

1. PROTECTION OF PROPERTY, EMPLOYEES, AND THE GENERAL PUBLIC

- 1.1 The Contractor shall provide watchmen, fences, planking, bridges, bracing, sheeting, shoring, lights, barricades, and warning signs as necessary to protect the property, employees, and general public, and shall apply with all applicable federal, state, and local regulations.
- 1.2 Existing roads, shoulders, and ditches shall be protected from damage. Damage caused by operations under this contract shall be repaired or replaced by the Contractor at his own expense.

2. EXISTING UTILITIES

- 2.1 Existing utilities are indicated on the drawings in accordance with available records. The drawings may not represent all utilities that may be encountered or the exact locations of the utility systems.
- 2.2 Before any work is started, the Contractor shall contact all corporations, companies, individuals owning, and local authorities owning, maintaining, or regulating conduits, wires, and pipes running to or on the property to make suitable arrangements for handling and disposal of such lines.
- 2.3 The Contractor shall excavate to determine the exact location of existing utilities. This work shall precede pipe laying and other construction as far as practicable, to permit adjustments where required.
- 2.4 Power poles, telephone poles, and gas lines shall be protected from damage by the Contractor in accordance with the utility owner's instructions. The Contractor is responsible for contacting utility owners, obtaining the proper protective measures for each individual construction location and for protecting utilities from damage. Any damage caused by the Contractor or the Contractor's construction operations will be corrected by the Contractor at his expense.

3. EROSION CONTROL

- 3.1 Throughout construction, temporary measures shall control erosion and shall minimize siltation of adjacent property, streets, drainage ditches, storm drains, and waterways.
- 3.2 Vehicles leaving the site shall be cleaned to remove mud before entering public rights-of-way.
- 3.3 The Contractor shall inspect the erosion control system weekly to ensure its maximum effectiveness. Any damage to the system shall be repaired immediately.
- 3.4 If the Contractor repeatedly fails to control erosion and siltation, the Owner reserves the right to employ outside assistance or to use his own forces to provide the erosion control indicated and specified. The cost of such work, plus related engineering costs, will be deducted from monies due the Contractor for other work.

4. BACKFILL AND BEDDING MATERIAL

- 4.1 Suitable materials for backfill shall be GW, GP, GM, GC, SW, SP, SM, SC, ML, or CL as classified by the Unified Soil Classification System in accordance with ASTM D 2487-69 (R 1975). Moisture-density relations shall be established in accordance with ASTM D 1557-78 for all material to ensure its suitability. Testing shall be at no additional cost to the Owner. The results of these tests shall be approved by the Engineer before the material is used. The material shall be free from large clods, large boulders, and large rocks, as well as ashes, cinders, organic material (leaves, grass, roots, brush, and rubbish), construction debris, or other material unsuitable for backfill. Rock fragments or boulders exceeding 6 inches in maximum dimension shall not be used as backfill, and those exceeding one inch in maximum dimension shall not be used within one foot of a pipe.
- 4.2 Bedding materials shall be well-graded, hard, durable aggregates and shall be No. 21, 21A, or 22 as defined in Sections 206 and 209 of the Virginia Department of Transportation Bridge Specifications, 1978 Edition. Aggregates for bedding shall not exceed 2 inches in maximum dimension.

5. TRENCH PREPARATION

- 5.1 Trench preparation for each type of pipe shall be in accordance with the pipe trench details.
- 5.2 The width of the trench from 12 inches above the pipe to the bottom of the trench shall not exceed the width indicated for the size of the pipe being used. Where trench widths are exceeded, re-design for stronger pipe or special installation procedures shall be necessary. Any additional expense, including related engineering design expenses, shall be borne by the Contractor.
- 5.3 Trench for gravity pipelines and culverts.
- 5.3.1 For Class C-1 trench as indicated, the bottom of the trench shall be rounded so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil for as nearly the full length of the pipe barrel as proper joining operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying.
- 5.3.2 For all other cases of trench, excavation shall be performed to the depths required to provide the trench indicated.
- 5.4 Where the bottom of the pipe trenching occurs in rock, the rock shall be excavated a minimum of 6 inches below the trench depth indicated, as specified. Overdepth shall be backfilled with bedding material. Authorized overdepth excavation and backfill shall be completed at the contract price.

