

**WASTEWATER DEPARTMENT  
CITY OF ELIZABETHTON, TENNESSEE**

**WPC 02-0725**



**STANDARD SEWER SYSTEM SPECIFICATIONS**


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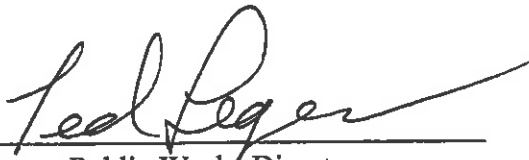
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Gravity sewers and force mains.

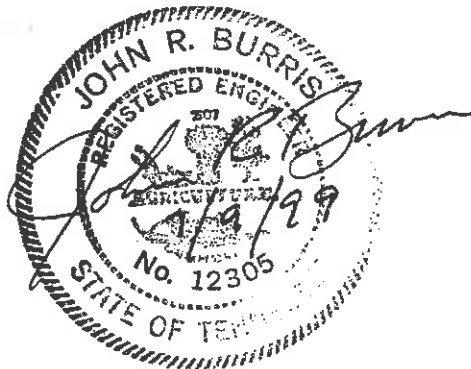
STANDARD SEWER SYSTEM SPECIFICATIONS  
GRAVITY AND FORCE MAIN SECTION

APPROVED FOR CONSTRUCTION  
THE DOCUMENT HEREIN HAS BEEN RECEIVED AND REVIEWED BY THE  
TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION  
DIVISION OF WATER POLLUTION CONTROL  
AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER  
OCT 02 2002  
WASTEWATER DEPARTMENT  
CITY OF ELIZABETHTON, TN.  
THE APPROVAL SHALL NOT BE CONSTRUED AS CREATING A PRESUMPTION OF  
CORRECT OPERATION OR AS WARRANTING BY THE COMMISSIONER THAT THE  
APPROVED FACILITIES WILL REACH THE DESIGNED GOALS. FOR THE COMMISSIONER  
BY 

System approval:

  
Public Works Director  
City of Elizabethton, TN

Engineer:



Allen & Hoshall, Inc.  
9950 Kingston Pike, Suite 300  
Knoxville, TN 37922

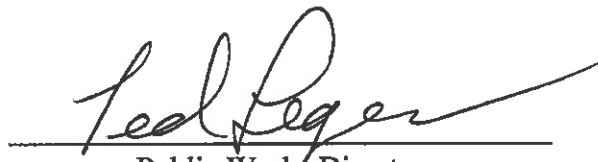
WPC 02-0725

# STANDARD SEWER SYSTEM SPECIFICATIONS

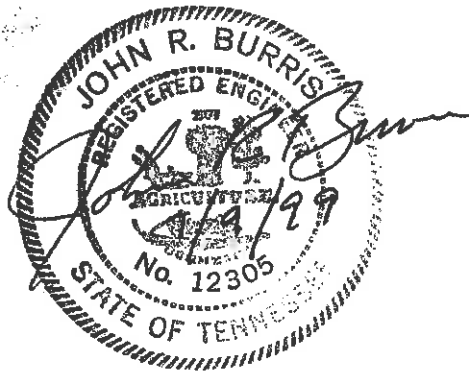
## GRAVITY AND FORCE MAIN SECTION

WASTEWATER DEPARTMENT  
CITY OF ELIZABETHTON, TN.

**System approval:**

  
Public Works Director  
City of Elizabethton, TN

**Engineer:**



Allen & Hoshall, Inc.  
9950 Kingston Pike, Suite 300  
Knoxville, TN 37922

## STANDARD SANITARY SEWER SYSTEM SPECIFICATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Provide pipe.
- B. Provide manholes, covers, cleanouts, and related appurtenances.
- C. Lines, grades, stakes, and templates.
- D. Provide valves and boxes.
- E. Provide required fittings.
- F. Provide air and/or vacuum valves

#### 1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: All work shall comply with rules and regulations of local and state agencies having jurisdiction.

#### 1.3 JOB CONDITIONS

- A. Existing Conditions: Carefully maintain bench marks, fences, roads, traffic, monuments, and survey control references.

#### 1.4 SUBMITTALS

- A. Cut Sheets: Before laying any gravity sewers, calculate all proposed sewer grades, and prepare and submit "cut sheets" on forms furnished by the City of Elizabethton. Start all levels from established bench marks, and "tie-in" the close of the run to the point of beginning and to the inverts of all existing sewers to which the new sewers connect. At Contractor's expense, correct all laying errors caused by failure to run levels properly, by taking up and relaying pipe.
- B. Submit manufacturer's installation instructions and certificates for product compliance.
- C. At project completion, provide the Owner all valve keys, locks, special tools, accessories, etc., and receive the Owner's signed receipt therefore.

#### 1.5 MATERIALS, STORAGE AND PROTECTION

- A. Materials which will be installed outdoors: At all times prior to its installation, store these materials on pallets, skids, runners, platforms, or other suitable supports which will hold all parts of these materials at least six inches above ground. Comply with manufacturer's instructions regarding protection against ultraviolet degradation or other adverse climatic conditions.

- B. **Payment for Stored Materials:** No payment will be made for on-site or off-site stored materials unless approved by separate agreement with the Owner.

## **PART 2 PRODUCTS**

### **2.1 GRAVITY SEWER PIPE**

- A. **Pipe:**
1. **PVC Sewer Pipe:** This shall conform to ASTM 3034 with minimum wall thickness of SDR 35.
  2. **Ductile Iron Pipe:** At locations indicated, or where authorized, this shall conform to AWWA C151, Pressure Class 350 with AWWA C104 standard thickness bituminous sealed cement mortar lining, bituminous outside coating. Joints shall be AWWA C111 mechanical or push-on type with plain rubber gaskets.
- B. **Wyes and other fittings for pipe** shall have the same materials, strengths, and joint types as those specified above for the pipe types involved.

### **2.2 MANHOLES**

- A. **Manhole Rims and Covers:** Cast iron heavy traffic pattern with covers marked SEWER, total weight at least 500 pounds, metal used in the manufacturer of castings shall conform to minimum requirements of ASTM A48 Class 30B for Gray Iron; machine surfaces to prevent warplings; provide the following or as approved:
1. **Traffic Conditions:** Vulcan V-1365
- B. **Materials for Manholes:**
1. **Precast Manhole Sections:** These shall conform to ASTM C478; straight sections shall be of the lengths required for each manhole assembly; top sections shall be 36 inches high and conical, eccentric, tapering uniformly to 24 inch inside diameter at the top; each precast section shall have tongue and groove joints, and lifting holes to facilitate handling and laying.
  2. **Brick:** ASTM Specification C32 Grade NA hard burned clay or shale type, or ASTM Specification C55 concrete type.
  3. **Masonry mortar:** composed of one part by volume ASTM Specification C91 masonry cement, not more than three parts by volume of AASHTO Specification M45 masonry sand, and clean water as required for a workable consistency; do not put any additional lime into the mixture.
  4. **Non-shrinking mortar:** Sonneborn's "Ferrolith G", Master Builders "Embeco", AC Horn's "Vibro-Foil", or approved equal metallic compound and suitable aggregates, of US Grout Corporation's "Five Star" non-shrink grout, mixed and applied in strict accordance with the manufacturer's printed directions.
  5. **Cast-in-place Concrete:** as specified hereinafter.
  6. **Gasket material for precast joint sections:** premolded rubber "O" rings.
  7. **Flexible boots** shall be cast in the manhole for all required connections: Kor-N-Seal or approved equal.

### **2.3 FORCE MAIN PIPE FITTINGS AND JOINTS**

- A. **Ductile Iron Pipe:** Ductile iron pipe shall conform to AWWA Specification C151, and shall comply with the following pressure classes. Ductile iron pipe (hereinafter referred to as

"iron pipe") shall have AWWA Specification C104 standard thickness bituminous sealed cement mortar lining, bituminous outside coating, and ends as required for the joint types specified or indicated for the various pipe locations and applications. MINIMUM wall thickness and MINIMUM pressure classes at all points, including in bottoms of surface depressions, shall be as tabulated below.

Pipe Size	Wall Thickness	Pressure Class
4"	0.25"	350
6"	0.25"	350
8"	0.25"	350
10"	0.26"	350
12"	0.28"	350
14"	0.31"	350

1. For each individual laying length of iron pipe having threaded ends for screwed-on flanges or grooved ends for locking type joints, the pipe wall thickness shall be at least as recommended by the pipe manufacturer to provide ample strength in the thread roots or groove bottom to safely accommodate the pressure and other conditions involved, but in no case shall the pipe wall thickness before threading or grooving be less than the minimum wall thickness specified above for the size and type of pipe involved.
- B. Fittings for Ductile Iron Pipe: These shall be ductile iron short body pattern conforming to AWWA Specification C110, Class 150 or heavier, with AWWA Specification C104 standard thickness bituminous sealed cement mortar lining, bituminous outside coating, and ends as required for the joint types specified or indicated for the various pipe locations and applications.
- C. Ductile Iron Joints: Except as otherwise specified or indicated, joints in iron pipe and iron fittings shall be AWWA Specification C111 mechanical or push-on type, with plain rubber gaskets.
1. Where indicated or required, iron pipe and/or iron fittings shall have ANSI Class 125 faced and drilled flanged ends. Screwed-on flanges for iron pipe shall be especially designed and sized for iron pipe, with counterbored long hubs completely covering the pipe threads. Gaskets shall be plain rubber; bolts shall be standard square or hexagon head steel, with standard steel hexagon nuts.
- D. Ductile Iron Certificates: Submit in duplicate certificates from the manufacturers certifying that all iron pipe and iron fittings furnished for this project comply with these specifications.
- E. PVC Pipe: This shall be Class 200 (SDR 21) conforming to ASTM Specifications 02241, made of Type 1 Grade 1 material conforming to ASTM Specification D1784, NSF approved and so labeled, and with ends as specified below.

- F. **PVC Fittings:** Except as otherwise specified hereinafter, these shall be either PVC type or iron type, each with pressure rating at least equal to that of the pipe, and with ends as specified below.
1. **PVC fittings:** these shall be made of the same material as that of the pipe involved, shall have pressure rating not less than that of the pipe involved and shall have integral bells. PVC fittings shall only be used for pipe less than 3" in diameter.
  2. **Iron fittings:** These shall be ductile iron or cast iron, short or full body pattern, conforming to AWWA Specification C110 or C153 as applicable, Class 150 or heavier, with AWWA Specification C104 standard thickness bituminous sealed cement mortar lining, bituminous outside coating, and ends as required for the joint types specified or indicated for the various pipe locations and applications.
- G. **PVC Joints:**
1. **Pipe-to-pipe joints:** these shall be push-on type, with beveled spigot ends, bells having gasket retaining grooves, and rubber gaskets, to facilitate field assembly and to permit free expansion and contraction at each joint. Pipe shall have integral bells, or pipe may be plain end type coupled with suitable double-bell couplings made of same material as that of pipe involved and having pressure rating not less than that of pipe involved.
  2. **Pipe-to-PVC fitting joints:** these shall be push-on type, with rubber gaskets.
  3. **Pipe-to-iron fitting joints:** these shall be AWWA Specification C111 push-on or mechanical type, with plain rubber gaskets.
  4. **Solvent welded joints:** THESE WILL NOT BE PERMITTED ON UNDERGROUND PIPE.
- H. **PVC Adapter Fittings:** Provide suitable PVC or ductile iron adapter fittings as required to connect PVC pipe to other types of pipe.
- I. **PVC Certificates:** Submit in duplicate certificates from the manufacturers certifying that PVC pipe and fittings therefor furnished for this project comply with these specifications.

## 2.4 GRANULAR PIPE BEDDING

- A. Granular pipe bedding material shall be either of the following types:
1. Crushed rock, crushed stone or washed gravel, 95 percent by weight passing through a 3/4 inch screen, and 95 percent by weight retained on a No. 4 sieve.
  2. Sand: A clean well graded mixture.

## 2.5 GRANULAR BACKFILL

- A. Granular backfill material shall be one of the materials specified above for granular pipe bedding material.
- B. Usage: use granular backfill material ONLY where indicated, specified hereinafter, or authorized.

## 2.6 CONCRETE

- A. Concrete shall be 3,000 psi ready mixed type conforming to ASTM Specification C94 composed of Portland cement, sand, and washed coarse aggregate all conforming to ASTM Specifications; mixed with clean water free of oil, acid, alkali, and organic matter; and



furnished by an approved ready mix plant's standard for the specified strength, as established and tested by an approved laboratory, in accordance with applicable ASTM Standard Specifications.

## **2.7 ROAD GRAVEL**

- A. This shall be crushed stone, crushed slag, crushed or uncrushed gravel, or crushed or uncrushed chert conforming to Tennessee Department of Transportation, Bureau of Highways Subsection 903.05 (b), Class B aggregate, grading C.

## **2.8 AIR RELEASE AND AIR/VACUUM VALVES FOR SEWAGE FORCE MAINS**

- A. Sewage air release valves, sewage air and vacuum valves, and sewage combination air valves shall be furnished and installed on the force mains at the locations specified and indicated.
- B. Valves shall be standard sewage air release, sewage air and vacuum release valves and sewage combination air valves and shall have provisions for backflushing from an approved water supply for blowing off accumulated sediment. Provide at each air valve a brass gate or ball type cut-off valve between the force main and the air valve; provide non-corrosive handwheel operator.
- C. Sewage Air Release Valves: shall be APCO Series 400 SARV as manufactured by Valve & Primer Corporation, Schaumburg, Illinois; or equal. Valves shall be designed specifically for sewage service, complete with: 2" NPT inlet connection; cast iron body and cover; stainless steel float; stainless steel linkage; Buna-N needle; 1/4" minimum size orifice; drain valve; backflushing connection; and other standard features.
- D. Sewage Air and Vacuum Valves: shall be APCO Series 400 SAVV by Valve & Primer Corp., or equal. Valves shall be designed specifically for sewage service, complete with: NPT or flanged inlet connection; cast iron body and cover; stainless steel floats, float stem and float guide; Buna-N seat; brass drain valve; backflushing connection; and other standard features.
- E. Sewage Combination Air Valves: shall be a single combination valve or an air release valve and an air and vacuum valve installed to function in the same manner as the combination valve.
  - 1. Single combination valve shall be APCO Series 440 SCAV or equal, specifically for sewage service, complete with: 2" NPT connection; cast iron body and cover; stainless steel floats, stem and float guide; 2" outlet; Buna-N seat; brass drain valve; backflushing connection and other standard features.
  - 2. Two valve combination shall consist of an air release valve as specified in 2.06 C and an air and vacuum valve as specified in 2.06 D. These two valves shall be connected to the pipeline with a galvanized IPS tee fitting.
- F. Location and Size: Valve location shall be at the highest elevation of the pipeline or at a definite change in pipeline grade at the approximate locations indicated.

## **2.9 CUT-OFF VALVES AND VALVE BOXES**

- A. General: For each location where a certain type of cut-off valve is specified, indicated on the drawings and/or valve schedule, or required for the application involved, provide the

appropriate type accordingly. Detailed requirements of the various types of valves shall be as specified below. Where the type of valve is not indicated or specified, types of valves shall be:

1. 12" and larger cut-off valves: plug type only.
2. 10" and smaller cut-off valves at tapping sleeves and tapping saddles: gate type only.
3. Other 10" and smaller cut-off valves: wedge gate or plug type.

B. Gate Valves: These valves shall be Mueller or as approved resilient seat with iron body; modified wedge disc; resilient rubber seat ring; bronze stem nut; "O" ring type stem seal; flanged or mechanical joints ends, 2" square stem nut or floor stand and handwheel as indicated, and shall be opened by COUNTER-CLOCKWISE stem rotation.

1. Underground valves shall have standard 2" square stem nuts; above ground valves have handwheels.
2. Where indicated, gate valves shall have standard extension stems, with stem guides and handwheel, furnished by the valve manufacturer.

C. Plug Valves: These shall be DeZurik, "Series 100", Keystone "Ballcentric", or equal non-lubricated eccentric type with plug faced with resilient material as recommended by the manufacturer for sewage service. Port areas shall be at least 80% of full pipe area and valve shall be capable of passing the same size solid as required by pump specifications, where applicable. Bodies shall be semi-steel with raised seats. Seats of 3" and larger valves shall have welded in overlays of at least 90% pure nickel on all surfaces contacting the plug faces and shall comply with AWWA C509. All valves shall have stainless steel permanently lubricated upper and lower plug stem bushings. All 4" and larger valves shall be designed so that they can be repacked without removing bonnet from valve. Packing on all valves shall be adjustable. All exposed nuts, bolts, springs, and washers shall be zinc plated. Valve ends shall be screwed, ANSI Class 125 flanged or mechanical joint type, as applicable to the piping or equipment connections involved. Flanged valves shall comply with all requirements of ANSI B161 including flange thickness.

1. Ends: underground plug valves shall have mechanical joint ends; above ground plug valves shall have flanged ends or mechanical joint ends, as applicable. Valves 2" and smaller may have screwed ends.
2. Buried valves shall have 2" square operating nuts and extension stems to place the nut approximately 6" below valve box top.
3. Where indicated, valves in valve pits, manholes and similar locations shall have extension stems and floor stands with lever or wrench operators aboveground.
4. Manual Operators:
  - a. 10" and larger plug valves: these shall have geared operators, sealed watertight type with 2" square stem nuts for underground, and non-watertight type with handwheels for aboveground.
  - b. 8" and smaller plug valves: where geared operators are indicated on these valves, the operators shall be as specified in paragraph a above; otherwise, operators for 8" and smaller plug valves shall be non-geared type, with 2" square stem nuts for underground valves, and lever handles for aboveground valves.

D. Valve Boxes: These shall be standard cast iron two-piece 5-1/4" inside shaft diameter screw adjustable type, each consisting of a cover marked SEWER, and upper telescoping section, and a lower section. Where necessary to provide extra depth, provide cast iron extension pieces as required.

