used for distribution system or water service lines without the written approval of the Owner.

a. Joints: Malleable iron couplings, Type II, Zinc coated, federal specification WW-P-521d(1).

4. Wrought Iron: Class A, Standard weight, zinc coated, Federal Specification WW-P-441b(1). Use only where indicated on the drawings or with the written approval of the Owner.

a. Joints: Wrought iron couplings, Type II, zinc coated, Federal Specification WW-P-521d(1).

5. Copper: Federal specification WW-T-799, Type K.

a. Joints: Flared, or where otherwise indicated, wiped joints.

6. PVC: PVC Pipe shall be SDR 21 as specified in the contract documents (Schedule of Bid Items). The pipe shall be plainly marked with the following information: manufacturer's name, size, material (PVC) type and grade or compound, NSF Seal, pressure rating and reference to appropriate product standards.

a. PVC pipe used for construction shall comply to the following standards:

(1) Standard dimension ratio - ASTM-D-2241

200 psi pipe SDR 21

(2) Grade 1 PVC Compound Material - ASTM-D-1784
1254-B

(3) Rubber Coupling Rings - ASTM-D-1869

(4) Burst Pressure Test - ASTM-D-1599

200 psi, SDR-21-minimum quick

burst pressure 800 psi

- (5) Impact Strength - ASTM-D-2444
- (6) Schedule 40 Fittings - ASTM-D-2466
- (7) Schedule 80 Fittings - ASTM-D-2467

b. Joints: Push on joints utilizing elastomeric ring gaskets complying with ASTM D-3139.

C. Fittings:

1. Ductile Iron: Ductile iron fittings shall be mechanical joint or slip joint in accordance with the requirements of ANSI/AWWA C153/A21.53. The fitting shall be made of ductile iron complying with ASTM A536 and the working pressure shall be 350 PSI. The joints shall conform to ANSI/AWWA C111/A21.11. Bolts and nuts shall be low alloy steel.

Linings and coatings shall be as required in the specifications for ductile iron pipe.

In the case of mechanical joint fittings, payment shall be made on a weight basis and shall include the body and accessories.

Payment for all fittings shall be based on the main body weight, not including accessories, as published in ANSI 21.10 for all mechanical joint fittings. PVC fittings may be used for 4" and 2" PVC pipe. The cost of PVC fittings shall be included in the price bid per l.f. of pipe since there will be no pay item for fittings other than ductile iron.

2. Flanged Pipe: ASA Specification B16.1, Class 125, flanged. Gaskets shall be one-sixteenth inch thick ring gaskets of red sheet rubber.

3. Steel Pipe: Malleable iron, zinc coated, Federal Specification WW-P-521d(1), Type II, where approved for use.

4. Copper Pipe: Brass or bronze fittings for flared copper pipe, or wiped joint fittings where indicated or required.

5. Wrought Iron Pipe: Wrought iron, zinc coated, Federal Specification WW-P-521(d), Type II, where approved for use.

D. Certificate of Inspection: Submit to the engineer a certificate of inspection from the pipe manufacturer that the pipe supplied has been inspected at the plant and meets the requirements of these specifications.

E. Valves: Valves supplied shall be of the designations and description indicated on the plans or described herein. The contractor shall insure himself that all valves supplied are produced in accordance with any references to codes or standards.

1. Gate Valves: Gate valves shall be designed and manufactured in accordance with the requirements of the latest revision of AWWA C-509. All valves shall be of iron body, bronze mounted, resilient seat type with nonrising stems and a 2" square operating nut. Valves shall be manufactured with "O" Ring stem seals. Valves 16" and larger shall have a by-pass to equalize pressure on both of the valves to facilitate opening. All valves 24" and larger shall be equipped with gearing and asbestos packing.

Valve ends shall be of the size and type required for connections to the type service line used. Standard connections shall be push-on w/gaskets for PVC pipe, or M.J. for CI or DI pipe.

Pressure ratings for the valves shall be as follows:

SIZE	WORKING PRESSURE	HYDROSTATIC TEST PRESSURE (SHELL)
2"-12"	200 psi	400 psi
14"-24"	150 psi	300 psi

Mueller, American-Darling, Kennedy, American, U.S. Pipe, M&H or approved equal will be accepted.

F. Valve Boxes: Adjustable valve boxes shall be of equal quality and workmanship to those manufactured by Mueller Company, or Resslerer Valve Company. Valve boxes shall be of close-grained gray cast iron. The valve boxes shall be the two-piece screw type and the cover or cap shall have cast on the upper surface in raised letters the word "Water". Valve boxes shall be painted with a coat of protective asphaltum paint before being shipped from the factory.

G. Hydrants: All hydrants shall comply with AWWA Standard C502, the latest revisions thereof, and the following design standards.

1. Fire hydrants shall be of the compression type, closing with the line pressure, with a 4 1/2" valve opening.

2. Hydrants shall have a minimum of 3'-6" bury and shall stand approximately 30" above surface elevation.

3. Hydrants shall be furnished with a sealed oil or grease reservoir located in the bonnet, so that all threaded and bearing surfaces are automatically lubricated. Teflon washers shall be used for ease of operation.

4. Hydrants shall be furnished with a breakable feature that will break cleanly upon impact. This shall consist of a two-part breakable safety flange.

5. The seat ring shall be bronze and thread into a bronze drain ring located between the lower barrel and shoe.

6. All hydrants will be cast marked or outside design shall be such that visible identification can be made as to type and design.

7. Hose and pumper nozzles shall be threaded or leaded-in nozzles with caps and chains supplied.

8. Paint: All hydrants shall receive two exterior shop coats of fire hydrant red paint as specified by AWWA C502. In addition, one finish exterior coat of fire hydrant red paint shall be applied after construction operations are complete.

The paint schedule shall comply with the following:

(a) Preparation: Steel structures painting council - SP1-63 and SP2-63. Solvent and tool cleaned. Lightly sand existing coatings. Spot prime all damage areas of existing coating.