- 5.5 Whenever the bottom of the trench contains soil that, in the opinion of the Owner, is incapable of properly supporting the pipe, such soil shall be removed to a depth determined by the Owner, and the trench shall be backfilled to the proper grade with bedding material. Authorized excavation and backfill shall be completed at the unit price.
- 5.6 Unauthorized overdepths shall be backfilled with bedding material at no additional expense to the Owner.
- 5.7 Excavation for manholes and similar structures shall leave at least 12 inches in the clear between their outer surfaces and the embankment or the timber which may be used to hold and protect the banks. Overdepth of excavation below such appurtenances shall be backfilled as specified above for overdepth in trenches.
- 5.8 Sheet piling and Shoring. Trenches and excavations shall be sheeted and braced as required by governing laws and ordinances, and as required for the protection of life, property, and the work. When close sheeting is required, it shall be driven to prevent adjacent soil from entering the trench. Close sheeting shall not be removed, except when such removal would not damage the work or property.
- 5.9 Surplus excavated suitable material not required for fill and excavated unsuitable fill material shall be disposed of by the Contractor off the site, at no additional expense to the Owner.

6. COMPACTION

- 6.1 Compaction shall be performed by rolling or tamping with approved compaction equipment. The degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure in ASTM D 1557-78. Backfill material shall be moistened or aerated to provide a moisture content that falls within 3 percent of either side of optimum, unless otherwise approved in writing by the Owner. The minimum compaction effort required shall be as follows:

Fill, Backfill and Bedding	Percent of Maximum Density
Under pavement, shoulders and ditches	95
Yards and Grassed areas	85

- 6.2 Field Control: At least two field density tests per lift shall be performed. Tests shall be in accordance with ASTM D 1556-64 (R 1974) or D 2922-81 and D 3017-78. Tests shall be performed at the Contractor's expense. Written reports of each test and its location shall be promptly submitted to the Owner. If the tests indicate that the required density has not been obtained, the Contractor shall remove, replace, and recompact the material at no additional cost to the Owner.

7. PIPING, GENERAL

- 7.1 Sanitary sewers shall be ductile-iron pipe or PVC gravity pipe except where ductile-iron pipe is indicated or specified.
- 7.2 Casing pipe shall be steel casing pipe.

8. PIPE MATERIALS AND PIPE JOINTS:

- 8.1 Ductile-Iron Pipe: Pipe shall conform to AWWA C151-81, and shall be a minimum rated working pressure of 200 psi. Pipe shall have mechanical or push-on joints conforming to AWWA C111-80. Fittings shall have mechanical joints, shall be ductile-iron or gray iron and shall conform to AWWA C110-82. Joints and fittings shall have a pressure rating not less than that of the pipe. Pipe and fittings shall have a standard thickness cement mortar lining, conforming to AWWA C104-80, and an exterior coal-tar coating. Each pipe and each fitting shall be marked at the foundry with its class number and weight. Ductile-iron pipe and fittings shall also be marked "DI" or "Ductile".

- 8.2 Polyvinyl Chloride (PVC) Gravity Pipe: Pipe and fittings shall conform to ASTM D 3034-81 and shall be SDR-35. Joints shall be either solvent cement welded in accordance with ASTM D 2564-80 and D 2855-81 or push-on bell-and-spigot joints sealed with elastomeric gaskets in accordance with ASTM D 3212-81.

- 8.3 Steel Casing Pipe: Pipe shall be seamless or straight millseam pipe with a wall thickness not less than the thickness indicated on Carrier Installation Pipe Detail. The pipe shall conform to AWWA C200-80. The interior and exterior coatings shall conform to AWWA C210-78. Protection saddles shall be sections of steel H-pile, channel, or wide flange, strapped to the carrier pipe. The steel sections shall be sized to prevent the bell from dragging as the carrier pipe is installed.

9. PIPE LAYING AND INSTALLATION:

- 9.1 General: The Contractor shall furnish and install a complete piping system as shown on the drawings and in accordance with the intention of the Contract Documents. Accessories shall be installed in accordance with the accessory manufacturer's recommendations.