1. Provide a valve box over the operating stem of each underground valve. Set and support each valve box so that no stress or shock can be transmitted to the valve, with the box centered and plumb over the valve wrench nut. Set each valve box top in a concrete slab 18" square and 6" thick, flush with finished grade.

- E. **Extension Stems:** Provide extension stems as indicated and/or required to facilitate operation of inaccessible valves. Extension stem assemblies shall be standard types as furnished by the manufacturers of the valves involved, each complete with Schedule 80 steel pipe stems, hardware to attach stems to valves, steady bearings, brackets or floor stands, and handwheels. Length of extension stem shall be as required to position nut operator within 12 inches of grade or operating platform, or to connect to floor stand where applicable.

## **2.10 UNDERGROUND WARNING TAPE**

- A. **Tape:** This shall be Lineguard or as approved polyethylene film, 0.004 inch minimum thickness, that is highly resistant to acids, alkalis, and other soil components, color coded in accordance with APWA specification, and marked "CAUTION - RAW SEWAGE" or similar wording.
- B. **Installation:** Place tape in trench backfill immediately above the pipeline, all in accordance with the manufacturer's instructions.

## **2.11 POLYETHYLENE ENCASEMENT OF DUCTILE IRON PIPE**

- A. Provide polyethylene casement for the ductile iron pipeline where indicated or authorized. Encasement shall conform with AWWA C105. Minimum thickness of polyethylene film shall be 0.008 in. (8 mil). Installation in accordance with AWWA C195 and manufacturer's recommendations.

# **PART 3 EXECUTION**

## **3.1 TRENCHING, EXCAVATING, SHORING, BRACING, AND DEWATERING**

- A. **Special Requirements:**
  - 1. Lay all pipe to the grades indicated. Pipe shall be laid either on a uniform positive or negative grade as indicated. Pipe laying shall not fluctuate from positive to negative grade. Vent and vacuum valves are required for force mains at all grade changes from positive to negative.
  - 2. See **RAILROAD CROSSINGS** and **HIGHWAY CROSSINGS**, hereinafter, for special excavation requirements in those areas.
  - 3. See **ROCK EXCAVATION AND BLASTING**, hereinafter for special excavation requirements where rock is encountered.
  - 4. Unstable or unsuitable trench bottoms: where authorized because unstable trench bottom conditions, lay pipe on granular bedding, as specified in hereinbefore. Where the trench bottom at required subgrade contains ashes, cinders, any type of refuse, vegetable or other organic material, large pieces or fragments of inorganic material or other unsuitable materials which in the City's opinion should be removed, remove such material; before laying pipe, bring the trench bottom up to proper subgrade by backfilling with approved material placed in six inch maximum thickness loose layers, and thoroughly compact each layer as required to provide an approved firm and stable trench bottom.
- B. **General Excavation Requirements:** Except as otherwise indicated, specified hereinafter, or authorized, make all excavations by open cut as specified in this paragraph. Excavate trenches to the indicated lines and locations to provide uniform and continuous bearing and

support of each pipe barrel on firm undisturbed earth at every point between bell holes, with an ample bell hole at each joint to facilitate proper jointing and to prevent bells from bearing on the trench bottom. Gravity sewer depths shall be as indicated, or approved, on the drawings. Force main trench depths shall be as required to provide the specified MINIMUM cover over the tops of pipes; as required to permit pipes to pass under culverts, railroads, highways, existing pipelines, and other obstructions; and as required to accommodate valves and boxes. Trench widths shall be as required for the proper laying and jointing of pipes, and the proper placing and compacting of backfill; regarding force mains, in no case shall a trench be more than the maximum width tabulated below for the sizes of the pipe to be laid therein. Regarding gravity sewers, maximum trench widths, as measured AT TOPS OF PIPES, shall be as tabulated below; trenches may be wider ABOVE tops of pipes. Machine or hand-cut trenches, except that in all cases prepare the final subgrade accurately with hand tools, and in special cases where required, cut the trenches entirely by hand. Where excavation is carried below proper subgrade, before laying pipe bring the trench bottom up to proper subgrade by backfilling with approved material placed in six inch maximum thickness loose layers, and thoroughly compact each layer as required to provide uniform and continuous bearing and support for the pipe barrel at every point between bell holes.

1. Maximum Trench Widths Shall be Tabulated as Follows:

Pipe Size	Trench Width	Pipe Size	Trench Width
4"	1'-8"	15"	2'-8"
6"	1'-10"	16"	2'-10"
8"	2'-0"	18"	3'-0"
10"	2'-2"	20"	3'-2"
		21"	3'-4"
12"	2'-4"	24"	3'-8"
14"	2'-6"	27"	4'-0"

2. MINIMUM cover over tops of pipes shall be: 30 inches for all pipes NOT subject to traffic loads and 48 inches for all pipes subject to traffic loads. In all cases, the specified minimum cover over pipes shall be based upon final finished surfaces, including paving, if any. Where grading is involved, do not cut trenches under roads, streets, or other areas until the final finish grading has been done, unless otherwise authorized.
3. Install all shoring, sheathing, and bracing timber INSIDE of the specified MAXIMUM trench width.

- C. Excavations for Manholes: Excavate for manholes to the dimensions, shapes, and elevations as indicated and as required by mechanical and/or hand methods. Excavations for manhole bases shall be plumb, level, firm, clean, and free of loose earth, loose rock, vegetation, mud, water, frozen earth, topsoil, and other unsatisfactory materials immediately before concrete placement. The outside dimensions of manhole excavations shall be at least 12 inches greater than the manhole outside dimensions to facilitate manhole construction and backfilling around the structure.

1. If excavation is carried below indicated or authorized elevations or if the subgrade should be spoiled in any way, fill the over-excavated or spoiled areas with 3,000 psi concrete unless otherwise specified or authorized.

- D. **Unsuitable Surface Conditions:** Where excavation bottoms at required elevations are found to be unstable, or where rock, cinders, rubbish or other deleterious materials are encountered, extend excavations down to firm earth and at least six inches below deleterious materials. The excavation bottoms shall be brought up to pipe laying elevation by backfilling with suitable granular material compacted in place. Suitable materials and compaction shall be as specified herein. Dispose of excavated unsuitable materials in an approved manner.
- E. **Maintaining Drainage:** Provide and maintain in proper working order all dewatering equipment required to remove water from the excavations and to keep the excavation bottoms stable until the work has been installed properly and will be unaffected by submersion. Where the excavation bottom is mucky or otherwise unstable because of ground water, lower the ground water level and stabilize the trench bottom by the use of bailing, pumps, or other suitable method. Where quicksand or other water bearing strata are encountered, install and connect the necessary number of well points with pumping equipment of sufficient capacity to prevent rise of water in the excavation.
- F. **Shoring, Sheathing, and Bracing:** Adequately shore and brace trenches and other excavations as required to protect personnel, adjacent structures, and adjacent property. Where required for the conditions encountered, brace trenches and excavations with suitable close sheeting or sheet piling. Do all necessary cribbing up required for the proper operation of trenching machines. Repair all damage resulting from inadequate shoring, sheathing, and bracing.
- G. **Removal of Sheathing:** Sheathing or shoring that does not extend below the pipe centerline may be removed after the trench backfill has been placed and compacted to at least one foot above the tops of the pipes. Immediately after such removal, fill all resulting void spaces and recompact backfill. Sheathing may be left in place only where specifically approved. Cut off the tops of all sheathing left in place at an approved depth below finished grade.
- H. **Excavation in Cultivated Fields and Farm Areas:** In all cases where the pipeline passes through cultivated fields and/or farming areas, perform excavation in the following manner: Notify owner of time and location of work. Schedule work so as not to interfere with farming operations. Remove the topsoil from the entire width of sewer trench to a minimum depth of 12 inches, stockpile topsoil in area so as not to interfere with farming operations, and protect stockpiled topsoil from erosion. After backfilling excavation to within 12 inches of the ground surface, replace topsoil uniformly over the entire excavation.
- I. Do not install any work until excavations are free of water, mud, and loose earth. Do not install any work on frozen ground.

### 3.2 ROCK EXCAVATION AND BLASTING

- A. Wherever used as the name of an excavated material, the term "rock" shall mean any one or more of the following materials which in the opinion of the City requires for their removal drilling and blasting, wedging, sledging or barring, or breaking up with power operated hand

tools: boulders, pieces of concrete, and pieces of masonry, each weighting more than 250 pounds; and solid ledge rock, concrete, and masonry, each with more than ½ cubic yard of volume. No measurement or allowance will be made for: soft or disintegrated rock or gravel which can be removed with a hand pick or power operated excavator or shovel; loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere; rock exterior to the limits of measurement allowed which may fall into the excavation; and removal of existing pavement.

- B. Where rock is encountered in pipe trenches, remove all rock from sides of trench to provide at least 6 inches horizontal clearance from the pipe bells on each side, and remove all rock from required subgrade down to at least 4 inches below the bottom of the pipe bells. Bring trench bottom up to required subgrade by backfilling with granular bedding materials placed and compacted as required to provide uniform and continuous bearing of pipe barrels at every point between bell holes.
- C. Where rock is encountered in manhole excavations, excavation shall be limited to the inside diameter of the manhole plus 36 inches and 18" below the invert elevation.
- D. Where blasting is required, conduct all blasting operations only with properly qualified personnel in accordance with all applicable ordinances and regulations. Cover all blasts with suitable blasting mats, and use all other safety precautions as required to prevent personal injury and property damage. Repair all damage caused by blasting operations, and settle in total cost all damage suits or claims which might arise from blasting operations.
- E. Preblast Survey: The Contractor shall conduct a preblast survey of the surrounding structures within 200 feet of any blasting operation and document conditions before any blasting begins. The documentation will include written descriptions, photographs of the structures, and measures of obvious signs of structural distress such as cracks.

### 3.3 PIPE BEDDING GRAVITY FLOW SEWERS

#### A. General:

- 1. Pipe bedding includes all materials placed below and on each side of pipe and also INITIAL BACKFILL up to 12" above pipe top. Remaining backfill from 12" above pipe top up to finished grade or paving subgrade (as applicable) shall be as specified hereinafter under BACKFILLING.
- 2. Do not install initial backfill until the pipework has been inspected and accepted by the City.
- 3. Bedding shall be placed on trench subgrade to 12" above pipe top and shall be thoroughly hand tamped in 6" layers equally and uniformly into bell holes, between pipework and trench walls, in each side and top of pipework, all to prevent pipe displacement and as approved by the City of Elizabethton, and as specified below.
- 4. Bedding shall be as indicated in the following table:

BEDDING CLASS	APPLICATION
A	Only where indicated on the drawings or authorized.
B	Unless otherwise specified or authorized, all gravity flow piping except PVC gravity flow sewers.

B modified

PVC gravity flow sewers, all piping under paved areas, and where indicated on the drawings.

C

Ductile Iron Pipe in general (non-rock) excavations.

- B. Class A Bedding: This shall consist of: Concrete cradles, cast-in-place to full width of subgrade extending at least 6" or  $\frac{1}{4}$  pipe inside diameter (whichever is greater) below pipe bottom, and extending up on sides of pipe to pipe horizontal centerline; and initial backfill from concrete up to 12" above pipe tops, hand placed and compacted BEFORE placing any remaining backfill.
- C. Class B Bedding: This shall consist of: Granular bedding materials placed on subgrade to full trench width, extending at least 6" or  $\frac{1}{8}$  pipe outside diameter (whichever is greater) below pipe bottom, and extending up on sides of pipe to pipe horizontal centerline; and initial backfill from pipe horizontal centerline up to at least 12" above pipe top, hand placed and compacted BEFORE placing any remaining backfill.
- D. Class B Modified Bedding: This shall consist of: Granular materials placed on subgrade to full trench width, extending 6" below bottom and extending up sides of pipe to 12" above pipe top, hand placed and compacted.
- E. Class C Bedding: This shall consist of: Pipe bedded on native material of subgrade (except in rock excavation); and initial backfill over and around pipe and in bell holes, up to 12" above pipe tops, hand placed and compacted BEFORE placing any remaining backfill.
- F. Initial Backfill Materials:
  - 1. For Class A, B and C Pipe Bedding: Unless otherwise indicated, specified, or authorized this shall be finely divided earth, free of debris, organic material, stones or rock, and highly plastic clays.
  - 2. For Class B Modified Pipe Bedding and where otherwise indicated, specified, or authorized, this shall be granular materials.
- G. Compaction of Pipe Bedding:
  - 1. Pipe bedding composed of selected earth specified above shall be compacted to 95% of the maximum density as determined by ASTM D698 (Standard Proctor).
  - 2. Pipe bedding composed of granular materials specified above shall be compacted to 100% of the maximum density as determined by ASTM D2049.
  - 3. All trench compaction shall be subject to field density tests by the testing laboratory. Any trench compaction that is not compacted as specified above shall be removed, replaced, recompacted, and retested prior to its acceptance.

### 3.4 HANDLING AND LAYING GRAVITY FLOW SEWER PIPE

- A. General: Lay gravity flow sewer lines so that their inverts will conform accurately to the lines, grades, and elevations indicated and/or shown on previously approved cut sheets. Provide lasers, mason's lines, batter boards, and supports, and/or other suitable equipment as necessary to insure the installation of the sewer lines to the required lines, grades, and elevations.
- B. Handling: Provide and use suitable equipment for the safe and convenient handling of piping materials. Unload all piping materials carefully, and lower them carefully into the trenches, piece by piece, in a manner that will prevent damage to the materials and

trenches. Do not under any circumstances drop or dump piping materials, either from transportation vehicles or into trenches. Before laying inspect each length of pipe and each fitting for defects. Promptly remove all defective pipe and defective fittings from the pipe laying area.

- C. Before laying pipe, remove all dirt and other foreign matter from the insides of the pipe and fittings, spigot ends, insides of bells, gasket grooves, and gaskets. (Use every precaution to prevent dirt and other foreign matter from entering the pipe and fittings while they are being laid. Spigot ends, insides of bells, gasket grooves, and gaskets shall be kept free of dirt and other foreign matter after they have been cleaned and before the joints have been made up.)
- D. Laying: Begin laying pipe in finished trench at the lowest points, proceeding upgrade without breaks between manholes, with pipe spigots facing down-grade. Lay pipe with the bedding method required to accommodate the conditions encountered, with full length support of the pipe barrel at every point between bell holes, without groove or bell ends bearing on trench bottom, and with water-tight joints. Dewater trenches during laying and jointing, as specified hereinbefore. Keep trenches water-free and as dry as practicable during bedding, laying, and jointing, and until the work will not be adversely affected by submergence.
- E. Jointing: Before jointing, all mating surfaces of each joint and all joint material shall be clean and dry. Make up all joints in strict accordance with the pipe and gasket manufacturer's printed directions. Immediately after jointing, secure each previously laid length of pipe in place with tamped backfill of each side of pipe.
- F. Wye and Tee Branches: As pipe laying progresses, install wyes and tees at locations specified hereinafter in WYES, TEES, AND HOUSE CONNECTIONS. Incline each wye branch opening at a 45 degree angle, and seal each wye and tee with an easily removable standard stopper until the service pipe has been connected to wye or tee.
- G. Test for Line and Grade: During pipe laying, light from the beginning end of each straight section between manholes shall remain constantly visible from the working end, and shall show the true character and shape of the inside surface of the sewer, which shall be circular in form. This test will be applied to each completed section of sewer before its acceptance. Take up and relay all pipe which is not in true alignment or shows any settlement after laying.
- H. Protection of Pipe after Laying: As the pipe laying progresses, keep all dirt, trash, and other foreign materials cleared from the inside of the pipes. At all times when pipe laying is not in progress, keep the open ends of all pipes securely closed to prevent entrance of water, mud, or foreign matter, and secure all pipes to prevent displacement by movement of backfill, flotation, and other causes.
- I. Provide a "check dam" in the pipe trench, adjacent to every manhole influent connection, to prohibit groundwater migration through the trench. Construct of compacted impermeable clay, or concrete where indicated, to the dimensions shown.
- J. Provide a concrete collar, at every pipe bell and for pipes with full flow velocity of 15 fps or greater, to the dimensions shown.



### 3.5 BACKFILLING - GRAVITY SEWER

#### A. General:

1. Backfilling specified below DOES NOT include INITIAL BACKFILL up to 12 inches above pipe tops; INITIAL BACKFILL is specified hereinbefore under PIPE BEDDING for the type of pipe involved.
2. After pipework and pipe bedding has been approved, backfill trenches with TYPE I, TYPE II, OR TYPE III BACKFILL, as hereinafter specified, indicated, or as authorized.
3. Pipes Crossing Streets, Roads, Gravel Driveways, and Dirt Driveways: Backfill the trenches and make the crossing usable by vehicular traffic immediately after laying pipe and obtaining approval thereof, and maintain these crossings usable by vehicular traffic until project acceptance. Do not under any circumstances leave street or road crossing or a private driveway unusable overnight.
4. For each section of pipe laid, allow only a minimum length of trench to remain without backfill at the end of the day on which the section of pipe was laid. All unbackfilled trenches shall be provided with barricades, warning lights and flares, and other safety devices or measures when the work is not in progress.
5. All compaction of backfill shall be subject to field density tests by the testing laboratory.
6. At contractor's expense, remove, replace, and recompact all backfill which fails to comply with compaction density requirements herein specified.
7. Manholes: Backfill around manholes in accordance with applicable requirements for trench backfilling.
8. Unsatisfactory Backfilling Conditions: For just cause, the City may stop pipe laying at any time and require Contractor to properly backfill and/or clean up previously laid sections of pipe.