MANUFACTURER	SPOT PRIMER	FINISH COAT
Tnemec	37-77	Tneme-Gloss
Koppers	622	Glamortex
Pratt and Lambert	40.90	Vitralite Gloss

9. Hydrants shall be equipped with one 4 1/2" pumper connection and two (2) 2 1/2" fire hose coupling connections. Outlet nozzle caps shall be provided for all outlets.

10. Hose gauge will be national standard, operating nut will be 1 1/2" pent. open counter clockwise.

11. Hydrants shall be Mueller Centurion, American Darling Mark 73 or approved equal.

12. Repair kits, tools and wrenches shall be provided as listed below:

- (a) Traffic Repair Kit - 1 for every 20 hydrants,
- (b) Main Valve Repair Kit - 1 for every 20 hydrants,
- (c) Maintenance Tool Kit - 1 for every 50 hydrants,
- (d) Hydrant wrenches - 1 for every 10 hydrants.

Whenever the number of hydrants is between the unit quantities listed here, round up to the next unit for determining the number of kits and wrenches.

Payment for items in this section will be included in the unit price bid for the hydrants.

H. Services: 3/4" to 2"

1. Tapping Saddles: Tapping saddles shall provide full support around the circumference of the pipe with a designed in safeguard against overtightening to prevent deforming the pipe. All parts of the saddle shall be constructed of corrosive resistant bronze or galvanized malleable iron including bolt and nuts required to assemble. Only saddles designed specifically for the type water main pipe used shall be allowed. Threads shall be AWWA standard cc tapered. Dresser 194, Rockwell 395, Ford S70, Mueller H-13000 Series, or approved equal will be accepted.

2. Corporation Stops: Corporation stops are to be of bronze construction and a minimum size of 3/4" (inlet and outlet). Inlet threads will be AWWA Standard Taper cc. Outlets will be IP threads with a brass compression-fitting adapter for the appropriate water service pipe size. Ford, Mueller, Hayes or approved equal will be accepted.

3. Pipe for Service Lines:

a. Type - Polyethylene

b. General: All polyethylene pipe shall conform to all applicable requirements in the latest revisions of the following standards:

(1) AWWA C901-78 - Standard for polyethylene (PE) pressure pipe 1/2" through 3" for water.

(2) ASTM-1248 - Standard for polyethylene molding and extrusion materials.

(3) ASTM-2239 - Standard for polyethylene (PE)Plastic pipe (SDR-PR). (IPS-I.D.)

c. Material - Polyethylene extrusion compound from which the polyethylene pipe is extruded shall comply with the applicable requirements for PE-3406 high density, ultra high molecular weight polyethylene material as described in ASTM D-1248 (latest revision). The PE pipe shall be rated for use with water at 73.4° F at a hydrostatic design stress of 800 psi and a maximum working pressure of 200 psi.

d. Dimensions and tolerances shall comply with ASTM D-2239 (Iron pipe size [SDR-7]).

e. Marking: The following data shall be clearly marked on all service pipe installed:

(1) Nominal size

- (2) Operating pressure @ 73.4° F
- (3) Type of pipe, i.e., "water service pipe"
- (4) Material designation code, "PE-3406"
- (5) Date code: Month, year and day
- (6) Manufacturer's brand name
- (7) National sanitation foundation logo (indicating approval for potable water and compliance with ASTM specifications)
- (8) ASTM Specification - "ASTM D-2239"
- (9) Plant location code

NOTE: Typical house service shall be 3/4" "IPS" as shown on plans.

4. Meter Yoke: Meter yoke shall consist of copper and have a height of seven inches. Yoke shall have an inverted key type valve with lockwing on the riser and an angle check valve with dual independently acting check valves located at the outlet of the meter. The check valve shall have spring-assisted seating, and the seat shall be of Buna-N Rubber. All other valve parts shall be red brass or stainless steel. Inlets will have a brass adapter as required for a compression fitting to "IPS" water service pipe. Outlet shall be Ford Double Purpose coupling, Mueller 14222, or approved equal. The yoke shall have a brace pipe eye for support. Supplier shall provide certification that meter yokes meet all requirements of AWWA C-800-84 or latest revision. Yoke shall be Ford 170 series Coppersetter or approved equal.

5. Compression Fittings: Compression fittings shall be Ford, "Pack-joint", Mueller, "110 Compression", Hayes, "Hayes-Tite" or approved equal. A stainless steel insert will be required with any fitting that compresses the outside of the pipe to hold the pipe in place.

6. Meter Boxes: Meter boxes shall be supplied with each service connection. Boxes may be constructed of either cast iron, concrete, non-corrosive high-density polyethylene, or PVC. Box shall have an inside lip for support of the lid where the Owner can place an identification number.

a. Cast Iron Boxes will be made in two pieces, i.e., box and cover. The box shall be a minimum of 12 inches deep by 17 inches long by ten inches wide. Boxes shall be manufactured by Dewey Brothers, Ford Meter Box Company, Opelike Foundry Company or equal.

b. Concrete Boxes shall not be less than 12 inches in depth by 17 inches long by 10 inches wide, and shall be cast from Class "A" concrete. The cover shall be made of either

reinforced concrete and cast separately from the box with a cast iron reading lid, or the lid may be of all cast iron construction.

c. Plastic Boxes: High-density polyethylene material used in the boxes shall meet or exceed the following physical properties:

- (1) Flexural modulus, psi - 90,000
- (2) Compression strength 10% deflection, PSI - 1,100
- (3) Heat distortion, 66 psi - 170°
- (4) Specific gravity - .6
- (5) Hardness, Shore D – 58
- (6) Impact strength, 1016., falling dirt - 160 in-lb.
- (7) Total load at center of top - 2,800+ lbs.

Boxes shall not be less than 12" deep, by 17" long by 10" wide. The box cover may be either plastic with a cast iron reader lid or of all cast iron construction.

d. PVC Boxes: PVC boxes shall be made of an extrusion grade PVC material with a wall thickness of at least .300" and a minimum diameter of 15". The lid shall be cast iron with a rim extending 1/2" below the base to fit inside the box.