- 9.2 Pipe Installation: Installation shall ensure compliance with paragraph "Cleaning and Testing" hereinafter. Bedding is specified in Section "Earthwork".

- 9.2.1 PVC pipe shall be installed in accordance with the manufacturer's recommendations. Trench shall be Class B, as shown on Trench Detail except that concrete encasement shall be centered for a total of 6 feet when PVC is installed below other pipe.

- 9.2.2 Ductile-iron pipe shall be installed in accordance with the manufacturer's recommendations. Trench shall be Class C-I, as shown on Trench Detail.

9.3 Pipe Laying:

- 9.3.1 Pipe shall be laid to a true, uniform line and grade. Indicated grades and elevations show the position of the invert of the pipe. The Contractor shall establish and maintain alignment and grades from bench marks and reference points indicated on the drawings, employing workmen skilled in the use of measuring equipment.

- 9.3.2 When work is not in progress, open ends of pipe and fittings shall be closed, to the satisfaction of the Owner, so that trench water, earth, and other substances will not enter the pipe or fittings.

- 9.3.3 Pipe and fittings shall be handled to avoid damage. Such materials shall be carefully inspected for defects before being lowered into the trench.

- 9.4 Connection to Existing Sanitary Sewers: The Contractor shall connect to the existing systems where indicated or directed. Pipeline connections shall be constructed as indicated and specified for new construction. Debris shall be prevented from entering the pipelines. Work shall include all necessary concrete work, cutting, and shaping.

10. MANHOLES

- 10.1 Manholes shall conform to details as designated on the drawings. The invert channels shall be smooth and semi-circular, conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. The invert channels of the manhole outside the channels shall be smooth and shall slope towards the channels not less than one inch per foot nor more than two inches per foot. Steps shall be built in to manholes and thoroughly anchored to the walls.

11. SEPARATION OF POTABLE WATER AND SANITARY SEWER LINES

- 11.1 Where the locations of potable water and sanitary sewer lines are not clearly defined on the drawings, the potable water line shall not be laid horizontally closer than 10 feet to the sanitary sewer. Should conditions prevent lateral separation of 10 feet, the potable water line may be laid closer, provided it is in a separate trench and the bottom of the sewer line is at least 18 inches below the bottom of the potable water line.

- 11.2 Where sanitary sewer lines cross under potable water lines, the top of the sewer shall be at least 18 inches below the bottom of the potable water line. When the elevation of the potable water line does not provide the required separation, the sewer line, for a distance of 10 feet on each side of the crossing, shall be made of ductile-iron with joints a minimum of 8 feet from the crossing.

- 11.3 Sewer manholes shall not be constructed over potable water lines. New potable water lines shall not be constructed to pass through sewer manholes.

12. PIPE AND MANHOLE TESTING REQUIREMENTS

- 12.1 Test for Displacements of Buried Sanitary Sewers: After the trench has been backfilled and compacted and cover over the pipeline has been brought to finished grade, pipelines will be tested as follows: light will be flashed between manholes, or, if manholes have not yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. Poor alignment, displaced pipe, or other defects shall be remedied by the Contractor at no additional cost to the Owner.

- 12.2 Test for Deflection of Flexible Gravity Drains:

- 12.2.1 Flexible gravity drains are drains constructed of PVC gravity pipes.

- 12.2.2 Pipelines shall be measured for vertical ring deflection within 15 days after completion of backfill. Maximum ring deflection of the pipeline under load shall be limited to 5 percent of the vertical internal pipe diameter. Pipe exceeding this deflection shall be relaid or replaced, and retested by the Contractor, at no additional cost to the Owner.

- 12.2.3 Tests for deflection shall be made with a deflectometer that produces a continuous record of pipe deflection, or by pulling a mandrel, sphere, or pin-type go/no-go device through the pipeline. The diameter of the go/no-go device shall be 95 percent of the undeflected inside of the pipe.

- 12.3 The Contractor shall prove the watertightness of the sewer system by one of the following tests. Tests shall be made under the supervision of the Owner. The Contractor shall furnish all materials, labor and equipment required for the tests and shall repair the system until test results are satisfactory.