#### B. Type I Backfill, for pipe under non-paved areas, except areas within 10 feet horizontal distance from edge of pavement, and for pipe where indicated or authorized:

1. Unless otherwise indicated, specified, or authorized, place all Type I backfill from 12" above pipe tops up to finished grade by approved methods. Windrow excess excavated materials over the trenches, and after sufficient settlement satisfactory to the City has occurred, complete the surface dressing surplus material removal, and surface cleanup and restoration.
2. Type I backfill materials from top of pipe bedding up to finished grade shall be any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following materials which are larger than 6" in their greatest dimension for up to 3 feet above top of pipe and 12" in the greatest dimension thereafter up to finished grade: rock, stone, concrete, asphalt paving; or masonry.

#### C. Type II Backfill, for pipe which parallels paved surfaces and which is installed within 10 feet horizontal distance from edge of pavement and for pipe where indicated or authorized:

1. Unless otherwise indicated, specified or authorized, place all Type II Backfill from top of pipe bedding to finished grade or paving subgrade in 6" maximum thickness loose layers, and compact each layer with mechanical tampers to obtain 95% of the maximum density as determined by ASTM D698 (Standard Proctor).
2. Backfill materials from top of pipe bedding up to finished grade or paving subgrade shall be any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following materials which are larger than 6" in the greatest dimension for up to 3 feet above top of pipe and 12" in their

greatest dimension thereafter up to finished grade: rock; stone; concrete; asphalt paving; or masonry.

- D. Type III backfill, for pipe under paved areas, for areas proposed to be paved, and for pipe where indicated or authorized:
  - 1. Where Type III backfill is indicated, specified, or authorized, backfill trenches from top of pipe bedding to paving subgrade with granular materials compacted to 100% of the maximum density as determined by ASTM D2049.
  - 2. Backfill materials from top of pipe bedding up to finished grade or paving subgrade shall be any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following materials which are larger than 6" in the greatest dimension for up to 3 feet above top of pipe and 12" in their greatest dimension thereafter up to finished grade: rock; stone; concrete; asphalt paving; or masonry.
- E. Dispose of all excavated materials which are not replaced as backfill in a manner and location approved by the City.
- F. Final Requirements
  - 1. Throughout construction of the project until the time of final acceptance, and also during the duration of the guarantee period: Maintain the backfilled and repaved trenches.
  - 2. At the Contractor's expense:
    - a. Refill, recompact, and smooth off as required all backfill which settles, so that all backfill finally conforms to the original grade or paving subgrade as applicable.
    - b. All pavement which may be damaged by settlement of backfill shall be removed and replaced after backfill has been repaired as specified above.

### 3.6 MANHOLES

- A. General: Manholes shall be concrete type, each constructed completely when the pipe laying reaches the manhole location. Manholes shall have cast-in-place circular concrete foundation slabs below sewer invert elevation or precast bottom section, and precast reinforced concrete conical top section, all as detailed on the drawings.
- B. Manhole Construction: Assemble each manhole with one or more straight vertical wall section and one top taper section as necessary to provide the required manhole depth. Seal all joints between precast sections with the above specified gasket material. Plug all lifting holes with non-shrinking mortar after laying sections, and seal around all pipe entrances with gasketed watertight connection, all to provide strictly water-tight construction. **DO NOT USE MORTAR TO SEAL PRECAST SECTION JOINTS.** Provide 24 inch inside diameter, precast concrete, or cast-in-place concrete spacer rings between rim and precast taper section, as required to set rim at proper elevation. Securely grout spacers and rim to manhole structure with non-shrinking grout.
- C. Inverts: Provide an invert in each manhole bottom as required to accommodate the inflowing and outflowing pipes, constructed with concrete (3000 psi), with full pipe size flow channels carefully and smoothly shaped and finished to prevent splashing and turbulent flow. Make all changes of flow directions within manholes with the maximum practical radius curves. Where possible, lay pipe through manhole, and remove upper half of pipe to form invert. Manhole floor outside of invert shall be smooth and shall slope toward invert at least one inch per six inches.

- D. **Drop Construction:** Provide drop connections where indicated, and in all cases where the drop through the manhole exceeds 2'-0", with drop pipe and fittings arranged and encased in concrete or brick masonry, as detailed. Where the difference in elevation between manhole invert and incoming sewer is less than 2'-0", the manhole invert shall be filleted to prevent deposit of sewage solids.
- E. **Set manhole tops as follows, unless otherwise indicated or authorized:**
1. In streets, roads, highways, and other paved areas: flush with finished paving grade.
  2. Undeveloped areas, such as fields, woods, etc.: 18 inches above ground.
  3. Other areas: 12 inches above ground.
- F. **Connect new sewers to existing manholes where indicated. Rebuild existing inverts and provide new drop connections on existing manholes in accordance with the requirements of paragraphs hereinbefore, and as approved.**
- G. **Force Main Connections:** At manholes where a force main discharges at an elevation greater than two feet above the gravity sewer invert, provide a 90° elbow and install a pipe section parallel to the manhole wall. Pipe section shall extend from point of entry, terminating at an elevation within two feet of the sewer invert. The manhole receiving the force main shall receive the following special repair and protective coating treatments. The manhole immediately downstream of the manhole receiving the force main shall also receive special protective coatings:
1. **Repair:** Completely eliminate all visible points of infiltration using leak plugging compound as follows:
    - a. Remove all loose material, and saturate dry areas with water, removing surface water.
    - b. Apply waterproofing compound per manufacturer's directions.
    - c. Fill penetration opening to one inch below surface with plugging compound per manufacturer's directions. Fill balance of penetration opening with patching compound using a pneumatic rammer or hammer block.
  2. **Protective Coating:**
    - a. Patch all dry surface defects and pipe penetrations using patching compound.
    - b. Brush-apply waterproofing compound from the bottom of the manhole to the bottom of the cover frame. Allow thirty minutes between first and second coatings to allow initial set of first coating, but apply second coating as soon as possible then after.
  3. **Materials:**
    - a. Plugging Compound - plugging compound shall be Xypex Ultra-Plug mixed with Xypex Quickset liquid.
    - b. Patching Compound - patching compound shall be Xypex Concentrate mixed to "dry-pac" consistency (6 parts Concentrate : 1 part water).
    - c. Waterproofing Compound - waterproofing shall be a two-coat system consisting of:
      - (1) first coat of Xypex Concentrate mixed to "slurry" consistency (5 parts Concentrate : 2 parts water).
      - (2) second coat of Xypex Modified mixed to "slurry" consistency.
- H. **Protect and maintain each manhole until it is accepted. The City may inspect completed manholes separately or in groups. The Contractor will be relieved from further responsibility of protecting the top of each manhole which is accepted in writing.**

- I. Manhole connections: Flexible boots, cast in the manhole; Kor-N-Seal or equal, with stainless steel internal band and external pipe clamp, conforming to ASTM C923.
- J. Vents for manholes subject to flooding: Provide vents for manholes indicated as watertight type, fabricated of steel pipe and steel plates and hot dip galvanized after fabrication, all as detailed.

### 3.7 BEDDING - FORCE MAIN

#### A. General:

- 1. Pipe bedding includes all materials placed below and on each side of pipe and also INITIAL BACKFILL up to 6" above pipe top. Remaining backfill from 6" above pipe top shall be specified under BACKFILLING hereinafter.
- 2. Do not install initial backfill until the pipework has been inspected and approved.
- 3. Testing for leaks on the surface of the pipe prior to initial backfilling will not be required, but other test procedures, as specified in TESTING AND STERILIZING hereinafter, shall be followed.

- B. Bedding shall be placed on trench bottom to 6" above pipe top and shall be thoroughly hand tamped in 6" layers equally and uniformly into bell holes, between pipework and trench walls, on each side and top of pipework, all to prevent pipe displacement and as approved by the City and as specified below.

- C. For general (NON-ROCK) excavations: Pipe bedding for ductile iron and PVC pipe, unless otherwise indicated, specified, or authorized shall consist of selected earth which is free of rocks, stone, bricks, broken concrete, rubbish, wood, vegetable matter, topsoil and other unsuitable materials.

- 1. Where TYPE III BACKFILL (From 6" above pipe top to finished grade or paving subgrade) is indicated or specified hereinafter, pipe bedding shall consist of granular materials ONLY from trench bottom to 6" above pipe top.
- 2. Where TYPE "I" and "II" BACKFILL (from 6" above pipe top to finished grade or paving subgrade) is indicated or specified hereinafter, pipe bedding shall consist of granular materials from trench bottom to approved limits ONLY where authorized by the City.

- D. For ROCK excavations, pipe bedding up to pipe bottom shall be as specified in ROCK EXCAVATION AND BLASTING hereinbefore. Remainder of pipe bedding shall be as specified in paragraph C above.

- E. Granular materials shall be one of the following:

- 1. These shall conform to the requirements of GRANULAR PIPE BEDDING, as specified hereinbefore.

- F. Compaction of Pipe Bedding:

- 1. Pipe bedding composed of selected earth as described in paragraph C above shall be compacted to 95% of the maximum density as determined by ASTM D698 (Standard Proctor), unless otherwise specified.
- 2. Pipe bedding composed of granular materials as described in paragraph E hereinbefore shall be compacted to 100% of the maximum density as determined by ASTM D2049.

3. All trench compaction shall be subject to field density tests by the testing laboratory. LABORATORY TESTING SERVICES shall be initially paid for by the City, and only retesting shall be paid for by the Contractor. Any trench compaction that is not compacted as specified above shall be removed, replaced, recompacted and retested prior to the acceptance.

### 3.8 HANDLING AND LAYING FORCE MAIN PIPE AND FITTINGS.

- A. Provide and use suitable equipment for the safe and convenient handling of pipe, fittings, valves, and other force main piping materials. Unload all force main piping materials carefully, and lower them carefully into the trenches, piece by piece, in such a manner that will prevent damage to the materials and their protective coatings and linings. Do not under any circumstances drop or dump force main piping materials, either from transportation vehicles, or into trenches.
  1. Generally, handle and lay PVC pipe and PVC fittings in accordance with the manufacturer's printed instructions. Obtain these instructions, read them thoroughly, and keep at least one copy thereof on the job at all times in good condition.
  2. Lay PVC mains with joints and fittings in good alignment and arranged to allow for free expansion and contraction of piping without causing excessive stress on piping. DO NOT "SNAKE" PIPE INTO TRENCHES.
- B. Before laying, inspect each length of pipe and each fitting for defects. Promptly remove all defective pipe and defective fittings from the pipe laying area.
- C. Before laying pipe and fittings: Remove all lumps, blisters, and excess coal tar coating from each spigot and the inside of each bell for iron pipe; wire brush and/or wipe all dirt and other foreign matter from the outside of each spigot and the inside of pipe, fittings, gasket, grooves, and bells; swab out the inside of each length of pipe and each fitting; and remove all dirt and other foreign matter from all gaskets, glands, bolts, and nuts. Use every precaution to prevent dirt and other foreign matter from entering pipe and fittings while they are being laid. Spigot ends, insides of bells, gasket grooves, gaskets, glands, bolts, and nuts shall be kept free from dirt and other foreign matter after they have been cleaned and before the joints have been made up.
- D. Mechanical Joints: After placing pipe and fittings into the trench, slide gland over spigot, apply proper lubricant to gasket and spigot, slip gasket over spigot, center spigot end in bell, force pipe home, and bring it into correct line and grade. Press gasket evenly in place into bell, slide gland into position for bolting, insert all bolts, screw on and hand tighten all nuts, then tighten all nuts with an approved wrench. Tighten diagonally opposite nuts alternately to obtain uniform pressure on all parts of the gland, with torques of 40 to 60 foot pounds for 5/8 inch bolts, and 60 to 90 foot pounds for 3/4 inch bolts. Realign pipe as required and secure it in place with approved backfill material tamped around pipe, except at bells.
  1. On retainer type glands, after pipe has been aligned properly, tighten all set screws as specified hereinafter under ANCHORAGE.
- E. Push-On Joints: Make up push-on joints in accordance with the manufacturer's recommendations, generally as follows: after placing pipe and fittings into the trench, insert gasket in gasket groove, apply proper lubricant to gasket and spigot, center spigot end in bell, and force pipe home with proper jacks, bars, chains, cables, or other suitable equipment. For PVC force mains, push spigot end into bell until depth indicating stripe on spigot is covered by bell; then pull pipe out until the stripe on the spigot end reappears in

line with the outer end of the bell, to allow for free expansion of the piping. Realign pipe as required, and secure it in place with approved backfill material tamped around pipe, except at bells. Taper each field cut spigot end back about 1/8 inch at a 30 degree angle, using a coarse file or portable grinder, or special tools as recommended by the piping manufacturer, to prevent gasket damage.

- F. Do not "buckle-in" any pipe without approval.
- G. At all times when pipe laying is not in progress, keep all open ends closed tightly with suitable caps or plugs to prevent foreign material from entering any part of the pipework.

### 3.9 ALIGNMENT OF FORCE MAIN PIPE

- A. In straight trenches, lay pipe in reasonably straight lines, using appropriate fittings at all sharp breaks in grade. In curved trenches, lay pipe to follow the trench centerline as closely as practicable, using appropriate fittings at all sharp breaks in grade, and using appropriate fittings or deflecting joints and using shorter than standard lengths of pipe as necessary to make the required curves. Do not deflect any joint in excess of pipe manufacturer's recommendations.

### 3.10 ANCHORAGE

- A. Provide anchorage for each bend, tee, plug, deadend, and other fitting subject to blowing off of the line under pressure.
- B. Unless otherwise indicated, anchorage shall consist of 3,000 psi concrete blocking poured between firm undisturbed earth and the unbalanced sides of the items to be anchored, with sufficient earth bearing area to prevent displacement of joints under pressure. Pour concrete blocking before applying pressure test on piping and arrange it so that the pipe and fitting joints will be accessible for repair. BLOCKING BEARING AREA SHALL BE BASED UPON THE SPECIFIED TESTING PRESSURE.
- C. Retainer Glands: These shall be ductile iron mechanical joint set-screw type, installed in accordance with manufacturer's directions, with set screws tightened uniformly to about 80 foot pounds torque. This type of anchorage MAY be used at any location instead of concrete anchorage subject to approval, and SHALL be used at the following locations:
  - 1. Where indicated.
  - 2. Where concrete anchorage is not practicable.
- D. At the locations indicated or where required to prevent separation of lines on steep slopes, provide cast-in-place concrete collars as indicated.

### 3.11 VALVE AND BOX INSTALLATION

- A. Install valves with their operating stems plumb, at approximate locations indicated, but at exact locations as approved and as specified below. Leave all valves in normal operating positions, free from leakage.
  - 1. All valves: insofar as practicable, install these at locations in runs where easy to find in the future.
- B. Set and support each valve box so that no stress or shock can be transmitted to the valve, with the box centered and plumb over the valve wrench nut, and the box top exposed and

flush with finished grade. Readjust boxes as required so that all boxes conform to these requirements at the time of acceptance of the system. For valves located in unpaved areas, set each valve box in a concrete slab 18-inches square and at least 5-inches thick, flush with finished grade.

### **3.12 INSTALLATION OF AIR RELEASE AND AIR AND VACUUM RELEASE VALVES**

- A. Install an air release or air and vacuum release valve at each high point or change in grade of the force main as indicated and/or authorized. Unless otherwise indicated, connect valve to force main using a brass tapping saddle, galvanized steel pipe nipples and a bronze rising stem gate valve between air release valve and force main, all enclosed in a precast concrete manhole with cast iron rim and cover.

### **3.13 BACKFILLING - FORCE MAIN**

#### **A. General:**

1. Backfilling specified as follows DOES NOT include INITIAL BACKFILL up to 6" above pipe tops; INITIAL BACKFILL is specified hereinbefore under PIPE BEDDING for the type pipe involved.
2. After pipework and pipe bedding have been approved, backfill trenches, with Type I, Type II, or Type III BACKFILL, as hereinafter specified, indicated, or as authorized.
3. Pipes Crossing Streets, Roads, Gravel Driveways, and Dirt Driveways: Backfill the trenches and make the crossing usable by vehicular traffic immediately after laying pipe and obtaining approval thereof, and maintain these crossings usable by vehicular traffic until project acceptance. Do not under any circumstances leave street or road crossing or a private driveway unusable overnight.
4. For each section of pipe laid of trench to remain without compacted backfill at the end of the day on which the section of pipe was laid. All unbackfilled trenches shall be provided with barricades, warning lights and other safety devices or measures when the work is not in progress.
5. All compaction of backfill shall be subject to field density tests by the testing laboratory.
6. At Contractor's expense, remove, replace, and recompact all backfill which fails to comply with compaction density requirements hereinafter specified.
7. Manholes: Backfill around manholes in accordance with applicable requirements for trench backfilling.
8. Unsatisfactory Backfilling Conditions: For just cause, the City may stop pipe laying at any times and require the Contractor to properly backfill and/or clean up previously laid sections of pipe.

#### **B. Type I Backfill, for pipe under non-paved areas, except areas within 10 feet horizontal distance from edge of pavement, and for pipe where indicated or authorized:**

1. Unless otherwise indicated, specified, or authorized, place all Type I backfill from 6" above pipe tops to finished grade by approved methods. Windrow excess excavated materials over the trenches, and after sufficient settlement satisfactory to the City and has occurred, complete the surface dressing, surplus material removal, and surface cleanup and restoration.
2. Type I backfill materials from top of pipe bedding up to finished grade shall be any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following materials which are larger than 6" in their

greatest dimension for up to 3 feet above top of pipe and 12" in their greatest dimension thereafter up to finished grade: rock, stone, concrete, asphalt paving, or masonry.