7. Teflon Tape: Teflon tape will be used on all threaded connections to reduce the possibility of leaking joints.

I. Tapping Sleeves: Tapping sleeves shall consist of two sections of heavy welded steel which bolt together on the pipe and seal against a concave wedge gasket around the tap opening. The outlet shall have a flat-faced flange that is recessed to mate with standard tapping valves per MSS SP60 up through 12-inch size on size. Finish shall be a fusion-bonded epoxy coated to an average of 12 mil thickness. Bolts and nuts shall be stainless steel. Tapping sleeve shall be Rockwell 622 or approved equal.

J. Air Release Valves: The air release valves shall automatically function to release to atmosphere entrained air that may accumulate in the pipeline. Once the accumulated air is exhausted, the valve shall seat tightly to prevent water leakage. The valve shall operate through a compounded lever system. The valve body and cover shall be of cast iron; float of stainless steel; levers of brass; and with a resilient seat. The valves shall be sized and installed as shown on the contract drawings. Valves shall have 250 lb. flanged inlet. Valves shall be capable of operating from 0 to 100 psi. The air valve

body shall be rated for a system pressure of at least 250 psi. Valves shall be Crispin Model P32 or approved equal.

Note that the isolation valve for the air release valve installation must have a rated working pressure of at least 200 psi and be provided with 250# flanges or have a flange adapter.

03. CONSTRUCTION METHODS:

A. General: All pipe shall be laid when and as directed by the Engineer. The work shall be discontinued to the least degree possible.

B. Trenching: The trench shall be dug to the required alignment and depth as shown on the plans or directed by the Engineer, and only so far in advance of the pipe laying as the Engineer shall permit. The width of the trench shall be kept at a minimum. The depth of the trench shall generally be sufficient to allow a minimum of three feet of cover over the top of the pipe. The bottom of the trench shall be shaped by hand and shall support the pipe for the entire length.

It shall be the responsibility of the contractor to provide adequate bearing for all pipe lines laid in uncertain soil conditions. If the trench bottom should be softened by flooding, rain or other causes, the unsuitable material shall be removed and replaced with suitable material properly shaped and tamped to grade.

The use of timber or other material to support the pipe shall not be used.

C. Pipe Laying: All water pipe shall be laid by experienced workmen with straight lines, even grades, and all joints shall be perfectly fitted. All pipe fittings, valves, hydrants, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Engineer. All foreign matter or dirt shall be removed from the interior and machined ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean by means approved by the Engineer during and after laying.

D. Joining Mechanical Joint Pipe:

1. Joining Existing Bell and Spigot to New Mechanical Joint: Due to the difficulty that may be encountered in attempts to make such a connection of this type, an adapter having a fitting bell and a M.J. socket may be used by the contractor.

2. Cleaning and Assembling Joints: Clean last 8" outside the spigot, and the inside of the bell of mechanical joint pipe to remove oil, grit, tar (other than standard coating) and other foreign matter from the joint and then paint clean area with an approved soap solution. The cast iron gland shall then be slipped on the spigot end of the pipe with the extension of the gland toward the socket or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with thick edge toward the gland.

3. Bolting of Joints: Push entire section of pipe forward to seat spigot end in the bell. Press gasket into place within the bell, being careful to have the gasket evenly located around the entire joint. Move C.I. gland along the pipe into position for bolting, insert all bolts, and screw nuts up tightly with fingers. Tighten all nuts with a suitable (preferably torque-limiting) wrench. Tighten nuts that are spaced 180 degrees apart alternately in order to produce equal pressure on all parts of the gland.

E. Joining Rubber Gasket Pipe (Bell Tite, Tyton, or Equivalent):

1. Cleaning Joint and Gasket: Clean gasket and spigot and inside of bell thoroughly to remove all dirt and other foreign matter.

2. Inserting Gasket: Insert gasket furnished by the pipe manufacturer into the gasket seat in the bell. Gasket shall be properly seated in the grooves provided in the pipe bell.

3. Lubricating Gasket and Pipe Spigot: Using a non-toxic vegetable soap, apply a film by hand to the inside surface of the gasket that comes into contact with the entering pipe and to the first 1" of the spigot end of the entering pipe. Use only lubricant specified by the pipe manufacturer.

4. Final Assembling of Joint: Align entering pipe with the bell to which it is to be joined. Enter the spigot end into the bell until it just makes contact with the gasket. Apply sufficient pressure to force the spigot end past the gasket up to solid contact with the bell.

5. Field Cutting Pipe: Rubber gasket pipe - when it is necessary to field cut rubber gasket pipe, chamfer the cut end 1/8 inch x 30° before inserting into a rubber gasket bell.

F. Joining Plastic Pipe: Plastic pipe shall be joined in strict accordance with the manufacturer's recommendations.

G. Testing: The contractor shall provide a suitable pump for applying pressure and an accurate gauge for measuring the pressure. Immediately upon completing a portion of the line between two valves, the pipe shall be tested by applying one hundred fifty (150) pounds per square inch hydrostatic pressure.

This pressure shall be maintained for two hours. Hydrostatic testing shall conform to all applicable requirements of ANSI/AWWA C600-82, Section 4. Leakage shall not exceed 10 gallons per inch of pipe diameter per mile of pipe per 24 hours.

H. Disinfection: After pipes are laid, and before cutting into the existing system, they shall be disinfected in a manner acceptable to the Engineer, and to his complete satisfaction, such disinfection to meet the requirements of the North Carolina Department of Environment and Natural Resources, Division of Environmental Health, and all applicable requirements of AWWA C601-68, and shall be accomplished by filling the pipe with a solution of 50 parts per million residual chlorine. This solution shall remain in the pipe for 24 hours.

After a section of pipe has been tested and disinfected, the pipe shall be flushed to remove excess chlorine. Water samples shall then be taken by the contractor at each fire hydrant, as directed by the Engineer, for biological testing. The Contractor shall have these tests run by an approved testing laboratory. No portion of the system shall be placed in operation until the tests are approved. If the presence of coliform bacteria is detected in the water samples, the section of pipe shall be disinfected again and additional samples shall be taken. The expense of disinfecting again shall be borne by the Contractor with no additional expense to the Owner.