- 12.3.1 Exfiltration: The pipe shall be subjected to a hydrostatic head of at least 4 feet above the pipe crown. The line shall be filled until the appropriate water level is obtained at a selected upstream manhole. The rate of drop at this manhole shall be observed for one hour. Leakage shall not exceed a rate of 200 gallons per inch of pipe diameter per mile per day in any section of the sustum.

- 12.3.2 Air Test: At the Contractors option, a low-pressure air test may be used instead of an exfiltration test for pipelines 12 inches and smaller. The test shall be in accordance with ASTM C 828-80. The procedure is as follows:

- 12.3.2.1 Determine the test time for the section of line to be tested using the table below.

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES			
Nominal Pipe Size (In.)	T (Time) Min./100 ft.	Nominal Pipe Size (In.)	T (Time) Min./100 ft.
3	0.2	8	1.2
4	0.3	10	1.5
6	0.7	12	1.8

- 12.3.2.2 Plug all openings in test section.

- 12.3.2.3 Add air until internal pressure of the line is raised to 4.0 PSI (28 kPa), allowing the pressure to stabilize. This will take 2 to 5 minutes, depending on pipe size. The pressure may be reduced to 3.5 PSI (24 kPa) before starting the test.

- 12.3.2.4 When the pressure is stable at or above 3.5 PSI (24 kPa), start the test. If the pressure drops more than 1.0 PSI (7 kPa) during the test time, the line has failed the test, and must be repaired or replaced. If the 1.0 PSI drop does not occur during the test time, the line has passed the test.

- 12.3.3 Exfiltration Test of Manholes: Each manhole shall be tested for exfiltration. The test shall be performed by plugging all connecting pipes with inflatable stoppers and filling the manhole with water to the top. A 12 hour soaking period will be allowed. Leakage from the manholes on sanitary sewers shall not exceed one-half gallon per hour. Leakage from manholes designated as water-tight tested shall be zero when tested for a period of 2 hours with readings every thirty minutes. The Contractor shall maintain written records of all manhole exfiltration tests showing test location, date and time and hourly leakage rate.

- 12.3.4 Vacuum Test of Manholes: At the Contractor's option, an air-vacuum test may be applied to precast manholes only, with the following requirements:

- 12.3.4.1 Manholes shall be tested after assembly and prior to backfilling.