- C. **Type II Backfill**, for pipe which parallels paved surfaces and which is installed within 10 feet horizontal distance from edge of pavement and for pipe where indicated or authorized:
  - 1. Unless otherwise indicated, specified or authorized, place all Type II Backfill from top of pipe bedding to finished grade or paving subgrade in 6" maximum thickness loose layers, and compact each layer with mechanical tampers to obtain 95% of the maximum density as determined by ASTM D698 (Standard Proctor).
  - 2. Backfill materials from top of pipe bedding up to finished grade or paving subgrade shall be any materials removed from the excavation and suitable for backfill, except do not use as backfill materials any pieces of the following materials which are larger than 6" in their greatest dimension for up to 3 feet above top of pipe and 12" inches in their greatest dimension thereafter up to finished grade: rock, stone, concrete, asphalt paving, or masonry.
- D. **Type III Backfill**, for pipe under paved areas, for areas proposed to be paved, and for pipe where indicated or authorized:
  - 1. Where Type III backfill is indicated, specified, or authorized, backfill trenches from top of pipe bedding to paving subgrade with granular materials compacted to 100% of the maximum density as determined by ASTM D2049.
- E. Dispose of all excavated materials which are not replaced as backfill in a manner and location approved by the City.
- F. **Final Requirements**
  - 1. Throughout construction of the project until the time of final acceptance, and also during the duration of the guarantee period, maintain the backfilled and repaved trenches.
  - 2. At the Contractor's expense:
    - a. Refill, recompact, and smooth off as required all backfill which settles, so that all backfill finally conforms to the original grade of paving subgrade, as applicable.
    - b. All pavement which may be damaged by settlement of backfill shall be removed and replaced after backfill has been repaired as specified above.
- G. **Special Backfill Requirements:**
  - 1. Pipes in tunneled or bored holes, without casings: backfill with sand only, placed as approved and as required to prevent caving and settling.
  - 2. See HIGHWAY CROSSINGS AND RAILROAD CROSSINGS, hereinafter for special backfill requirements.

### 3.14 HIGHWAY CROSSINGS

- A. At no cost to the Contractor, the City will obtain permission from the Highway Department for each required crossing of a highway by a gravity sewer line or force main.
- B. Do all work on the highway rights-of-way under the supervision of the Highway Department, and in strict accordance with their requirements. DO NOT UNDER ANY CIRCUMSTANCES PLACE ANY EXCAVATED MATERIALS, CONSTRUCTION MATERIALS, CONSTRUCTION EQUIPMENT, OR OTHER ITEMS ON THE HIGHWAY PAVEMENT. Arrange



all work to avoid all unnecessary interference with highway traffic. As soon as practicable after installation of each force main and/or sewer line across the highway, restore all highway property at that location to at least the conditions that existed prior to the beginning of work thereon.

- C. Where indicated and/or required by the Highway Department, provide pipe casings around force main and/or sewer lines which cross the highway. Depths of casings below paving and lengths of casings beyond each side of highway shall be as indicated or as required by the Highway Department. Except as authorized, construct all highway crossings by boring or tunneling techniques. Bore or tunnel holes as required under the pavement and shoulders and install the casings through these holes, as prescribed and/or approved by the Highway Department. Open cut will be permitted only beyond pavement and shoulders. Install pipes in casings by methods that will positively prevent separation of pipe joints and damage to pipes.
  - 1. Casings shall be  $\frac{1}{4}$  inch minimum wall thickness black steel pipe, with inside diameters as required for the satisfactory installation of the carrier pipes through the casings. Weld all casing joints.
- D. Where casings are not indicated or required by the Highway Department, bore the smallest practicable diameter hole under the pavement and shoulders as prescribed and/or approved by the Highway Department, and install the pipe through the hole by methods that will positively prevent separation and excessive deflection of pipe joints. Open cut will be permitted only beyond pavement and shoulders.

### 3.15 RAILROAD CROSSINGS

- A. At no cost to the Contractor, the City will obtain permission from the Railroad Company for each required crossing of their tracks by a force main and/or sewer line.
- B. Do all work on the railroad rights-of-way under the supervision of the Railroad Company involved, and in strict accordance with their requirements. DO NOT UNDER ANY CIRCUMSTANCES PLACE ANY EXCAVATED MATERIALS, CONSTRUCTION MATERIALS, CONSTRUCTION EQUIPMENT, OR OTHER ITEMS ON THE TRACKS OR AT ANY OTHER LOCATION WITHIN RAILROAD TRAFFIC CLEARANCE LIMITS. Arrange all work to conform with the railroad operating schedules, and to avoid all unnecessary interference therewith. As soon as practicable after installation of each force main and/or sewer line across the tracks, restore all railroad property at that location to at least the conditions that existed prior to the beginning of the work thereon.
  - 1. The City will pay all charges that the Railroad Company may make for supervising the Contractor's work on their property.
- C. Where indicated and/or required by the Railroad Company, provide pipe casings around force main and/or sewer lines which cross railroad tracks. Depths of casings below tracks and lengths of casings beyond each side of tracks shall be as indicated or required by the Railroad Company. Except as authorized, construct all railroad crossings by boring or tunneling techniques. Bore or tunnel holes as required under the tracks and install the casings through these holes as prescribed and/or approved by the Railroad Company. Install pipe through casings by methods that will positively prevent separation of pipe joints and damage to pipes.
  - 1. Casings shall be black steel pipe having the wall thickness as required by the Railroad company and with an inside diameter at least four inches larger than the outside diameter of the sewer pipe bells. Weld all casing joints.

- D. Casings for Mains: For pipes 10 inches and smaller, these shall be ¼-inch minimum wall thickness black steel pipe, with an inside diameter at least four inches larger than the outside diameter of the sewer pipe bells. For pipes 12 inches and larger, wall thicknesses shall be as tabulated as follows or as required by the railroad company, whichever requires the heavier wall. Weld all casing joints.

<u>CARRIER PIPE SIZE</u>	<u>CASING NOMINAL DIAMETER</u>	<u>MINIMUM WALL THICKNESS</u>
12	24	0.407"
16	30	0.469"
18	30	0.469"
20	36	0.532"
24	36	0.532"

- E. Where casings are not indicated or required by the Railroad Company, bore the smallest practicable diameter hole under the tracks as prescribed and/or approved by the Railroad Company, and install the pipe through the hole by methods that will positively prevent separation and excessive deflection of pipe joints.

### 3.16 CREEK AND STREAM CROSSINGS

- A. All creek and stream crossings shall be as indicated on the drawings or as indicated by the typical creek and stream crossing drawings included in these specifications. Bagged concrete encasement and granular backfill shall be as indicated on the drawings or as required by local codes and permits. Comply with all State and Federal regulations regarding siltation and erosion control, restoration of stream beds to original grades and contours, and protection of the aquatic environment.

### 3.17 AIR, EXFILTRATION, PRESSURE, AND DEFLECTION TESTS - GRAVITY SEWER

- A. General: Before putting it in service, test all in-place sewer piping as specified below. Tests may be made in sections as the work progresses, between manholes for gravity flow lines. In each case where a test is required in accordance with an ASTM Specification or other publication, obtain a copy of the publication involved, and maintain it on the job site in good condition at all times, for Contractor's and the City's use in conducting tests and computing permissible leakage. Where tests indicated leakage in excess of permissible limits, locate sources of excessive leakage, make necessary repairs, and repeat tests until they are approved. Types of tests shall be as follows:
1. Gravity flow line, including house services, UNLESS OTHERWISE APPROVED: air test.
  2. Gravity flow lines, including house services, WHERE APPROVED ONLY: exfiltration test.
- B. Air Tests: Perform these in accordance with ASTM Specification C828.
- C. Exfiltration Tests: Fill piping with water to provide at least a four foot hydrostatic head above inside top of pipe at high end of section involved and to provide at least a four foot standing head there at end of test, but not more than 15 feet hydrostatic head above inside top of pipe at lowest end thereof. Maintain each test for at least two hours. Tests shall include all manholes, each of which shall be considered as a section of pipe with inside diameter equal to that of manhole. Test heads specified above are based upon trenches

and backfill free of excess water. If excess water is present in trenches or backfill, increase above specified test head to compensate for counteracting external pressures on pipes.

1. Exfiltration of total new sewers, or each section thereof, shall not exceed 25 gallons per mile of pipe per 24 hours per inch of internal pipe diameter, including house connections.
- D. Deflection Tests: Each in-place reach of PVC sewer pipe shall be checked for excessive deflection by pulling a 9-arm go-no-go mandrel through the pipe, or by other approved test methods. Deflection tests shall not be performed until at least 24 hours after backfilling. Pipe with diametral deflection exceeding 5 percent of its inside diameter shall be uncovered, rebudded, and rebackfilled as required to correct excessive deflection. Rebudded and rebackfilled pipe shall be retested prior to its acceptance. Each mandrel to be used in the deflection tests shall be approved by the Engineer prior to testing.
- E. Manhole Testing: All precast concrete manholes shall be vacuum tested to determine if they pass the infiltration/inflow requirements. The vacuum test shall be as follows:
1. The testing shall be done after assembly of the manhole and prior to backfilling.
  2. The manhole-to-pipe connection shall be a flexible connector, such as the Kor-N-Seal or approved equal.
  3. All lift holes shall be plugged with an approved non-shrinking mortar.
  4. The seal between the manhole sections shall be in accordance with ASTM C923.
  5. The Contractor shall plug the pipe openings, taking care to securely brace the plugs and the pipe. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.
  6. The test head shall be placed at the inside of the top of the cone section and the seal inflated. The compression band shall be inflated to 40 psi to effect a seal between the vacuum base and the structure. The vacuum pump shall then be connected to the outlet port with the valve open, a vacuum drawn to 10" of Hg and the valve closed.
  7. With a measured vacuum of 10 inches of mercury established in the manhole, the time for the vacuum to drop to nine inches of mercury shall be recorded.

Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to nine inches of mercury. The maximum allowable leakage rate for a four-foot diameter manhole shall be in accordance with the following:

<u>Manhole Depth</u>	<u>Minimum Elapsed time for a Pressure Drop of 1 Inch Hg</u>
10 ft. or less	60 seconds
> 10 ft. < 15 ft.	70 seconds
> 15 ft. > 25 ft.	90 seconds

For manholes five feet in diameter, 15 seconds shall be added to the above minimum times. For manholes six feet in diameter, 30 seconds shall be added to the time requirements for four-foot diameter manholes.

8. If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated for four-foot diameter manholes.
9. If a manhole joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

### 3.18 TESTING - FORCE MAIN

- A. After backfilling, subject all pipework to pressure and leakage tests. Piping may be tested in sections between valves as the work progresses. Admit water slowly (velocity of one foot per second or less) into the section to be tested, and expel all air through vent valves, at all high points in the piping, as required. After all air has been expelled apply a hydrostatic pressure of 200 psi measured at the lowest point in the piping section involved. Maintain the test pressure at least two hours, during which time the leakage shall not exceed that permitted by AWWA Specification C600 for mechanical joint and push-on joint pipe. Repair all apparent leaks. If the measured leakage exceeds the maximum specified allowable leakage locate and repair the leaks, and repeat the tests on sections of pipe involved until all tests have been approved. Furnish approved testing equipment, consisting of a suitable pump to apply and maintain test pressure, accurate pressure gauges, suitable equipment to measure volume of water pumped, and other necessary equipment, and conduct all tests in the presence of the City, as approved. Determine leakage by measuring the volume of water pumped to maintain the required test pressure for the duration of the leakage test. Obtain a copy of AWWA Specification C600, and keep it on the job in good condition for the use of the City in computing the permissible leakage in each section to be tested.
- B. Water for testing, will be furnished by the City from existing water facilities, without cost to the Contractor, but the Contractor shall furnish all piping and equipment to convey the water to the new pipe lines.
- C. Corporation stops shall match those of the customer's typical water service connections; provide these as required for testing and after that use, leave them in place with their outlets plugged.

### 3.19 CUTTING AND REPLACING PAVEMENT AND OTHER SPECIAL SURFACES

- A. Do not cut streets, roads, and other paved surfaces except where necessary for the pipe line installation.
- B. Restore to at least the conditions which existed before excavation, all surfaces which have been disturbed by the pipeline construction as specified hereinafter. Prior to construction, the City will examine the existing surface in the Contractor's presence, and the type of surface to be replaced in each case shall be determined by the City.
  - 1. Where pipe lines are indicated to be installed along shoulder of roads and streets but not under paving, the Contractor shall repair all damage to paving which occur as a result of the pipeline installation, all at no cost to the City unless otherwise approved in writing. Maintain all crossings until project completion.
- C. As specified under TRENCHING, EXCAVATION, SHORING, BRACING, AND DEWATERING, the maximum pipe trench width shall be as specified. The maximum width of all pavement and other surface repairs allowable for payment by the City will be: three inches beyond each side of concrete caps required at Open Cut Highway Crossings; at all other locations, six inches beyond each side of maximum allowable trench width. At Contractor's expense, make all repairs outside of this limits. If the repairs do not reach this limit, the City will pay ONLY for the actual extent of the repairs. Prior to making any excavation, outline the limits of the proposed excavation, and saw-cut the pavement along the outline to a depth of at least one inch to provide a smooth pavement cut-line. Carefully remove the pavement between the saw-cuts and avoid damage to the paved surface outside the saw-cuts.

Replace with new surfaces all existing surfaces which are cut, removed, or otherwise damaged by the work under this Contract, as specified hereinafter. All new surfaces shall conform accurately to the elevations and contours of the existing adjacent undisturbed surfaces.

1. Existing Gravel Surfaces: Replace these with a six inch thick compacted layer of new road gravel.
2. Existing Asphalt ("black top" single bituminous surfaces and double bituminous surfaces): Replace these with a six-inch thick compacted base course of new road gravel. The 6" base course shall be considered as a temporary traffic surface and shall be maintained in good condition until paved. Maintenance shall include: filling pot holes, work necessary to confine stone to trench area by sweeping with mechanical sweeper with collection hopper and water-fed brooms, and watering temporary surface daily, if necessary, for dust control. To avoid mixture of earth backfill and limestone base, all excess excavated material shall be removed from the work area prior to placing of the base course. Permanent pavement to consist of two (2) inches of Tennessee Department of Transportation, Bureau of Highways Subsection 411, Grading D, Asphaltic Concrete Surface (Hot Mix). Before laying asphaltic concrete surface course, apply a prime coat to the underlying base course. When authorized by the City the Contractor shall proceed immediately with the application of the permanent Asphaltic Concrete Surfacing. Not having sufficient area to warrant moving paving Sub-contractor to site will not be acceptable as reason for delaying paving when there is as much as one block or 600 feet of trench ready for permanent paving.
  - a. Failure by the Contractor to proceed with the performance of this phase of the work immediately after above authorization, may be considered cause for deducting the section of pipe line from the periodic estimate.
3. Temporary Pavement: Where authorized by the City in the field, the Contractor shall immediately provide temporary pavement over the base course. The temporary pavement over the pipe line trench shall be a 1" thick approved, plant mixed, bituminous pavement rolled to conform to existing surrounding street surfaces. The temporary pavement shall be allowed to settle under traffic for a time period determined by the City, after which the temporary pavement shall be removed and replaced by permanent pavement as specified hereinbefore. The length of pipeline trenches along or across paved streets, which are to be temporarily paved as above, shall not exceed one block or 600 feet at any time on any single street or road.
4. Repair of Existing Concrete Surfaces Including Roads, Sidewalks, Curbs, and Gutters:
  - a. General: Remove existing sidewalks and curbs and gutters only as required for new pipe line installation, and replace removed sidewalks and curbs and gutters with new sidewalks and curbs and gutters, which shall match existing undisturbed corresponding items in dimensions, finishes, grades, and arrangements.
  - b. New concrete shall be 3,000 psi with an air entrainment value of six percent ( $\pm$  1 percent). The water cement ratio shall be not greater than 0.50 by weight. Concrete slump shall be one to three inches.
  - c. Expansion Joints: Provide expansion joints on 20 foot maximum centers in curbs and gutters and on 35 foot maximum centers in sidewalks, full depth of concrete cross section, and formed with ASTM D1751  $\frac{1}{2}$ " thick expansion joint filler.
5. Prime Coat: This shall be one of the following types of liquid asphalt as authorized for the conditions involved: RC-70; RC-250; MC-70; or MC-250. Heat the priming material and apply it with a suitable asphalt distributor, at a uniform rate of 0.25 to 0.50 gallons per square yard of base, all as approved.

- D. Where pipe is installed on the shoulders parallel to asphalt, double bituminous surface treatment, concrete, or other surfaces, maintain ditches until they are firm and present no traffic hazard. Where authorized, place six-inch thick compacted layers of new road gravel.
- E. Road Gravel Material: Road gravel shall be as specified hereinbefore.
- F. City Approvals: All repairs to City roads shall be subject to the approval of the Elizabethton City road department. FINAL PAYMENT WILL NOT BE MADE UNTIL THE CONTRACTOR HAS OBTAINED ALL NECESSARY CITY ROAD DEPARTMENT APPROVALS AND SUBMITTED ACCEPTABLE WRITTEN EVIDENCE THEREOF.