I. Connections to Existing Mains: No connection shall be made by the contractor to any section of the existing water system unless the Resident Inspector, Field Engineer, or Water Plant Superintendent is present at the site. No valve or hydrant shall be opened or closed unless one of the above-listed persons is present at the site.

In making connections to the old distribution system, valves shall be set as shown on the plans, or at such designated place as the Engineer may direct. If, due to unforeseen conditions, these locations have to be changed or additional valves or fittings added, the Contractor shall install the valves or fittings at the new locations.

J. Valves: All valves set by the Contractor shall include a valve box set to grade as directed by the Engineer. Valves shall not be set under pavement.

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

L. Hydrants: Fire hydrants shall be set where shown on the plans or as directed by the Engineer. The hydrants shall be set upon a bed of compacted crushed stone at least thirty (30) inches square by ten (10) inches in depth.

Extreme care shall be taken in excavating a vertical bank on the back side of the hydrant in order to leave a firm bank of earth against which to block or brace the hydrant. The hydrant shall be blocked or braced by placing concrete behind the back of the hydrant to keep the hydrant from being forced off of the end of the pipe by water pressure in the main. There shall be furnished and installed an approved strapping assembly to securely anchor the hydrant to the main line. The cost for the strapping assembly shall be included in the unit price for hydrants.

When the hydrant is backfilled, crushed stone or gravel shall be placed around the hydrant to a point just above the drain holes of the hydrant.

M. Blocking: All turns, fittings, etc., that induce pressure which would cause separation of the pipe, breakage, etc., shall be blocked with 3,000 lb. concrete. Blocking shall be formed and placed in such a manner that the pressure to be exerted at the point of blocking shall be transferred to firm, undisturbed earth at a maximum load of 2,000 lbs. per square foot. The Contractor shall insure that blocking at all tees, bends, plugs, etc., shall be sufficient to contain all pressure exerted by the pipe up to a pressure of 150 lbs. per square inch hydraulic pressure within the pipe, i.e., pressure at plug = $150 \div (\text{area of pipe in inches})$. The Contractor shall also be responsible for any damage or repairs caused by blowouts of any insufficiently blocked pipe.

When gray cast or ductile iron fittings are used with SDR 21 pipe, restrained joints may be provided in lieu of concrete blocking in the following cases:

JOINTS TO BE RESTRAINED

Direction Change-bends, offsets	inlet and outlet
Size Change-reducers	inlet and outlet
Branches-tees, crosses, wyes	branch(es) only
Dead ends-caps, valves	all joints

The contractor shall use Uni-Flange 1300-S PVC pipe restrainers by Ford Meter Box Company or equivalent to achieve restraint from pipe to mechanical joint connection. These restrainers shall be a two piece clamping ring and incorporate serrations on the I.D. for 360 degrees contact and support of pipe. The restrainers shall not be used as a combination mechanical joint gland and restrainer.

All restrainers used shall have Factory Mutual approval for use on the type of pipe on which the restrainer is to be installed.

In addition to the above, a sufficient length of restrained pipe shall be provided before and after these joints where needed. To restrain the bell and spigot ends, use the Uni-Flange 1350-S restrainer or equal. The length to be restrained shall be determined from the following schedule:

<u>NOM.</u>	<u>L-MINIMUM LENGTH TO BE RESTRAINED ON EACH SIDE OF FITTING(ft.)</u>				
	<u>PIPE</u>	<u>ELBOWS(deg.)</u>			<u>VALVES, DEAD ENDS, TEES</u>
<u>SIZE</u>	<u>11 1/4</u>	<u>22 1/2</u>	<u>45</u>	<u>90</u>	
2	2	4	6	11	9
4	4	6	11	17	13
6	4	7	13	21	15
8	5	10	16	26	18
12	7	14	24	39	27
14	8	16	28	44	41
16	9	18	31	50	46
18	10	20	34	55	50
24	12	26	40	65	60

Payment for restrainers shall be paid for at the unit price bid for concrete for blocking. The quantity used shall be the volume required by the schedule for blocking the fitting in question.

N. Borings:

1. Boring under paved roads and highways:

a. Standards: Procedures for boring shall be in accordance with the best accepted methods of the construction and as shown on the plans and specified in these specifications.

b. General: Lines installed under highways shall be bored as shown on the detailed drawings. Casings will be installed of the type, size, and thickness as specified herein or on the detailed drawings. The contractor shall be responsible for notifying the Department of Transportation at least five days prior to any contemplated work and for securing any required permits for performing the work. All work shall be accomplished under the supervision of the Engineer and the District Engineer of the Department of Transportation or his authorized representative.

c. Carrier Pipe: Carrier pipe used under highways shall be of an approved material and installed to the satisfaction of the District Engineer of the Department of Transportation.

d. Casing Pipe: The inside diameter of the casing pipe shall not be less than two inches greater than the largest outside diameter of the joints and couplings for carrier pipe less than 6" o.d., and 4" greater for carrier pipe 6" and larger. It shall, in all cases, be great enough to easily remove carrier pipe without disturbing the casing pipe.

(1) Pipe Size 8" & Smaller: Schedule 40 wrought steel or wrought iron pipe having a wall thickness as shown below may be used for casing pipe 8" and smaller.

DIAMETER OF PIPE INCHES	WROUGHT STEEL WALL THICKNESS INCHES	WROUGHT IRON WALL THICKNESS INCHES
2 1/2	.203	.208
3	.216	.221
3 1/2	.226	.231
4	.237	.242
5	.258	.263
6	.280	.286
8	.322	.329

(2) Pipe Sizes 8" and Larger: Steel pipe for casings 8" and larger shall be manufactured from steel having a minimum yield strength of 35,000 psi with the minimum wall thickness as shown below:

DIAMETER INCHES	MINIMUM WALL THICKNESS INCHES
10"	.188
12"	.188
16"	.250
18"	.250
20"	.250
24"	.250
30"	.312
36"	.375

e. Installation: The minimum depth from the roadway surface to the top of the casing pipe at its closest point shall be three feet. Casing pipe shall be filled with sand as shown on

plans and the ends shall be sealed. Contractor may use casing spacers in lieu of filling with sand with prior approval of Engineers.