- 12.3.4.2 Stubouts, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

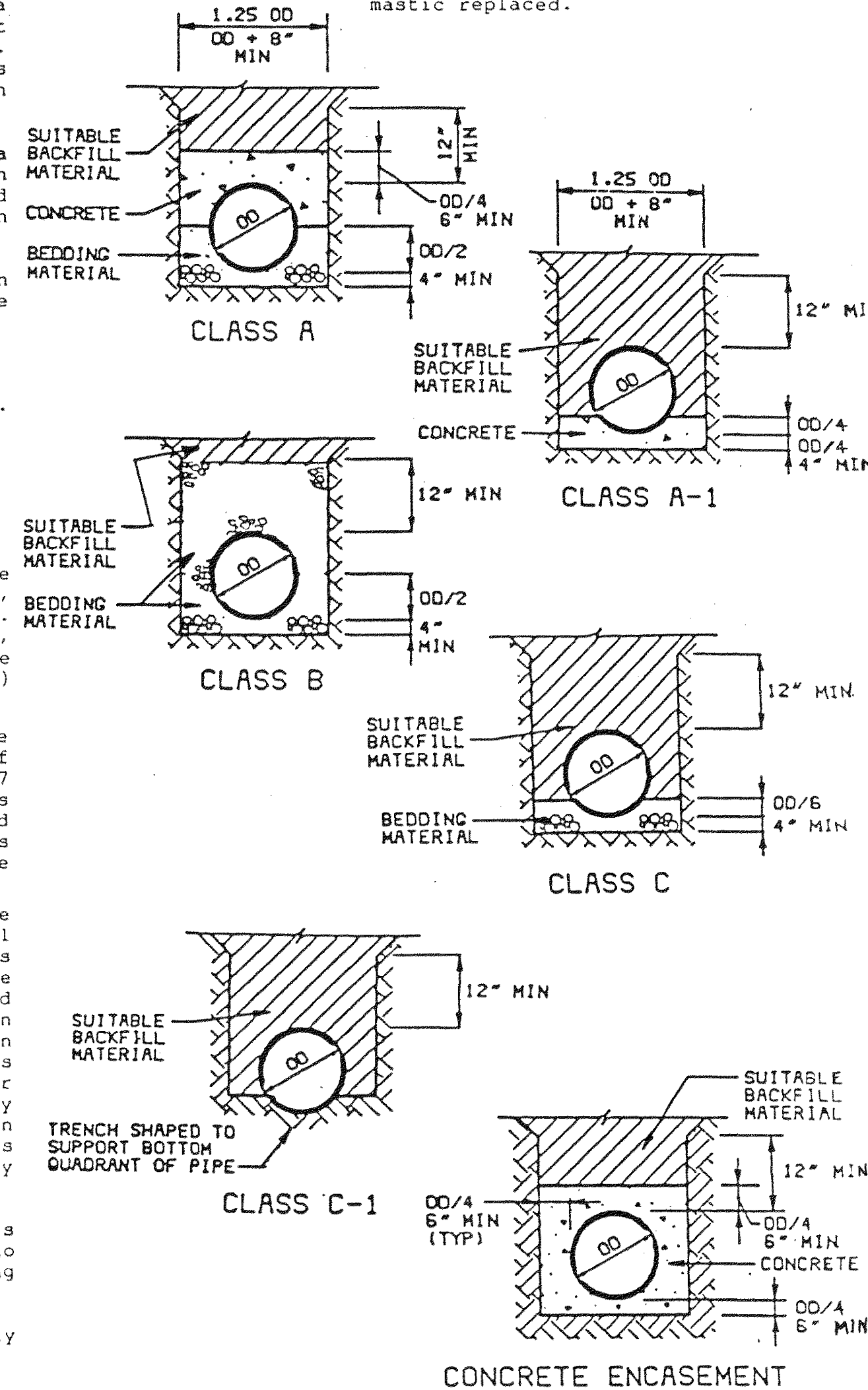
- 12.3.4.3 The installation and operation of vacuum equipment and indicators shall be in accordance with equipment specifications by the manufacturer and approved by the Bureau of Wastewater Engineering.

- 12.3.4.4 A measured vacuum of 10 inches of mercury shall be established in the manhole. The time for the vacuum to drop to 9 inches shall be recorded and compared to the table below. The maximum allowable leakage rate shall be in accordance with the following:

MANHOLE DEPTH	MINIMUM ELAPSED TIME FOR A PRESSURE CHANGE OF 1 INCH Hg		
	4 ft. diam.	5 ft. diam.	6 ft. diam.
< 10 ft.	60 sec.	75 sec.	90 sec.
> 10 ft. but <15 ft.	75 sec.	90 sec.	105 sec.
> 15 ft. but <25 ft.	90 sec.	105 sec.	120 sec.

- 12.3.4.5 If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs repeated until the manhole passes, or until a standard exfiltration test is run and the manhole is rated accordingly.

- 12.3.4.6 If a manhole joint mastic is completely pulled out during a vacuum test, the manhole shall be disassembled and the mastic replaced.



TRENCH WIDTH (1)	
NOMINAL PIPE DIAMETER	TRENCH WIDTH (2)
4" & 6"	2'-0"
8" THRU 12"	2'-8"
15" THRU 21"	PIPE OD + 20"
24" THRU 30"	PIPE OD + 24"
33" THRU 42"	PIPE OD + 30"
48" & LARGER	PIPE OD + 36"

(1) WIDTHS SHOWN ARE MAXIMUM TRENCH WIDTH FROM 12" ABOVE TOP OF PIPE TO BOTTOM OF TRENCH. TRENCH WIDTHS SHALL ALSO CONFORM WITH THE MINIMUM WIDTHS INDICATED

PIPE TRENCH

NO SCALE

SANITARY SEWER
SPECIFICATIONS
FOR
COUNTY OF BOTETOURT

T. P. PARKER & SON
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