### 3.20 WYES, TEES, AND HOUSE CONNECTIONS

- A. General: The GENERAL locations of wyes and house service pipes shall be as specified below, but the Contractor shall establish their EXACT locations, grades, and elevations.
  - 1. BEFORE LAYING EACH MAIN SEWER SECTION, THE CONTRACTOR SHALL EXAMINE THE PROPERTY ON EACH SIDE OF THE SEWER SECTION, RUN ALL NECESSARY LEVELS, AND INSTALL EACH WYE AND EACH HOUSE SERVICE PIPE AS REQUIRED TO SERVE THE PROPERTY INVOLVED, BY GRAVITY FLOW. IN EACH CASE WHERE IT IS FOUND THAT PROPERTY CAN NOT BE SERVED AS DESCRIBED ABOVE, IMMEDIATELY NOTIFY THE CITY FOR DECISION BEFORE PROCEEDING FURTHER WITH THE WORK ON THE SEWER SECTION INVOLVED.
- B. Wyes: Provide wyes at the following GENERAL locations in gravity flow service, unless otherwise approved:
  - 1. For each house, and for each other building requiring a sewer connection, including those existing and those under construction.
  - 2. For each vacant lot, on each side of the sewer, if authorized by the City.
  - 3. At each other location authorized.
- C. House Service Pipe: House service pipe and fittings shall be of the same materials and with the same type joints as those of the main sewers. Lay house services with MINIMUM uniform grade of one percent, depth at property line as required to serve the property, but in no case less than 4'-6" deep at property line, and with 1'-6" MINIMUM cover over top of pipe. In all cases where service pipe must cross a side ditch exposed, install cast iron pipe across ditch, extending at least 1'-0" into ditch banks on each side. Terminate each house service pipe at the property line with a plugged bell end. Unless otherwise authorized, install house service pipe only for existing houses and other existing buildings requiring sewer connections.
- D. Indicate the location of each service pipe by an approved mark on the curb or a metal stake at the property line end of the service pipe, and maintain these marks or stakes clearly visible until final project acceptance. Before final acceptance, at Contractor's expense locate and mark or stake each service pipe which is not so indicated, including replacing all marks or stakes which have been obliterated or removed.

### 3.21 WYE AND HOUSE SERVICE PIPE RECORD

- A. Keep an accurate record of the locations of all wyes, and the locations and lengths of all service pipes. Do not cover any wyes or service pipes until they have been recorded by both the Contractor and the City. Upon project completion and before final payment will

be made, submit an acceptable copy of the wye and service pipe record, showing the following:

1. Distance in feet from each wye to the centerline of the first manhole downstream from the wye, and the direction in which each branch inlet is turned.
2. Length in feet and routing of each service line.
3. Distance in feet from property line end of each service pipe to the centerline of the first manhole downstream from the service pipe, measured parallel to main sewer line.

### **3.22 CLEANING UP FORCE MAIN AND GRAVITY SEWER IMPROVEMENTS**

- A. Clean up the force main and/or gravity sewer improvements as the work progresses. Negligence in proper cleaning up which causes undue inconvenience to the public or private citizens, presents an unsightly or dangerous condition, or causes embarrassment to civic officials shall be sufficient reason for rejection of construction estimates until the unsatisfactory condition have been remedied.
- B. After all work is complete, make a final cleanup of all areas where work has been done and leave them in broom clean condition.

### **3.23 PIPE ENCASED IN CONCRETE**

- A. All pipe indicated to be encased in concrete shall be as indicated.
- B. Concrete encasement shall provide a minimum of six inches of concrete around the circumference of the pipe.

### **3.24 SEPARATION OF SEWERS AND WATER MAINS**

- A. Parallel Installation
  1. Normal Conditions: Force main and sanitary sewers shall be laid at least 10 feet horizontally from existing water mains wherever possible; the distance shall be measured edge-to-edge.
  2. Unusual Conditions: Where local conditions prevent a 10 foot horizontal separation, a sewer may be laid closer to existing water mains provided that the bottom of the existing water main is at least 18 inches above the top of the proposed sewer. Where this vertical separation cannot be obtained, the force main or gravity sewer shall be constructed of ductile iron pipe with mechanical or push-on joints and shall be pressure tested to assure water tightness prior to backfilling.
- B. Crossings
  1. Normal Conditions: Force main and sanitary sewer crossing existing house services shall be laid to provide a separation of at least 18 inches between the bottom of the existing water main and the top of the proposed sanitary sewer, wherever possible.
  2. Unusual Conditions: Where local conditions prevent a vertical separation as described above, the sewers passing over or under water mains shall be constructed of ductile iron pipe and conform to the following requirements.
    - a. A vertical separation of at least 18 inches between the bottom of the proposed sewer and the top of the existing water main.
    - b. Adequate structural support for the proposed sewers, to prevent excessive deflection of joints and settling on and breaking the existing water mains.

- c. A full laying length of existing water pipe centered at the point of crossing, so that the joints will be equidistant and as far as possible from the proposed sewer.

C. Manholes: No water pipe shall pass through or come into contact with any part of any proposed manhole.

### 3.25 FINAL VALVE CHECK - FORCE MAIN

- A. After completion of the force main and before the work will be accepted, make a final check of each valve installed in this project, and of each existing valve that has been operated in connection with the work under this project.
- B. Make this final check in the presence of the City, and demonstrate that each valve is in fully open position.

### 3.26 PAYMENT AND MEASURE OF QUANTITIES

**SPECIAL NOTE:** This Article may include pay items which are not applicable to this project. All pay items applicable to this project are shown in the PROPOSAL; disregard all pay items which are listed below, but are NOT shown in the PROPOSAL.

- A. Pipe, Gravity Sewer or Force Main, All Types, in Open Cut (does not include service lines, pipe in pipe casings, or pipe in bored holes): Paid for at the unit price per linear foot of sewer pipe in place in open cut, measured as the horizontal distance between centers of manholes, through wyes and fittings, but excludes alignment distance within limits of manhole exterior diameter. This includes a compacted clay "check dam" constructed for every manhole reach adjacent to the influent manhole connection, within the pipe trench, to the limits shown. Concrete "check dam" work is paid under miscellaneous concrete by the unit price per cubic yard. Allowance for increased length due to slope will not be made.
- B. Classification of Cut: Cut shall be classified on the basis of the average depth of cuts to sewer invert, between 50 foot stations, measured between manholes, beginning at the manhole with the lower invert elevation. The remaining distance between the last station and the center of the end manhole or end of sewer line shall be averaged separately. This classification applies ONLY to paragraph A. hereinbefore.
- C. Pipe, Gravity Sewer or Force Main, All Types, Mains and Service Lines, Bored (does not include pipe in pipe casings): Paid for at the unit price per linear foot of pipe in place within bored, jacked, or tunneled holes more than five feet long, WITHOUT pipe casings, measured along the top centerline of the pipe for the full length of the bored, jacked, or tunneled hole. NOTE: Pipe in bored, jacked, or tunneled holes that are five feet or less in length will be classified and paid for as specified hereinbefore.
- D. Pipe, In Casing, Gravity Sewer or Force Main, All Types: Paid for at the unit price per linear foot of pipe in place in pipe casings; includes PIPE AND ITS CASING; no payment will be made for any pipe in casing in excess of the lengths indicated or authorized. This does NOT include pipe on piers.
  - 1. Cased pipe: end points shall be at the actual ends of the casing pipe.



- E. Pipe, Gravity Sewer or Force Main, All Types, Bored in Casing: Paid for at the unit price per linear foot of pipe in place in pipe casing within bored, jacked, or tunneled holes more than five feet long; includes PIPE AND ITS CASING, measured along the top centerline of the pipe for the full length of the bored, jacked, or tunneled hole. No payment will be made for any pipe in casing in excess of the lengths indicated or authorized. Note: Pipe in bored, jacked, or tunneled holes that are five feet or less in length will be classified as, and paid for, AS PIPE IN OPEN CUT.
- F. Service Pipe, In Open Cut (does not include pipe in pipe casings or pipe in bored holes): Paid for at the unit price per linear foot of service pipe in place in open cut, measured along the service pipe from sewer centerline to service pipe end, through fittings, including both horizontal and vertical pipe runs, and including fittings and all necessary stoppers.
- G. Ductile Iron Fittings: Paid for at the unit price per pound of fittings in place, as established by the invoice weight of the fittings of the basis of AWWA C110 published body weights of mechanical joint fittings, but does not include tapping sleeves.
- H. Valves and Boxes: Paid for at the unit price for each valve and its box in place; does not include tapping type valves and their boxes, which will be paid for as specified below under "Pressure Connections".
- I. Air Release and Air and Vacuum Release Valves: paid for at the unit price of the complete unit in place, including release valve, manhole complete, valves, piping, and other items as required and as indicated.
- J. Wyes and Tees: Paid for at the unit price per wye or tee in place, including all necessary stoppers.
- K. Standard Manholes: Paid for at the unit price per complete standard manhole in place. A manhole 6'-0" or less in depth from the top of the rim to the sewer invert shall be classified as a standard manhole.
- L. Extra Depth Manhole: Paid for at the unit price per vertical foot for extra depth manhole construction, measured to nearest 1/10 of a foot. All manhole construction below the 6'-0" depth of the standard manhole shall be classified as extra depth manhole.
- M. Drop Manhole Construction: Paid for at the unit price per vertical foot. The length of each drop connection shall be the vertical distance between the high entering sewer invert and the low leaving sewer invert, measured to the nearest, 1/10 of a foot; includes new drop construction on existing manholes.
- N. Connections to Existing Manholes: Paid for as lump sum for each connection to an existing manhole.
- O. Granular Pipe Bedding Material and Granular Backfill Material: Paid for at the unit price per cubic yard of compacted material in place, based upon maximum trench widths and computation methods specified elsewhere herein. No payment will be made for material placed in locations other than those specified, indicated, or authorized.
- P. Backfill: Type I and Type II Backfill, in Place and Compacted (Type II). No separate payment will be made for these; include the cost thereof in the unit and/or lump sum prices of the various items where these as required.

- Q. Concrete for Pipe Support: Paid for at the unit price per cubic yard of concrete in place, measured along the horizontal run of the pipe to full width of trench bottom, and from  $\frac{1}{4}$  outside pipe diameter below bottom of pipe to  $\frac{1}{4}$  outside pipe diameter above bottom of pipe, exclusive of volume displaced by pipe.
- R. Sheathing Left in Place: Paid for at the unit price per thousand board feet of sheathing left in place, only where authorized in writing, and measured to the nearest 100 board feet.
- S. Placement of Road Gravel: Paid for at the unit price per cubic yard of compacted road gravel in place, as computed by actual measurements of surface area covered by a compacted layer of the indicated, specified, or otherwise authorized thickness. No payment will be made for any road gravel placed without the City's authorization, or any road gravel placed outside of the specified payment limits. Includes base courses under pavement and under special surface repairs.
- T. Replacement of Paving and Special Surfaces: Paid for at the unit price per square yard of each type of pavement or special surface in place, as computed by actual measurements of the areas repaired, except that no payment will be made outside of the specified payment limits. Does not include gravel base courses, which will be paid for separately as specified hereinbefore. Includes all necessary prime and tack coats.
- U. Rock Excavation: No separate payment will be made for rock excavation.
- V. Pipe, Gravity Sewer or Force Main, Concrete Encased: Paid for at the unit price per linear foot of pipe in place; includes sewer pipe and concrete required for encasement.
- W. Extra Depths Excavation: MINIMUM cover over pipes is specified hereinbefore; no extra payment will be made for any extra depth excavation that may be required to permit piping to pass under obstructions, whether they are indicated on the drawings or not.
- X. Stream or Ditch Crossings: No separate payment will be made for these; include the cost thereof in the various unit prices.
- Y. Tracer Tape: No separate payment; include this in the price of the pipe.
- Z. Other Miscellaneous Items: No separate payment, unless specifically otherwise indicated; include these in the various unit prices.
- AA. Quantities and Payments, General: Payments will be made to the nearest complete unit as listed in the PROPOSAL. Quantities submitted for payment shall be rounded off the nearest linear foot, pound, cubic yard, or other applicable unit.

END OF SECTION

## SECTION 02120

### SOIL EROSION AND SILTATION CONTROL

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. This item shall consist of temporary control measures as required during the life of the contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

##### 1.2 RELATED SPECIFICATIONS

- A. STANDARD SANITARY SEWER SYSTEM SPECIFICATION
- B. WATER LINE SPECIFICATION STANDARD
- C. STANDARD PRESSURE SEWER DOCUMENTS

##### 1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Comply with all local, state, and Federal agencies having jurisdiction and regulations regarding siltation and erosion control, restoration of stream beds to original grades and contours, and protection of the aquatic environment.

##### 1.4 JOB CONDITIONS

- A. Existing Conditions: Carefully maintain benchmarks, fences, roads, traffic, monuments, and survey control references.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

- A. Mulches: Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.
- B. Other: All other materials shall meet commercial grade standards and shall be approved by the City before being incorporated into the project.

#### PART 3 EXECUTION

##### 3.1 GENERAL

- A. In the event of conflict between these requirements and pollution control laws, rules or regulations of other Federal, state, or local agencies, the more restrictive law, rules or

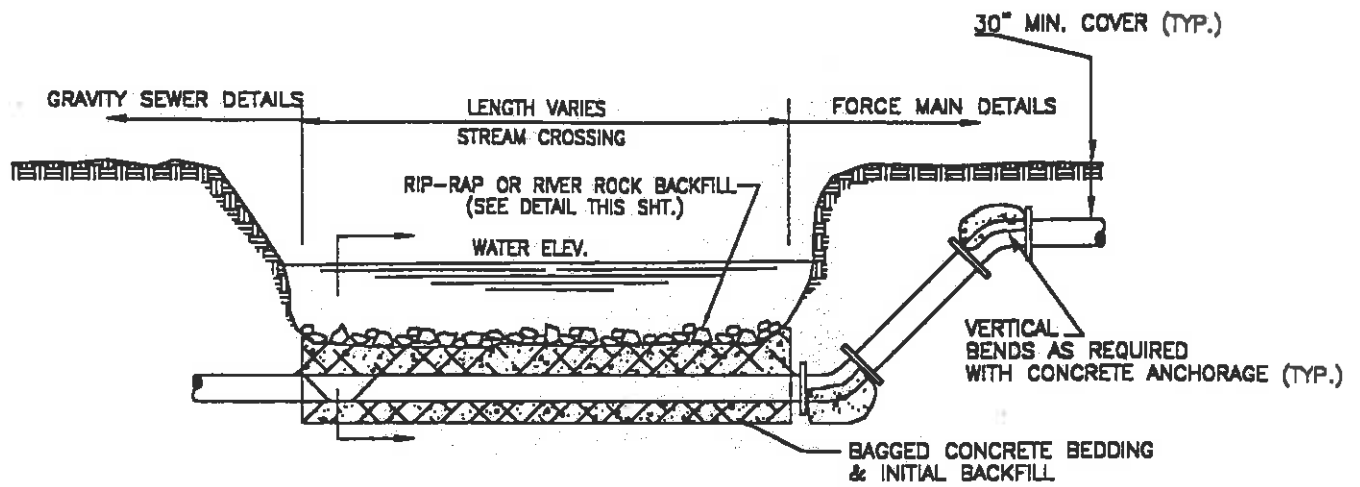
regulations shall apply. The Contractor shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

- B. **Schedule:** Prior to the start of construction, the contractor shall submit schedules for accomplishment of temporary erosion control work, as are applicable for clearing and grubbing. The contractor shall also submit a proposed method of erosion and dust control on haul roads and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction have been accepted by the City.
- C. **Authority of City:** The City has the authority to direct the contractor to provide immediate temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.
- D. **Construction Details:** Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that are needed temporarily to control erosion that develops during normal construction practices. Temporary silt fences or check dams shall be installed downgrade of all exposed earth. Materials shall be approved by the City prior to installation.
  - 1. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install controls as a part of the work as scheduled or as ordered by the City such work shall be performed by the Contractor at his/her own expense.
  - 2. The erosion control features installed by the Contractor shall be acceptably maintained by the contractor during the construction period.
  - 3. Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures should be provided.
  - 4. Pollutants such as fuels, lubricants, raw sewage, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or man-made channels leading thereto.

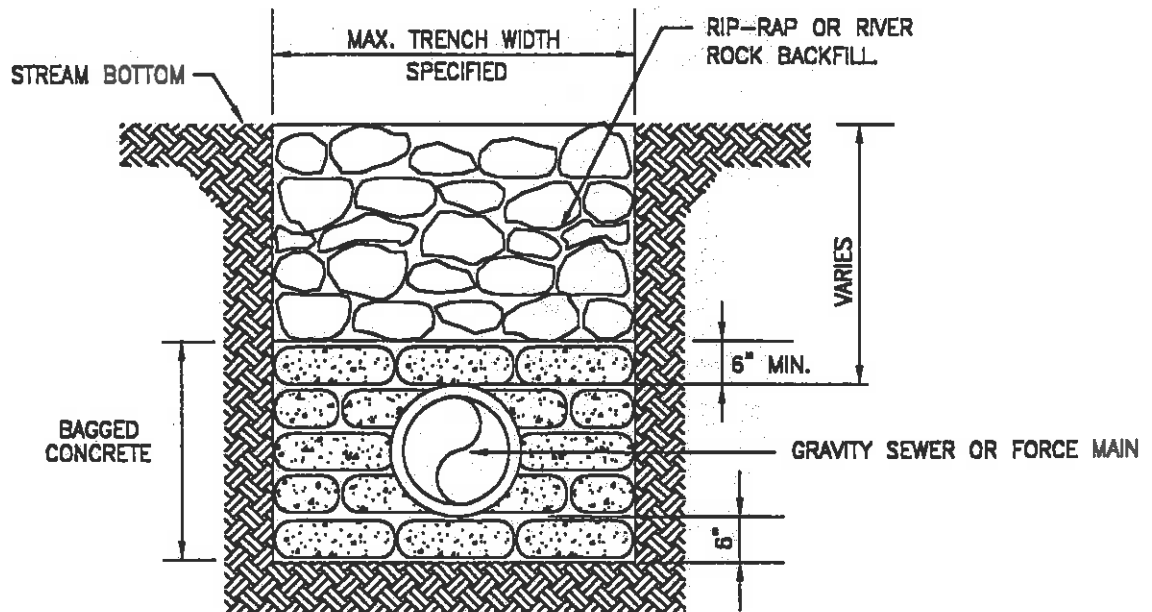
### 3.2 PAYMENT

- A. No separate payment will be made for the work, materials, equipment or other items required by this Section. Include the cost thereof in the unit prices for the work shown in the proposal.