Contractors shall be required to provide shoring of boring pits and trenches more than six feet deep in accordance with the North Carolina Department of Transportation and Federal Occupational Health and Safety Act.

2. Boring Under Railroads:

a. Standards: Procedures for boring shall be in accordance with the best accepted methods of the construction and as shown on the plans and specified in these specifications.

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

c. Carrier Pipe: Carrier line pipe and joints shall be of the material shown on the details of the railroad encroachment agreements or as approved by the Chief Engineer or his authorized representative.

d. Casing Pipe: The inside diameter of the casing pipe shall not be less than two inches greater than the largest outside diameter of the joints and couplings for the carrier pipe less than 6" o.d., and 4" greater for carrier pipe 6" and larger. It shall, in all cases, be great enough to easily remove carrier pipe without disturbing the casing pipe.

Steel pipe manufactured from steel having a minimum yield strength of 35,000 psi and having a minimum permissible wall thickness as listed below shall be used as casing pipe.

DIAMETER OF PIPE INCHES	MINIMUM WALL THICKNESS INCHES
10"	.188"
12"	.251"
16"	.312"
18"	.313"
20"	.375"
24"	.407"
30"	.469"
36"	.532"

e. Installation: The depth from the base of the railway rail to the top of the casing at the closest point shall not be less than 6 feet. Also, there should not be less than 3 feet from the bottom of the side ditches to the top of the casing pipe. Casing pipe shall be filled with sand as shown on plans and the ends shall be sealed. Contractor may use casing spacers in lieu of filling with sand with prior approval of Engineers.

Contractors shall be required to shore all pits used for boring if it is over six feet deep.

O. Stream Crossings: Streams, creeks or rivers will be crossed by one of the following methods as detailed on the plans:

1. D.I.-Ball Joint Pipe laid 18" (minimum) below bottom of stream creek, or river.
2. D.I.-Push on joint pipe encased in concrete laid 18" (minimum) below bottom of stream, creek, or river.
3. D.I.-M.J. pipe laid 18" (minimum) below bottom of stream, creek, or river.
4. D.I.-M.J. pipe encased in concrete and laid under stream bottom.
5. Steel casing pipe laid under stream, creek or river bottom with a carrier pipe placed inside.
6. D.I.-M.J. pipe attached to bridge by anchor bolts.
7. Span crossing with welded steel pipe.
8. D.I. - R.J. pipe laid 18" (minimum) below bottom of stream, creek or river.

The contractor shall construct each crossing as detailed and as directed by the Engineer. Construction will only be undertaken when the Engineer's representative is present.

P. Valve and Meter Vaults:

1. General: The contractor shall supply all specified material, labor, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation of all valve and meter vaults as shown on the plans. The meter and strainer will be supplied by others. However, installation will be the responsibility of the contractor under this item.

Although such work may not be specifically shown or specified, all supplementary or miscellaneous items, devices or appurtenances incidental to or necessary for a sound, secure, complete and compatible installation shall be furnished and installed as part of this work.

2. Submittals: The contractor shall submit complete shop drawings showing locations and dimensions of equipment proposed to be used in the construction.

3. Location: Valve and meter vaults will be located, as much as possible, within the rights of way of the N.C. Department of Transportation or public roads where the pipe lines to be connected are located. The contractor will construct the vaults in such a manner as to protect the existing structures, i.e., road surfaces, drainage piping, or road shoulders that exist close to the proposed vault locations.

4. Materials and Equipment:

a. Vault: The enclosing vault shall be constructed of formed and poured in place concrete as shown on the detailed drawings. The contractor may use as an equal a pre-cast vault if dimensions and design strength are adequate.

If a pre-cast vault is proposed, detailed drawings and design data shall be submitted to the Engineer for approval prior to beginning construction. Any pre-cast vault used must be on the N.C. Department of Transportation approved list of manholes and vaults.

b. Valves:

(1) Gate Valves: Gate valves supplied shall be as specified in Section 02. E. 1. of these specifications. All gate valves supplied for vault installation shall have ends as shown on the detailed drawings.

(2) Check Valves: Check valves supplied shall be iron body, fully bronze mounted swing type, gravity operated with lever and weight with 125# flanged ends as manufactured by Mueller Co., American Darling, Kennedy, American, or an approved equal.

04. BASIS OF MEASUREMENT:

A. Pipe: Pipe will be measured from the bell or connection at the beginning to the bell or connection at the end, per linear foot, complete in place and accepted, including the furnishing of all labor, tools, materials, and equipment necessary for trenching, laying, jointing, testing, sterilizing, backfilling, making connections to existing mains, and all other necessary incidentals.

B. Valves: Valves will be counted by unit, complete in place and accepted, including valve boxes set to grade.

C. Hydrants: Hydrants shall be measured by unit, complete in place and accepted. A hydrant unit shall consist of: (1) Hydrant (depth of bury as shown on plans; (2) 15' average length C.I. hydrant leg; (3) 2 3/4" threaded tie rods from tee to hydrant. Valves and fittings for hydrant branches shall be measured under A. above and D. below. This item shall include the furnishing of all labor, tools, materials, and equipment necessary to complete construction as specified.

D. Fittings: Cast iron fittings shall be measured by invoice weights, complete in place.

E. Bores: Bores shall be measured from end to end of casing pipe installed and accepted.

This item shall include casing pipe and other materials, tools, equipment, labor and incidentals required to bore and install casing as shown on the details and as directed by the highway or railroad district engineer and/or resident engineer.

F. 3/4" - 2" Services: Services shall be measured as a unit and shall include labor, materials, equipment, and all incidentals required to install the following:

1. Tapping saddle
2. Corporation stop
3. Service pipe and casing pipe if bored under road
4. Meter Setter
5. Meter Box

G. Blocking: Blocking for fittings shall be measured by the cubic yard of concrete. This item shall include all labor, materials, equipment, and incidentals necessary to properly block all fittings and bends according to the detailed drawings. Payment will not be made for more concrete than given in blocking schedule unless approved by the Engineers.