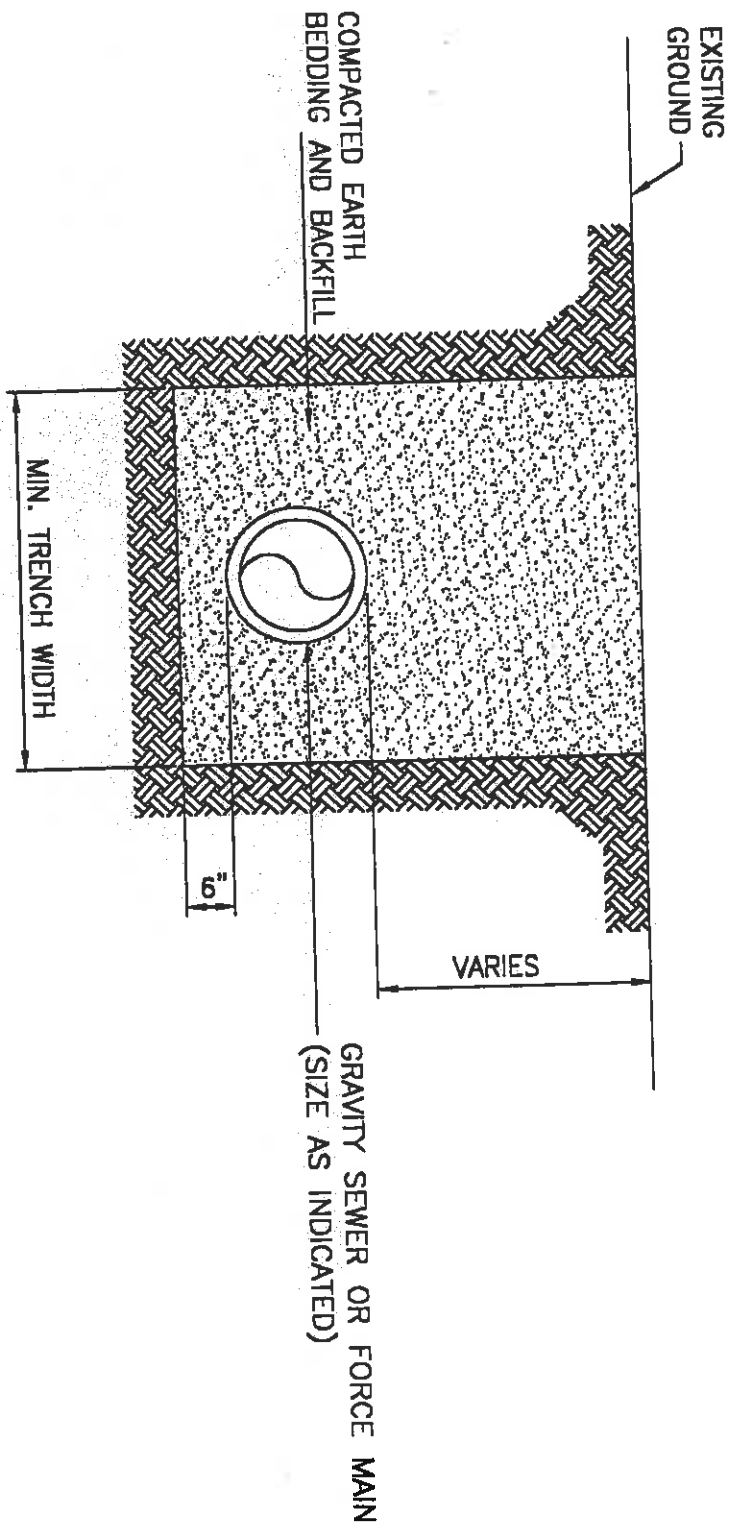
END OF SECTION



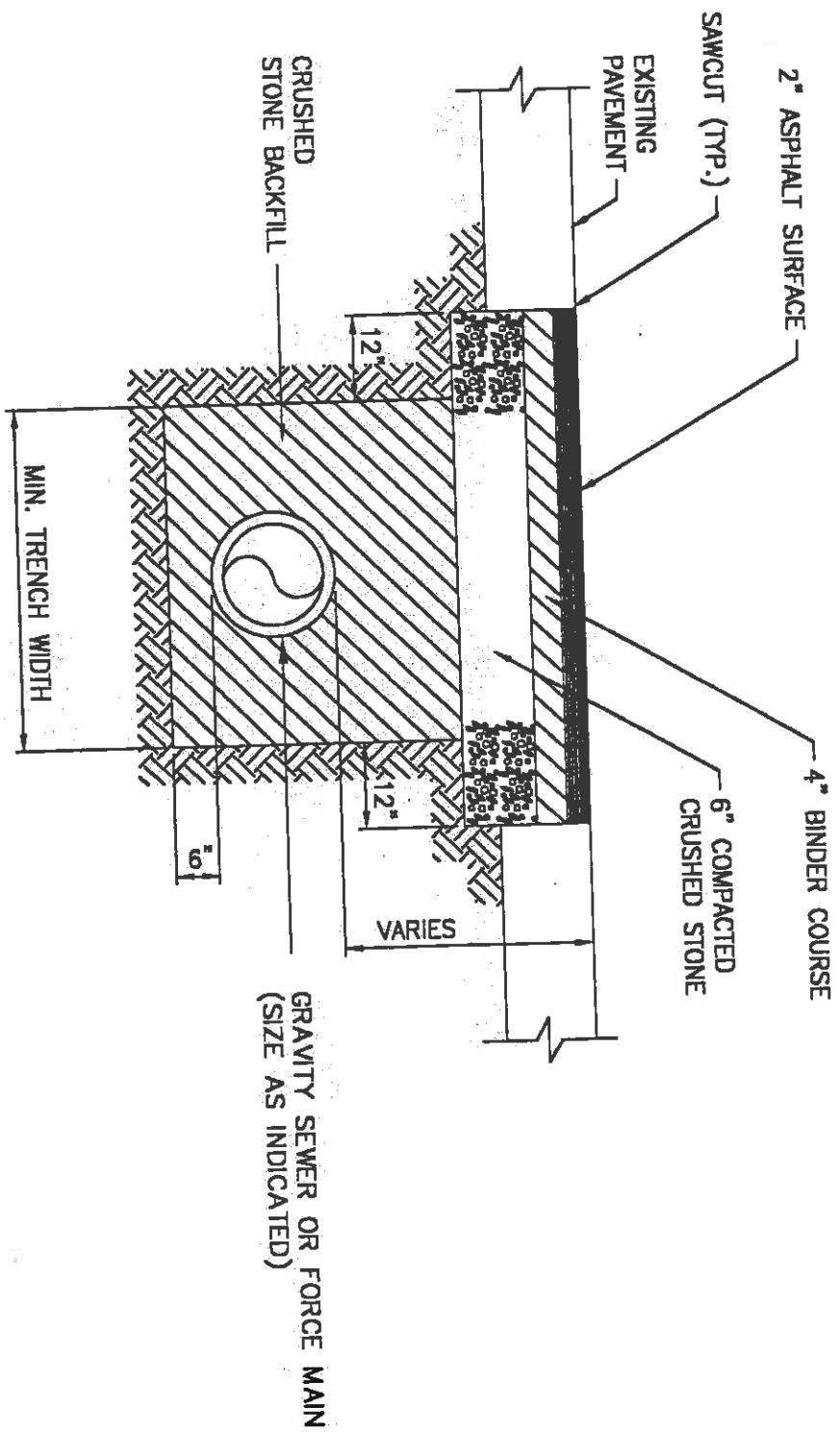
**TYPICAL STREAM CROSSING**  
N.T.S.



**STREAM CROSSING SECTION**  
N.T.S.



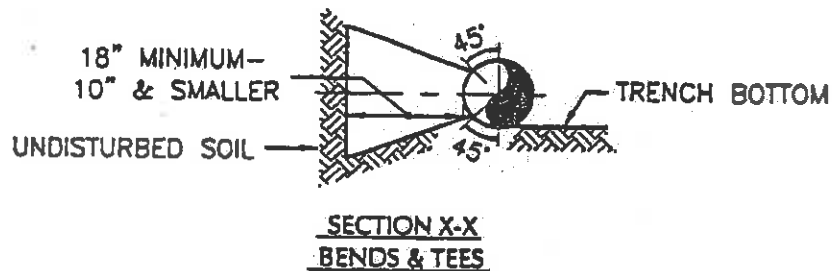
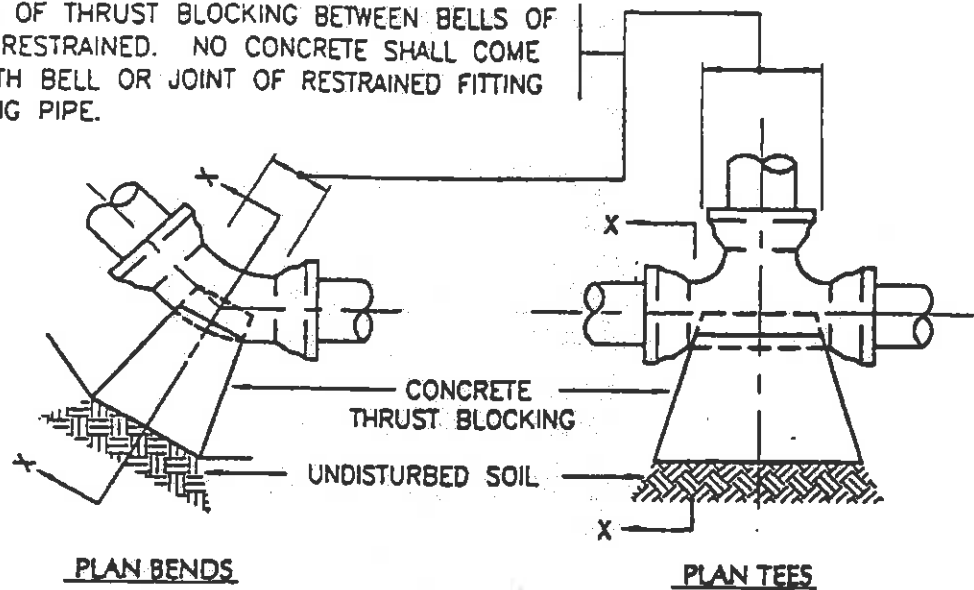
TYPICAL TRENCH DETAIL  
N.T.S.



# TYPICAL TRENCH DETAIL IN PAVED AREAS

N.I.S.

CONFINE LIMITS OF THRUST BLOCKING BETWEEN BELLS OF FITTING TO BE RESTRAINED. NO CONCRETE SHALL COME IN CONTACT WITH BELL OR JOINT OF RESTRAINED FITTING AND CONNECTING PIPE.



CONCRETE THRUST BLOCKING SCHEDULE  
IN SQUARE FEET

PIPE SIZE	BENDS				STD. TEE
	11-1/4'	22-1/2'	45°	90°	
4	1.0	1.0	1.5	2.5	2.0
6	1.5	2.0	3.0	5.5	4.0
8	1.5	2.5	5.0	10.0	7.0
10	2.0	4.0	7.5	14.5	10.0
12	3.0	6.0	11.5	21.5	14.5
14	4.0	7.5	15.0	28.0	19.5
16	5.0	10.0	20.0	35.0	25.5
18	6.5	12.5	24.56	35.0*	32.0
20	8.5	16.5	32.6	35.0*	35.0*
24	10.0	20.0	35.0*	35.0*	35.0*
30	18.0	34.5	35.0*	35.0*	35.0*
36	25.0	35.0*	35.0*	35.0*	35.0*
42	32.5	35.0*	35.0*	35.0*	35.0*

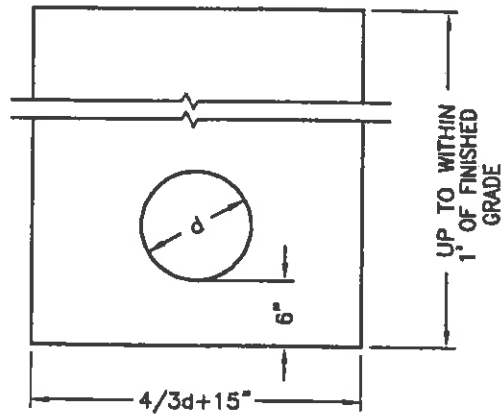
BLOCKING SCHEDULE BASED ON 200 PSI WATER PRESSURE,  
2,000 PSF SOIL BEARING PRESSURE & 1.25 SAFETY FACTOR.

\* INDICATES FITTINGS REQUIRING RESTRAINED JOINTS IN ADDITION  
TO CONC. THRUST BLOCKING. SEE RESTRAINED JOINT SCHEDULE.

## THRUST BLOCKING

N.T.S.

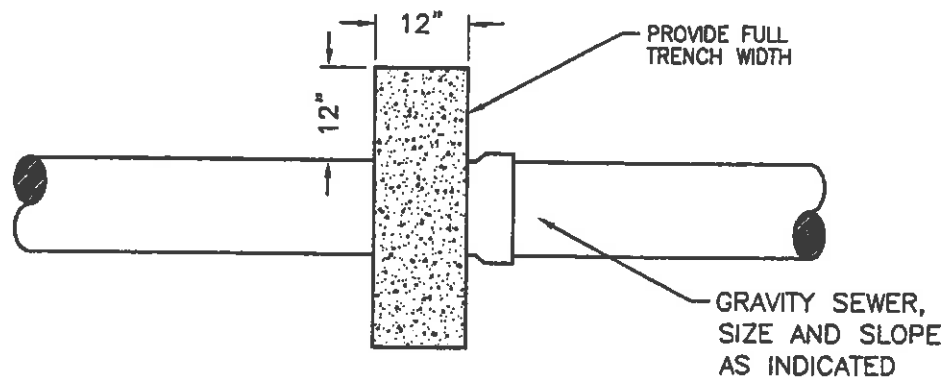




NOTE:  
ALL CHECKDAMS ARE 3' THICK AND ARE COMPACTED IMPERMEABLE CLAY, OR CONCRETE WHERE INDICATED, PROVIDE CONCRETE AT ALL STREAM CROSSINGS.

### TYPICAL GRAVITY SEWER CHECKDAM

N.T.S.



### ELEVATION TYPICAL CONCRETE COLLAR

N.T.S.

**ALLEN & HOSHALL**  
ARCHITECTS ENGINEERS

9950 KINGSTON PIKE SUITE 300 KNOXVILLE, TENNESSEE 37922

DRAWN		JOB NO.	
CHECKED		DATE	11-5-97
APPROVED		SCALE	NONE

SANITARY SEWER STANDARDS  
ELIZABETHTON TENNESSEE

GRAVITY PIPE APPURTENANCES

DRAWING NO.

1

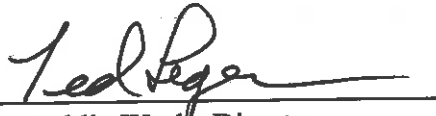
**Pressure sewers.**

# STANDARD SEWER SYSTEM SPECIFICATIONS

## PRESSURE SEWER SECTION

WASTEWATER DEPARTMENT  
CITY OF ELIZABETHTON, TN.

System approval:

  
Public Works Director  
City of Elizabethton, TN

Engineer:



Vaughn & Melton  
219 West Depot Street  
Greeneville, TN 37743

**STANDARD SPECIFICATIONS & DETAILS  
FOR  
PRESSURE SEWER SYSTEM COMPONENTS  
CITY OF ELIZABETHTON**

**February 1997  
(Revised May 1, 1997)  
(Revised June 10, 1997)**

## PART 1 - GENERAL

These standard specifications and details are to be followed and incorporated in the design and/or construction of any portion of a pressure sewer system to be served by the City of Elizabethton's sewer system.

A "pressure sewer system" is defined by an area where two or more on-site pumping units discharge into a pressure sewer main. This document does not apply to pumps which pump directly to a gravity sewer line nor to an area where only one pumping unit pumps into a pressurized line typically called a force main.

Pressure sewer systems are to be considered only, where based on the opinion of the City of Elizabethton, a gravity system is not feasible. Pressure sewers are most applicable where population density is low, severe rocky conditions exist, high groundwater or unstable soils prevail, and/or where undulating terrain predominates.

### REGULATORY REQUIREMENTS:

Conform to Tennessee Department of Environment & Conservation and local requirements for materials and installation of the work of this Section.

### SUBMITTALS:

Submit two (2) copies of shop drawings, product information, engineering calculations, manufacturer's installation and storage instructions and other pertinent information to the City of Elizabethton prior to installation of any materials or equipment for approval. Shop drawings and engineering calculations shall include at a minimum the following information:

- Area topography with contour lines,
- location of pipe runs,
- house connections,
- manholes,
- cleanouts,
- valves,
- hydraulic profiles,
- layout of piping,
- location of lowest point elevation on each lot,
- direction of flow,
- cut sheets,
- product specifications, and
- equipment installation instructions and shop drawings.

Following the completion of a project, the contractor shall submit the following items to the City:

- Keys for each size of operating nuts (valves) utilized.
- Two hoses with quick disconnect couplings are to be furnished for back flushing the air and vacuum valves supplied.
- All keys that come with the locks.
- Two sets of as-built blueprints (project record drawings), one set of mylars, and a 3½" computer disk containing the as-built drawings as described below.

#### PROJECT RECORD DOCUMENTS:

Accurately record location of pipe runs, connections, manholes, cleanouts, valves, and invert elevations.

Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### REFERENCE:

Reference is made to Section 022494 of the City of Elizabethton's Standard Sanitary Sewer System Specifications.

#### PART 2 - PRODUCTS

##### MANUFACTURERS:

Manufacturer's Qualifications: Firms regularly engaged in manufacture of sanitary sewage systems products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

##### PRESSURE COLLECTION SYSTEM PIPE:

Pipe shall be same as defined for Force Main in Section 2.3 of Section 022494 of referenced specifications.

Gravity Connections to Grinder Pumps: The pipe used for connections from the houses to the grinder pumps, where required, shall be Schedule 40 PVC with watertight joints. All fittings shall be of same class.

#### VALVES:

Valves shall be furnished and installed as indicated on the attached standard drawings and at other locations required by Designer and/or City of Elizabethton.

All valves other than the ones to be used for service lines or unless otherwise specified shall be the same or equal to the Mueller iron body gate valve, Catalog No. A-2380-8 unless otherwise indicated. The working pressure shall be 200 psi. Square operating nuts shall be substituted for the handwheel. The Contractor shall furnish a minimum of one key for each size of operating nuts utilized on the project.

All 2" valves for service line connections shall be the same or equal to Duo-Bloc 2-way blocking ball valve, PP Model, threaded connections, with EPDM "O" Rings, as manufactured by ASAHI/America, Inc., 425 Riverside Avenue, Medford, MA.

The air release valves shall be the same or equal to the Apco Model 400 (short height). The valve inlet must be 2". The valve shall be fitted with blow-off valves and quick-disconnect couplings to permit back flushing after installation without dismantling the valve. Two hoses with quick disconnect couplings are to be furnished to the City of Elizabethton to use for back flushing these valves.

The air and vacuum valves shall be the same or equal to the Apco Model 401 (short height). The valve inlet must be 2". Valve shall be fitted with blow-off valves and quick-disconnect couplings to permit back flushing after installation without dismantling the valve. Two hoses with quick disconnect couplings are to be furnished to the City of Elizabethton to use for back flushing these valves.

#### MARKING TAPE & WIRE:

Sewer Pipe Metallic Detection tape with the word "Sewer" printed continuously along the tape shall be wrapped around pressure collection system and force main pipe approximately every two feet and shall run the entire length of pipe. Another strip of tape shall be placed along the entire length of trench approximately one foot below the top of the ground. Also, a #16 gauge wire, for detection, shall be installed above the pipe for the entire trench length.

#### CASING PIPE:

The casing pipe, when boring is required, shall be Schedule 10 steel pipe for pipe diameters greater than 10" and shall be Schedule 40 steel pipe for diameters less than or equal to 10".

The casing pipe shall be the diameter called for on the drawings. Galvanized steel pipe will be acceptable for casing pipe for 2" pressure collection service lines which encase only one line.

**LOCKS:**

Locks shall be furnished for all disconnect boxes, pump basin lids, control panels and for any other areas which are indicated in the Specifications or Drawings as having locks. All keys shall be submitted to the City of Elizabethton. These locks shall be Master Lock Series 2004.

**RESIDENTIAL SEWAGE GRINDER PUMPING STATIONS:**

Furnish and install complete residential grinder pumping system(s) as outlined in these Specifications and as shown on the Drawings.

**Manufacturer:**

The pumps shall meet or exceed all Specifications herein and shall be from a manufacturer listed in the table below or from a pre-approved equal.

<u>Manufacturer</u>	<u>Model #</u>
Hydromatic	SPG 200
F. E. Myers	WG 20
Peabody-Barnes	SGV 200

All pumps shall be from the same manufacturer and the name of the manufacturer of pumps to be used on the project shall be submitted to the Owner with the bid. This shall be shown on bid form.

**General:**

The manufacturer of the sewage grinder pumps shall have manufactured grinder pumps for at least seven (7) years prior to bid date of this contract. The manufacturer of the grinder pumps must have a service shop within 175 miles of the project and must have a service representative available for installation consultation during the time the units are installed and operation begins.



Each pumping station shall be furnished with the following principal items of equipment in each station: sewage grinder pump(s); discharge piping with hydraulically sealed discharge flange, ball check valve(s), and brass gate valve(s), stainless steel lift-out guide rails and supports; stainless steel lifting cable, pedestal control stand; NEMA III R control panel; three mercury switch level controls; alarm system; and sump basin with cover. Details and dimensions shall be as shown on the attached standard drawings.

#### Operating Conditions:

Grinder pumps shall be capable of achieving proper stable system operation against fluctuating changes in total dynamic head (TDH). Each grinder pump shall be capable of equaling or exceeding the following performances:

<u>Capacity</u>	<u>at</u>	<u>TDH</u>
8 GPM		90 Ft.
16 GPM		85 Ft.
26 GPM		75 Ft.
38 GPM		45 Ft.

The pump motor shall be two horsepower, single phase, 230 volt, 60 Hertz, 3450 RPM. Pump motors shall be non-overloading over the entire operational range of the pump from shut-off head (TDH) to zero head (TDH).

#### Construction:

Each pump shall be of the sealed submersible type. The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 25. All external mating parts shall be machined and Buna N Rubber O-ring sealed on a beveled edge. Gaskets shall not be acceptable. All fasteners exposed to the pumped liquids shall be 300 series stainless steel.

#### Electrical Power Cord:

Electrical power cord shall be water resistant 600V, 60°C., UL and or CSA approved and applied dependent on amp draw for size.

The pump shall be protected with compression fitting and epoxy potted area at the power cord entry to the pump. A separation between the control panel areas of the pump and the motor by a stator lead sealing gland or terminal board shall not be acceptable.

The power cable entry into the cord cap assembly shall first be made with a compression fitting. Each individual lead shall be stripped down to bare wire, at staggered intervals, and each strand shall be individually separated. This area of the cord cap shall then be filled with an epoxy compound potting which will prevent water contamination to gain entry even in the event of wicking or capillary attraction.

The power cord leads shall then be connected to the motor leads with extra heavy connectors having brass inserts with a screwed wire to wire connection, rather than a terminal board that allows for possible leaks.

The cord cap assembly where bolted to the connection box assembly shall be sealed with a Buna N Rubber O-ring on a beveled edge to assure proper sealing.

#### Motor:

The stator, rotor and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F insulation, (155°C. or 311°F.), and a dielectric oil filled motor, NEMA B design (3 phase), NEMA L design (single phase). Because air-filled motors do not dissipate heat as efficiently as oil-filled motors, they shall not be acceptable.

The pump and motor shall be specifically designed so that they may be operated partially dry or completely submerged in the liquid being pumped. The pump shall not require cooling water jackets. Dependence upon, or use of, water jackets for supplemental cooling shall not be acceptable.

Stators shall be securely held in place with a removable end ring and threaded fasteners so they may be easily removed in the field without the use of heat or a press. Stators held by a heat shrink fit shall not be acceptable. Stators must be capable of being repaired or rewound by local motor service station. Units which require service only by the factory shall not be acceptable. No special tools shall be required for pump and motor disassembly.

Pump shall be equipped with heat sensors. The heat sensor(s) (one on single phase, two on three phase) shall be a low resistance, bi-metal disc that is temperature sensitive. It (they) shall be mounted directly in the stator and sized to open at 120°C or 130°C and automatically reset at 30-35°C differential. The sensor shall be connected in series with the motor starter coil so that the starter is tripped if a heat sensor opens. The motor starter shall be equipped with overload heaters so all normal overloads are protected by external heater block.

#### Bearings and Shaft:

An upper radial bearing and lower thrust bearing shall be required. These shall be permanently lubricated by the dielectric oil which fills the motor housing. Sealed grease packed bearings shall not be acceptable. Bearings which require lubrication according to a prescribed schedule shall not be acceptable. Bearings shall be locally available. Units which require the use of more than two bearings shall not be acceptable.

The shaft shall be machined from a solid 416 stainless steel and be a design which is of a large diameter with minimum overhang to reduce shaft deflection and prolong bearing life.

Seals:

The pump shall have two mechanical seals, mounted in tandem, with an oil chamber between the seals. John Crane Type seals shall be used with the rotating seal faces being carbon and the stationary seal faces to be ceramic. The lower seal shall be replaceable without disassembly of the seal chamber and without the use of special tools. Units which require the use of tungsten-carbide seals of foreign manufactured seals shall not be acceptable. Seals shall be locally available.

The pump shall be equipped with a seal leak detection probe and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking seal chamber oil level and consistency.

There shall be an electric probe or seal failure sensor installed in the seal chamber between the two tandem mechanical seals. If the lower seal fails, contaminants which enter the seal chamber shall be detected by the sensor and send a signal to operate the specified warning device.

Units equipped with opposed mechanical seals shall not be acceptable.

Impeller:

Impeller shall be of bronze construction and non-overloading. Impeller shall be of the multi-vane, semi-open design with pump-out vanes on the backside of the impeller to prevent grit and other materials from collecting in the seal area. Impeller shall not require coating. Because most impeller coatings do not remain beyond the very early life of the impeller, performance data submitted shall be based on performance with an uncoated impeller. Attempts to improve efficiency by coating impeller shall not be acceptable.

Impellers shall be hydraulically and statically balanced. The tolerance values shall be as listed below according to the International Standard Organization grade 6.3 for rotors in rigid frames. The tolerance is to be split equally between the two balance planes which are the two impeller shrouds.

<b>RPM</b>	<b>Tolerance</b>
3500	.01 in.-oz./lb. of impeller weight
1750	.02 in.-oz./lb. of impeller weight

### Grinder Cutters:

The combination centrifugal pump impeller and grinder unit shall be attached to the common motor and pump shaft made of 416 stainless steel. The grinder unit shall be on the suction side of the pump impeller and discharge directly into the impeller inlet leaving no exposed shaft to permit packing of ground solids. The grinder shall consist of two stages. The cutting action of the second stage shall be perpendicular to the plane of the first cut for better control of the particle size. The grinder shall be capable of grinding all materials found in normal domestic sewage, including plastics, rubber, sanitary napkins, disposable diapers, and wooden articles into a finely ground slurry with particle dimensions no greater than 1/4 inch. Both stationary and rotating cutters shall be made of 440C stainless steel hardened to Rockwell 60C and ground to close tolerance.

The upper (axial) cutter and stationary cutter ring shall be reversible to provide new cutting edges to double life. The stationary cutter ring shall be pressed into the suction opening of the volute and held in place by three (3) 300 series stainless steel screws. The lower (radial) cutter shall macerate the solids against the I.D. of the cutter ring and extrude them through the slots of the cutter ring. The upper (axial) cutter shall cut off the extrusions, as they emerge from the slots of the cutter ring to eliminate any roping effect which may occur in single stage cutting action. The upper (axial) cutter shall fit over the hub of the impeller and the lower (radial) cutter shall be slip fit and secured by means of peg and hole and rotate simultaneously with the rotation of the shaft and impeller. The grinding mechanism shall be locked to the shaft by a 300 series stainless steel countersunk washer in conjunction with a 300 series stainless steel flat head cap screw threaded into the end of the shaft.

### Painting:

The pump shall be painted after assembly, but before testing with a lead free air dried enamel. The paint shall be applied in one coat with a minimum mil thickness of 3 to 4 mils.

### Sump Level Controls:

Sealed float type mercury switches shall be furnished to control operation of the grinder pump and provide alarm signal. Three (3) float switches shall be furnished to control the following operations: (1) Pump "ON", (2) Pump "OFF", (3) Alarm for the Type "A" pumps.

The mercury tube switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have a heavy neoprene jacket. An external weight shall be attached to the cord above the float to hold the switch in place in the sump. The float switches shall hang in the sump supported only by the cord.

The sealed float type switch controls shall affect the following system operation.

Upon rise of the liquid level in the sump, the lower mercury switch (Pump "OFF") shall first be energized; thence, as the sump level continues to rise to pre-set level, the upper level switch (Pump "ON") shall next energize and start pump. With pump operating, sump level shall fall to lower switch (Pump "OFF") setting and pump shall stop. If the liquid level rises above the upper level switch (Pump "ON") to a pre-set level, the third switch shall be energized and signal a flashing high water alarm light mounted on the exterior of the panel.

#### Electrical Control Panels:

The control panel shall be located in the NEMA III R enclosure on a pedestal on each pump. The location of each pump shall be as approved by the Engineer. Each panel shall have a magnetic contractor, overload protection, manual reset button, H.O.A. switch and a transformer to supply 115 volts for the control circuit. A terminal strip shall be provided for connecting pump and control wires. Additional terminals shall be provided for connecting the alarm. Glow lights shall be provided for both pump run and alarm and these lights shall be mounted on the panel. Each control panel shall be lockable with locking hasp and a lock shall be supplied for each control panel. All locks are to be keyed alike and five (5) keys shall be supplied to the Owner. Locks shall also be furnished for disconnect boxes and basin covers. These locks shall be keyed the same as all other locks furnished on the project. The panels shall be third party certified.

#### Fiberglass Basin and Cover for Pumps:

For pumps, only fiberglass basins will be considered by the City of Elizabethton.

Unless otherwise indicated, the plastic terminology used in this specification shall be in accordance with the definitions given in American Society for Testing and Materials (ASTM) designations D3299-81. This specification is for the hand lay-up, chopped spray technique and filament wound methods for manufacturing of vertical underground fiberglass basins.

Other methods of manufacturing shall not be acceptable.

The resin used shall be of commercial grade and shall be evaluated as a laminate by test or determined by previous service to be acceptable for the environment. The resins used may contain the minimum amount of fillers or additives required to improve handling properties. Up to 5% by weight of thixotropic agent which will not interfere with visual inspection may be added to the resin for viscosity control. Resins may contain pigments and dyes by agreement between fabricator and engineer, recognizing that such additions may interfere with visual inspection of laminate quality.

The reinforcing material shall be a commercial grade of glass fiber having coupling agent which will provide a suitable bond between the glass reinforcement and the resin.

The laminate shall consist of an inner surface, an interior layer, and a filament-wound structural exterior layer of laminate body.

The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two (2) pits per square foot, providing the pits are less than 1/8" in diameter with not over 1/32" deep and are covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness shall be permissible as long as the surface is smooth and free of pits. Between 0.101 and 0.020 inches of resin-rich surface shall be provided.

A minimum of 0.100 inch of the laminate next to the inner surface shall be reinforced with 30% by weight of chopped-strand fiber having fiber lengths from 0.5 to 2.0 inches.

Subsequent reinforcement shall be continuous-strand roving fiberglass. The thickness of the filament-wound portion of the tank shell shall vary with the tank height to provide the aggregate strength necessary to meet the tensile and flexural requirements. If additional longitudinal strength is required, the use of other reinforcement, such as woven fabric, chopped-strand mat, or chopped strands shall be interspersed in the winding to provide additional strength. Glass content of this filament-wound structural layer shall be 50 to 80% by weight. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. Hand work finish shall be present to prevent fiber exposure.

The tank wall must be designed to withstand wall collapse based on the assumption that saturated soil exerts hydrostatic pressure of 120 pounds per cubic foot. The tank wall laminate must be constructed to withstand or exceed two times the assumed loading on any depth of basin.

For the tank bottom, subsequent reinforcement shall be of 1.5 oz./ft. 2 chopped strand fiber or woven roving to a thickness to withstand 62.5 lb./ft. 2 with a safety factor of 2. In saturated conditions, the center deflection of any empty tank bottom shall be less than 3/8" (elastic deflection) and will not interfere with bottom pump mounting requirements nor rail system.

The width of the first layer of joint overlay shall be 3" minimum. Successive layers shall uniformly increase in width to form a smooth contour laminate that is centered on the joint  $\pm 1/2"$ . A highly filled resin paste may be placed in the crevices between joined pieces leaving a smooth surface for lay-up. The cured resin surface of the parts to be joined shall be roughened to expose glass fiber. This roughened area shall extend beyond the lay-up areas so that no reinforcement is applied to an unprepared surface. Surfaces shall be clean and dry before lay-up. The entire roughened area shall be coated with resin after joint overlay is made.

The finished laminate shall be free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes, pimples, and delamination.

The surfaces shall be relatively smooth, hand finish is acceptable, with no exposed fibers or sharp projections.

Tanks shall be mounted on cradles if shipping is horizontal, or on a suitable skid or pallet if shipping in the vertical position. The tank shall be secured to the cradles or skid so that there can be no movement of the tank in relation to the skid or cradle under normal handling.

Minimum tank wall and bottom thickness shall be as listed:

Wall thickness is 0.200 inches

Bottom thickness is 0.715 inches

The tank bottom shall extend past the tank walls so that the O.D. is approximately 4" larger in diameter than the O.D. of the sidewalls. This larger diameter shall serve as an anti-flotation flange. Contractor shall place the tank on a concrete pad and either fill with grout covering the anti-flotation flange or secure with steel clips catching the anti-flotation flange and anchored to the concrete pad. Anti-flotation flange shall not require bolt holes to secure the tank to the concrete pad.

Tank shall include 1 1/4" NPT discharge fitting. A 4" caulking type bolt-on thermoplastic influent hub shall be provided for mounting in the field. The hub shall be beveled approximately three degrees to accommodate gravity pipe coming in from various angles. The influent hub shall have a textured surface in order to provide better caulking adhesion.

The top flange and cover O.D. shall assure a tight fit and afford ease of access not possible with recessed covers. Noncorroding stainless steel heli-coils shall be inserted in all bolts of the top flange and shall be positively locked with threads and resin to prevent stripping. A 10-hole pattern shall accommodate the mounting of a one-piece or split fiberglass cover.

Covers shall be fiberglass construction. Cover shall have a textured or nonskid surface. Covers shall be grass green in color and shall have a live load rating of 150 PSF.

#### Simplex Assembly:

The simplex guiderail assembly described in these Specifications shall be the Unirail assembly manufactured by Moran Manufacturing, Inc., Conway, Arkansas, or equal.

#### Guiderail Assembly For Individual Grinder Pumps:

The guiderail assembly shall be constructed of type 304 stainless steel and shall consist of a minimum of two rails, a bottom base plate, a minimum of one cross brace every 18 inches between the rails and a wall brace all welded together to provide the maximum structural integrity. The rails shall be round to provide a non binding surface during installation and removal of the pump. The guiderail assembly shall be installed as a one piece unit and shall be bolted to the basin bottom and the basin wall. Bolts shall be stainless steel.