H. Stream Crossings: Stream crossings shall be measured by the l.f. of the specified pipe and shall include all material, labor, equipment, and incidentals necessary to install the pipe for the crossing as indicated in the Schedule of Bid Items, detailed on the plans, and as directed in the field by the Engineer.

I. Metering and Valve Vaults: This item shall be measured by the unit and shall include the following: Concrete valve vault, piping, fittings, valves (Gate, check and pressure regulating if required) and all other incidentals shown on the plans or required for proper installation. Also included shall be all incidental excavation, dewatering, shoring, traffic control and all associated equipment and labor. This item shall begin and end at the existing or proposed service line on either side of the vault.

05. PAYMENT: Payment shall be made at the contract unit price on items measured as described above.

EARTHWORK (PIPE)

01. SCOPE: This section shall include all excavation, shoring, dewatering, filling, backfilling, and compacting as indicated on the drawings, and specified herein, and directed by the Engineer. Provisions of this section shall apply to all pipe work.
02. CHARACTER OF EXCAVATION MATERIAL: Since soils vary widely within the project area, the contractor shall satisfy himself as to the nature of material that will be encountered during the course of the project.
03. EXISTING UNDERGROUND UTILITIES: The contractor shall be responsible for locating all underground utilities and structures along the pipe lines to be installed in order to avoid conflict and costly repair of such utilities.
04. CONFLICTS: Where it is impossible to avoid conflict with existing utilities, the new construction shall be performed in a manner that will cause the least amount of disturbance to the existing facility. Any damage to existing facilities shall be repaired immediately according to the directions of the owner of such facility.
05. TEMPORARY DRAINAGE: Pumping equipment shall be provided and employed to promptly remove any water that accumulates in the excavation. The area of excavation shall be limited to that which can properly be dewatered by the equipment in use. The excavation shall be maintained in a dry condition while construction is in progress. Surface water shall be diverted from the excavation by sloping the ground away from the ditch.
- A. Disposal of Water: The water from the excavation shall be disposed of in such a manner that the natural drainage of the area shall not be disturbed. All gutters, drains, sewers, and culverts shall be kept clean for surface drainage.
06. SHORING: Shoring will be provided by the contractor when the excavation will endanger existing structures, utilities, pavements and banks, and when necessary to protect workmen. The shoring shall be constructed of adequate size members and the arrangement of members shall be suitable to withstand the earth pressure expected. Shoring, sheeting, and bracing that is utilized above the invert of the pipe shall be removed carefully during the backfilling process in order to prevent caving that might displace the pipe from the correct line and grade. When and where directed by the Engineer, sheeting may be left in place in the backfill with adequate braces to provide lateral support.
07. EXCAVATION: (General) Trenches shall be excavated by open cut to the line and grade given by the Engineer. Vertical cuts shall be used whenever possible, but in unstable soils, trenches may

be sloped from the top of the excavation to a point 3.0 feet above the top of the pipe with the width of the trench from this depth to the bottom of the ditch governed by A. below. The bottom four inches of the excavation shall be excavated by hand. Bell holes shall be excavated by hand to insure that the pipe is properly supported for its entire length.

A. Trench Width: The maximum width of the trench shall be 24" plus the outside diameter of the pipe. This width shall also apply to sloped trenches for the last three feet above the top of the proposed pipe.

B. Excavated Material: Material excavated from the ditch shall be placed (whenever possible) in piles along the side of the trench. When it is necessary to stock pile excavated material, it shall be the contractor's responsibility to secure the stockpile areas. No excavated material shall be placed on private property without the consent of the Owner.

C. All excavation shall be one classification regardless of nature of material encountered.

D. Whenever the bottom of the trench is unstable and does not afford a good foundation, the contractor shall remove such part as may be necessary and replace with suitable material from the surface to make a good foundation without extra compensation.

E. Under exceptional conditions where ground water and unstable soil are such that it is not possible to obtain a suitable foundation with material on the trench bank, the Engineer will determine the method to be followed and the Contractor will be compensated for extra foundation material delivered on the trench.

Because of the difficulty in determining extra labor involved, no extra compensation will be allowed for placing it, but it will be held to be included in the unit price bid per linear foot of pipe.

F. Excavation for manholes and other appurtenances shall be sufficiently large to leave at least 12" clear between their outer surfaces and in the line of the excavation or supporting timber.

G. Any unauthorized excavation below the pipe or structure shall be filled with sand, gravel, or concrete at the expense of the Contractor.

H. Where sheeting or bracing is used, no extra compensation will be allowed, except where the Engineer directs that it be left in place, in which case the Contractor will be allowed \$300 per thousand feet board measure for material so left.

I. The Contractor shall include in the unit price for laying pipe all necessary pumping and well pointing.

08. BACKFILLING: Backfilling shall progress as rapidly as the pipe laying and testing permits. The trench shall be backfilled with approved material free from large clods or stones. The initial backfill shall be carefully placed on both sides of the pipe at the same time and thoroughly tamped around the barrel of the pipe until enough material has been placed to provide one foot of cover above the top of the pipe. The remainder of the backfill shall be placed in well compacted, one foot layers using approved mechanical tampers. In no case shall the backfill material be placed in unequal layers on one side of the pipe that might cause pipe displacement.

A. Backfilling Street, Road and Alley Areas: In existing streets, roads or alleys, the backfill shall be compacted to a density of 95% as determined by ASTM A-695. In the case where the excavation from the trench proves to be unsuitable for proper backfilling and compaction as specified above, the contractor shall immediately notify the Engineer that such a condition exists. The Engineers shall then instruct the contractor to either stop the job until weather conditions allow the material from the ditch to be properly compacted at a more optimum moisture content or the Engineer shall direct the contractor to continue with construction using select backfill material approved by the Engineer. In such a case, select backfill material shall be considered extra work and shall be paid for at an agreed unit price, between the Contractor and the Owner, unless a unit price has already been received in the Schedule of Bid Items, for select material delivered to the ditch bank. Placement of the select material will be held to be included in the unit price bid per linear foot of pipe. Disposal of the extra excavated trench material shall be by the Contractor in stockpiled areas designed by the Engineer within one-half mile. No extra compensation shall be allowed for such disposal of unsuitable excess trench material. However, if no designated stock-pile areas are available within one-half mile, the Contractor shall be compensated for removing the unsuitable excess trench material at an agreed price between the contractor and the owner.

In no case shall muck or any other unsuitable, excessively saturated material be placed as backfill on pipelines in existing or proposed streets, roads, or alleys. If the contractor places such an unsuitable material as backfill and does not obtain the required compaction as specified above, the contractor shall be liable for any trench settlement that occurs either before paving or after paving in accordance with the warranty period of the contract. In such a case of trench settlement, the contractor shall remove all the unsuitable backfill material and replace and compact the select backfill material as hereinbefore specified. If pavement has been placed, the trench area shall be repaired as specified in Site Work (Pipe), Section 06, paragraphs A. and B., Removal and Replacement of Pavement. All such

repair work shall be at the total expense of the contractor, and shall be to the satisfaction of the Engineer and Owner.

A. Dewatering: Dewatering, when required, shall be continued during construction including the pipe laying and the backfilling process. Adequate equipment shall be used and maintained by the contractor to insure a dry trench.

B. Rock Cut: If rock is encountered in excavation, rock shall be removed to a depth of 8" below the bottom of the pipe. This 8 inches shall be refilled with select material.

C. Muck: Muck may be used in the backfill after at least 2.0 feet of approved material has been placed above the bell of the pipe. Muck shall not be used in the backfill in any street, road or alley. When it is encountered, approved backfill material shall be hauled in by the contractor.

D. Sheeting: When sheeting is removed from the backfill, all cavities shall be properly filled.

09. EXCESS MATERIAL: Excess material and material that is suitable for backfill shall be disposed of at sites obtained by the owner.

10. BORROW: When the material excavated is not sufficient to meet the requirements for fill material, borrow shall be obtained by the contractor. Borrow material shall be approved by the Engineer prior to placement and paid for as extra work.

11. PAYMENT: Payment for items in this section shall not be made directly, but shall be included in the unit price bid per l.f. of pipe.

SITE WORK (PIPE)

01. SCOPE: This section includes the clearing and grubbing of all required construction areas together with disposal of materials, site preparation, and clean up as specified herein.

02. SITE PREPARATION:

A. Existing Facilities: The Contractor shall provide protection for all existing structures, buildings, and utilities against all construction activity.

The Contractor shall protect and preserve the Owner harmless against damage and claims for resulting from these activities.

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

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

03. PRELIMINARY WORK:

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

B. Valuable Trees and Shrubs: When the construction work involves the removal of valuable trees and shrubs on existing public rights of way, the work shall be done in cooperation with the town, county, or state.

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

04. CLEARING AND GRUBBING: Clearing and grubbing shall be performed in areas indicated and where required for construction. It shall include the complete removal and disposal of all brush, weeds, timber, stumps, rubbish, and all other obstructions. All such material shall be removed to a depth of at least one foot below finished grade. In clearing and grubbing areas where excavation is done, all timber, roots, or stumps removed that are exposed by said excavation shall be removed to a depth of one foot below the excavated surface.

05. DISPOSAL OF CLEARED AND GRUBBED MATERIAL: All refuse from the clearing and grubbing operation shall be disposed of either by burning or removal to a dump area that is approved by the County. The contractor shall obtain a burning permit from the appropriate fire chief before any burning is started. Burning, if approved, shall be done in such a manner that does not create hazards such as damage to existing structures, trees and vegetation, interference with traffic and construction in progress. All disposal by burning shall be kept under constant supervision until all fires have been extinguished and all burning shall comply with all state and local laws relative to the building of fires.

06. PAVEMENT REMOVAL AND REPLACEMENT:

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

B. Replacement:

1. Concrete Base and Bituminous Surface Course: The concrete base shall be replaced with concrete, having a minimum compressive strength of 4,000 pounds per square inch and shall be poured at least six inches in thickness. The surface of the concrete shall be finished at least two inches below the asphalt surface. The concrete shall be poured and protected in a workmanlike manner until the asphalt surface has been replaced. The edges of the asphalt shall be neatly trimmed to a new face and mopped with asphalt cement. The concrete surface shall be placed and thoroughly rolled to a smooth, dense surface true to adjacent areas of the street. The asphalt surface course shall consist of 2" of Type I-2 bituminous concrete surface course in accordance with North Carolina Department of Transportation Specifications.

2. Concrete Pavement: The concrete pavement shall be replaced with concrete having a minimum compressive strength of 4,000 pounds per square inch, and shall be poured at least six inches in thickness.

3. Flexible Type Pavement: Base course for flexible pavement shall be replaced with a minimum of eight inches of aggregate base course compacted. The base course shall be surfaced with two inches of Type I-2 bituminous concrete in accordance with North Carolina Department of Transportation Specifications. Cut areas shall be maintained by the Contractor in a safe, passable condition until paved. Should the area create a dusty condition, the Contractor shall remedy this condition by the use of water or calcium chloride. Special care shall be given to the areas cut in traffic lanes and intersections by placing crushed stone and maintaining in a smooth condition at the Contractor's expense.

C. Sidewalk, Driveway and Curb and Gutter Replacement: Existing sidewalks and paved driveways, including curb and gutters removed, disturbed or destroyed by construction, shall be replaced or repaired. The finished work shall be equal in all respects to the original.

D. State Highway Crossings: All construction relating to state highway crossings shall be in full compliance with all requirements of the encroachment agreement and to the satisfaction of the North Carolina Department of Transportation.

07. WORK IN RAILROAD RIGHTS-OF-WAY: Permits for all construction within the rights-of-way of railroads shall be obtained by the Owner and shall be approved by the railroad before commencing work in these areas.

A. Installation: Utility lines shall be installed in full compliance with all requirements of the railroad and to their satisfaction, including any carrier pipe and encasement pipe. The Contractor shall provide all warning and protective measures required by the railroad company.

08. METHOD OF MEASUREMENT: The quantities to be measured under this item shall consist of the number of square yards of pavement replacement (aggregate base course and asphalt). For this contract, the following maximum trench widths shall be used for final measurement:

Pavement Replacement: Total maximum pay width shall be - 4.0' + O.D. of water main.

09. PAYMENT: Pavement replacement shall be paid for at the unit price bid per square yard for flexible type pavement replacement, concrete pavement replacement or concrete base and bituminous surface course. All other items under this section shall not be paid for directly but shall be included in the unit price bid per l.f. of pipe.

SEEDING AND MULCHING

01. SEEDING:

A. All disturbed areas shall be dressed to typical sections and plowed to a depth of five inches. The top two inches shall be pulverized to provide a uniform seedbed. NOTE: Lime should be applied before plowing operation.

B. Lime, seed, and fertilizer shall be applied with necessary equipment to give uniform distribution of these materials. The hand-bucket method is not acceptable. The following are rates and kinds of these materials to be applied per acre:

KIND	RATE PER ACRE
Kentucky 31 Fescue	75 lbs.
Pensacola Bahiagrass	50 lbs.
Korean Lespedeza	15 lbs.
Centipede	5 lbs.
10-20-20 Fertilizer	500 lbs.
Agricultural Limestone	4,000 lbs.

C. Seeded area shall be cultipacked to firm seedbed and to cover seed.

D. Mulching: Straw mulch shall be threshed straw of oats, rye, or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified. Thickness of the covering shall be adequate to hold the soil but sufficiently loose and open to favor the development of grass.

E. The mulched area shall be tacked with asphalt sufficient to hold straw in place.

F. Ditch treatment shall be used in areas where steep grades could cause ditch erosion. Use of jute mash, excelsior matting, or fiberglass roving is acceptable. Ditch treatment should be installed before mulching operation.

G. Establishing Turf: The establishment period shall continue until a stand of grass acceptable to the Owner, Engineers and N.C.D.O.T. is obtained. The Contractor shall be responsible for maintenance, protection, repairing, and resulting reseeding and refertilization during this establishment period.

H. Mowing: Mowing will be required up to the acceptance date of the project if the grass height is over 3 inches.

I. Refertilizing: Fertilizer shall be applied at the rate to provide 1,200 pounds per acre (complete mix fertilizer - 8 parts nitrogen, 8 parts phosphoric acid, and 8 parts potash), eight to ten (8 to 10) weeks after initial seeding as directed by the Engineers.

J. Basis of Payment: Payment for items in this section shall not be made directly but shall be included in the unit price bid per l.f. of pipe.

EROSION AND SEDIMENT CONTROL

01. GENERAL: The Contractor shall install erosion control measures as shown on the Erosion Control Plans. The Contractor shall comply with all local, state and federal laws, ordinances, rules and regulations pertaining to erosion and sediment control, including those promulgated by the State of North Carolina in the Sedimentation Pollution Control Act of 1973.

02. EROSION AND SEDIMENT CONTROL MEASURES: All measures shall be taken to control erosion and sedimentation at the construction site, including borrow and waste areas and temporary access roads, and at off-site areas especially vulnerable to damage from erosion and sedimentation. All erosion and sediment control measures will be subject to approval by the Engineer.

A. Critical Areas to be protected from damage due to severe erosion and sedimentation are as follows:

1. Exposed and disturbed areas.
2. Steep cuts and fills.
3. Open piles of unstable excavated material.
4. Existing slopes.

B. Exposed Areas: Work shall be scheduled so that areas subject to erosion are exposed for the shortest possible time. Only those trees, shrubs and grasses shall be removed that are necessary for construction; those remaining shall be protected to preserve the aesthetic and erosion control values. Temporary on-site structures and buildings shall be located to preserve the existing landscape and to minimize erosion, including that from construction traffic. If practicable, work shall be scheduled in seasons when erosion is less of a hazard, particularly for sites with steep slopes and erodible soils.

C. Disturbed Areas: Temporary protection shall be required for disturbed areas until final grading is completed and permanent vegetation is established, and shall consist of planting temporary grass cover or other vegetation when feasible. Other short term protection shall include covering disturbed areas and topsoil piles with a mulch of hay, straw or wood chips, stabilizing with netting, or covering with plastic sheets. Graded slopes and fills shall be limited to an angle and to lengths that will maintain stability and allow easy maintenance.

Construction equipment shall not be operated in a way to make the land more susceptible to erosion, such as leaving tracks up and down slopes. Access roads shall be located and constructed so as to prevent erosion.

D. Surface Water Runoff: Controls for surface water runoff shall be constructed as early as possible to prevent the formation of gullies or hills. These controls shall be maintained during the entire construction period or until permanent storm drains are completed. Runoff shall be controlled by diversion channels or berms, slope drains, flow barriers, dikes, or other structures which retard or spread its flow. Compacted embankments, ditches, furrows, or temporary diversions across slopes shall be provided to intercept runoff before it reaches erodible areas. Diversions and drains shall be directed into stabilized areas where the discharge can be spread out and dissipated.

E. Sediment: Barriers and settling basins shall be constructed to trap sediment before disturbing the land that drains into them. Dams, earth embankments, or temporary barriers such as small dikes consisting of semi-permeable materials or quickly compacted soils, shall be provided to trap sediment. Semi-permeable materials shall be sand or gravel and shall act as a filter, allowing water to flow through but retaining most of the sediment. Sediment basins shall be cleaned out periodically as required to maintain their capacity.

F. Protection of Slopes: Within 30 working days of the completion of any phase of grading, all slopes left exposed shall be provided with temporary grass cover or other suitable ground cover, devices or structures sufficient to control erosion.

03. EMERGENCY CONDITIONS: If unusually intense storms cause planned control measures to fail, prompt restoration and cleanup of sediment deposits shall be made, including damage to adjacent property. If construction is delayed or shut down, temporary cover of exposed and disturbed areas shall be provided.

04. PAYMENT: Payment for items in this section shall not be made directly but shall be included in the unit price bid per l.f. of pipe.