#### Pump Bracket Assembly For Individual Grinder Pumps:

The pump bracket assembly shall consist of a top bracket and a bottom bracket. The brackets shall be fabricated of 1/4" stainless steel material. The top bracket shall be attached to the discharge piping above the pump disconnect and shall be constructed in such a manner that pump cannot be removed from the guiderail assembly except when removing pump out the top of the sump basin. The bottom bracket shall be attached to the pump at the discharge connection and shall guide the pump along the guiderail assembly to insure proper alignment of the pump.

#### Lifting Cable Assembly for Individual Grinder Pumps:

A 3/16" (7 x 9) stainless steel lifting cable shall be furnished for lifting and lowering the pump in the sump basin. The stainless steel lifting cable shall be of the 18-8 type 302/304 stainless steel and shall have minimum nominal breaking strength of 15 times the weight of the pump. It shall be substantially attached to the top of the pump and shall have a formed loop at the other end.

#### Discharge Header for Individual Grinder Pumps:

The discharge piping shall include a cast iron ball check valve, with a natural rubber ball and clean out port with plug for easy access, a brass quick disconnect fitting, with an o-ring stem brass gate valve, per pump. All other piping shall be Schedule 40 galvanized malleable iron. The header shall be 1.25" diameter.

#### Gate Valve Extension Handle for Individual Grinder Pumps:

The station shall have a gate valve extension handle per valve which will allow the gate valve to be operated from a maximum of 6" below the basin cover. The handle shall be constructed of a minimum of 3/8" diameter, type 304 stainless steel. The handle shall be held in place by being attached to the gate valve and by the guiderail wall brace.

#### Painting for Individual Grinder Pumps:

All internal metal parts that are not brass, galvanized steel, or stainless steel shall be painted with two (2) coats of coal-tar epoxy paint to resist corrosion, unless otherwise noted. Allow first coat to dry before applying second coat.

#### Sump Level Control Switches for Individual Grinder Pumps:

Mercury level control switches shall be provided for pump on, pump off, and high level alarm.



The mercury switch shall be encapsulated in polyurethane foam for corrosion and shock resistance. Level switches shall be weighted to hold position in the sump. The cord connecting the control shall be No. 16-2, rated for 13 amps, and shall be Type C-SJO. To ensure optimum longevity, mercury contacts shall be of the mercury to mercury type and encapsulated in a glass tube and shall be rated for 20 amps at 115 vac.

A stainless steel mounting bracket shall be provided.

Packaging and Marking for Individual Grinder Pumps:

Installation instructions shall be furnished with the station.

**PART 3 - EXECUTION**

**GENERAL:**

Pipe, fittings, and valves shall be installed per requirements of Section 022494 of Standard Specifications.

**SERVICE LATERALS:**

Each individual home or lot shall have a lateral that serves that home or lot only.

For an undeveloped lot, the service lateral shall include a ball valve and check valve located in a meter box. A two foot portion of pipe shall be stubbed out of the check valve complete with a plug and a concrete kicker placed behind the plug.

For a developed lot, the service includes the ball and check valves located in a meter box, the line to the grinder stations, and the grinder stations as well.

**Please refer to the City of Elizabethton Sewer Extension Policy for information pertaining to equipment and cost requirements.**

**TIE-INS TO EXISTING MANHOLES:**

Tie-ins to existing manholes shall be constructed where indicated on the drawings. The Contractor shall submit in writing to the City of Elizabethton for approval, the method of tying into existing manholes. The connection shall be water tight.

The connections made to manholes can be made using a Kor-N-Seal joint, or equal. For pipes with diameter less than or equal to 4", the boot can be 4" diameter and a reducer fitting can be utilized. In manholes where pressure pipe enters at an elevation greater than two feet from top of invert, a 90° fitting shall be utilized and a pipe shall be installed parallel to manhole wall extending from point of entry to elevation within two feet of top of invert. The manhole where a pressure line enters and the manhole immediately downstream from that manhole (i.e. the two manholes from discharge point) shall be coated with two (2) coats of Xypex or approved equal per manufacturer's directions.

#### INSTALLATION OF INDIVIDUAL GRINDER PUMPS:

Individual grinder pump units shall be installed per manufacturer's instructions and as shown on the attached standard drawings.

#### Concrete Foundations:

Concrete foundations shall be formed and bolted to the pump station basins as indicated on the Drawings. Concrete shall be 3,000 psi. A 32" x 32" steel plate, 1/4" thick, welded to steel basin may be used in lieu of concrete foundation for individual grinder pump stations.

Concrete foundations will also be required for concrete or fiberglass basins, if used, but will not be required to be bolted, but shall be fastened as recommended by the basin manufacturer.

#### Electrical Connection:

Wiring from pump control panel to a disconnect box shall be #10/3 with ground and shall be in conduit. The disconnect box (NEMA 3R) shall be mounted on home, in sight of pump. A 30 Amp, 2 pole breaker is to be furnished. Conduit is to be buried 18" deep. All exposed conduit shall be rigid metal conduit. Materials used and installation shall be in accordance with National Electric Code.

#### Testing:

All pumps shall be tested prior to acceptance by the City of Elizabethton.

All pump basins shall be thoroughly cleaned and free of rock, mud and other debris before testing begins. The tank should then be filled with water to an elevation specified by Engineer and the pump allowed to pump the water. The discharge flow and amps measured should be compared to manufacturer's literature to determine if pumps meet discharge requirements.

In addition, testing shall include the following:

- The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase and hertz.
- The motor and seal housing chambers shall be hi-potted to test for moisture content and/or insulation defects.
- Pump shall be allowed to run dry to check for proper rotation.
- Discharge piping shall be attached, the pump submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator will be replaced.

**CONNECTIONS FROM HOME (OR OTHER STRUCTURE)  
TO GRINDER PUMP UNIT:**

**Electrical:**

The owner is required to furnish 220 volts (30 amp breaker or 30 amp time delay fuse) of electrical service to the outside wall closest to the grinder pump. Wire must be a minimum #10/2 wire with ground.

**Sewer Line:**

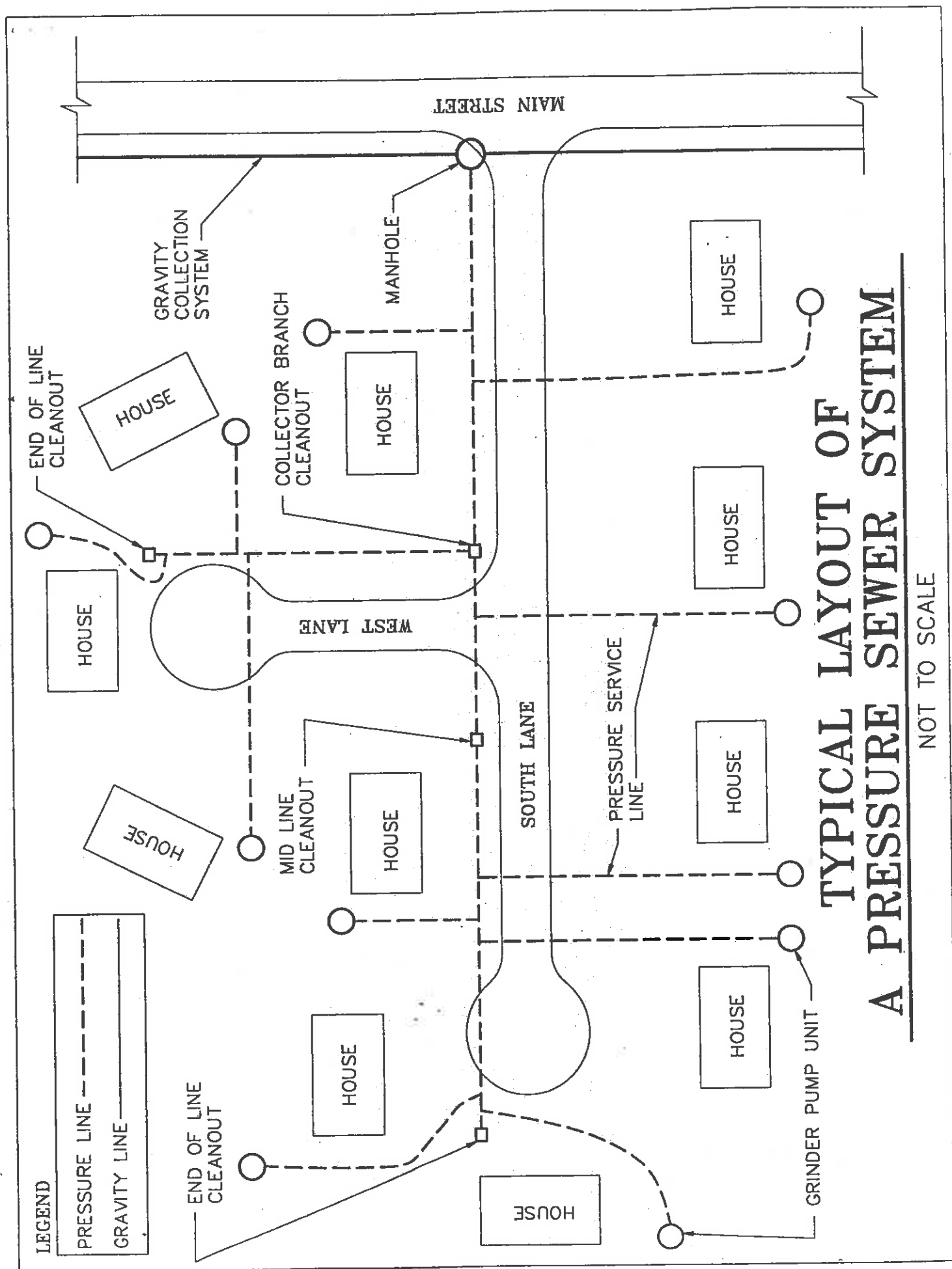
The property owner will construct a four (4) inch lateral from his home and connect it to the grinder pump unit.

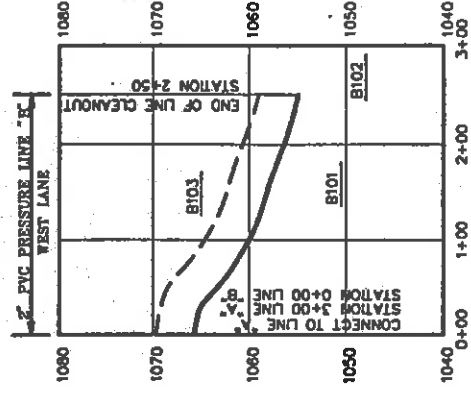
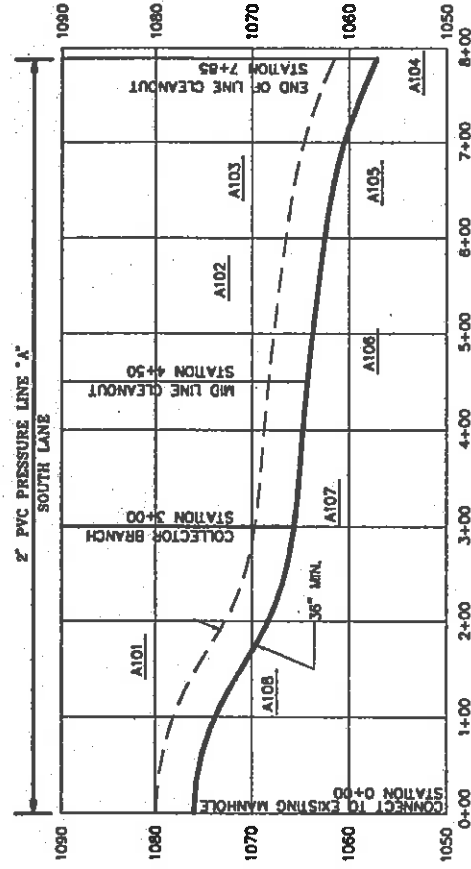
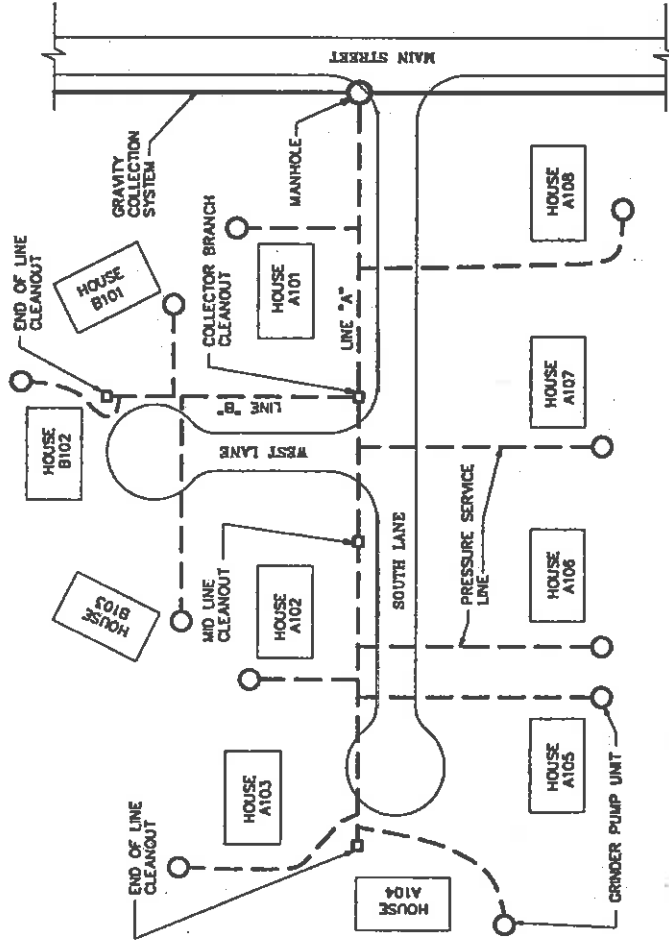
The pipe used shall be PVC, Schedule 40. All pipe shall be installed per applicable local, County, and State Building Codes. Cleanouts shall be installed as specified in applicable codes.

**Inspection of Connections:**

The sewer connection shall be inspected by the City before any underground portion is covered.

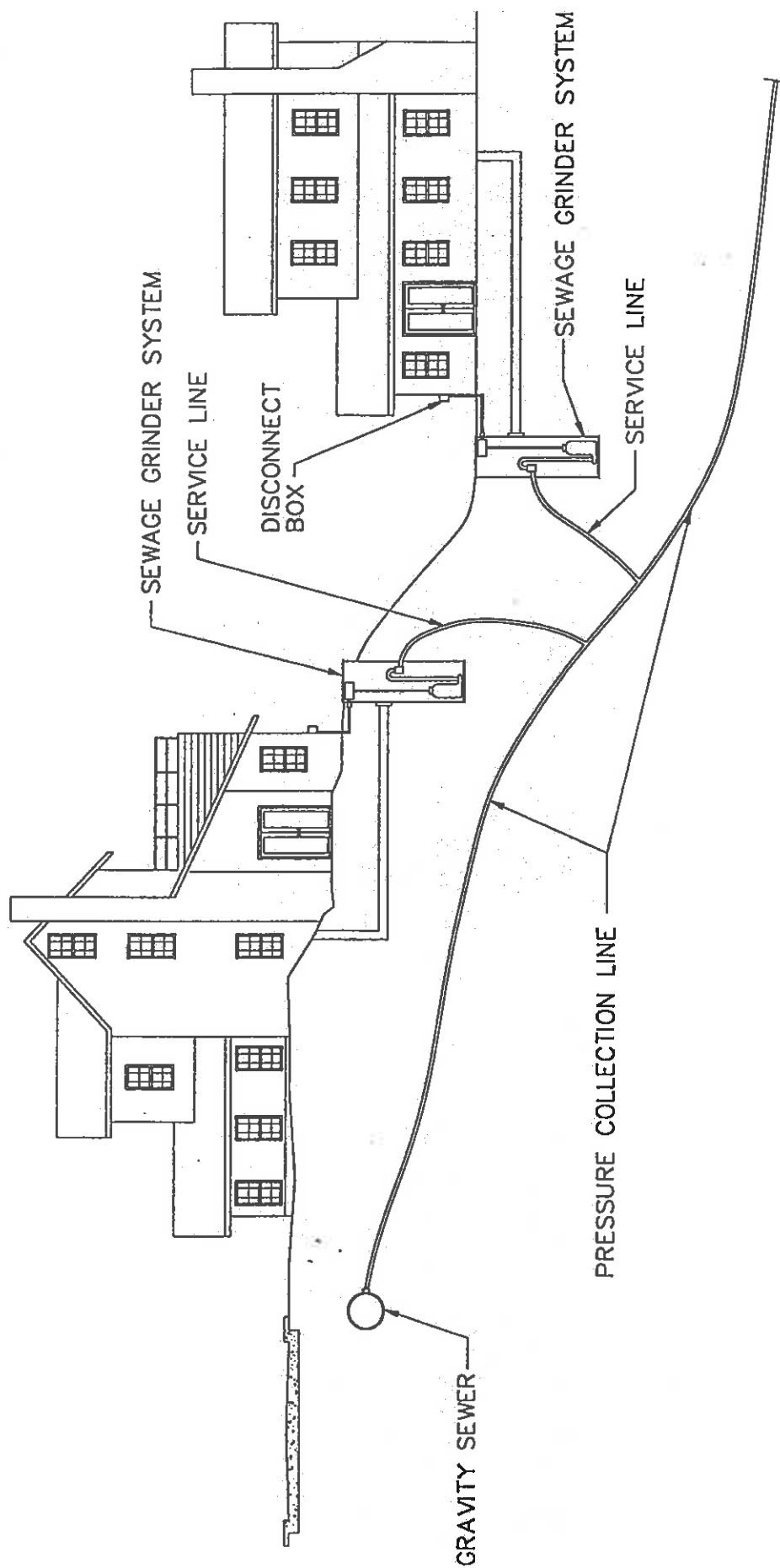
**END OF STANDARD SPECIFICATIONS**





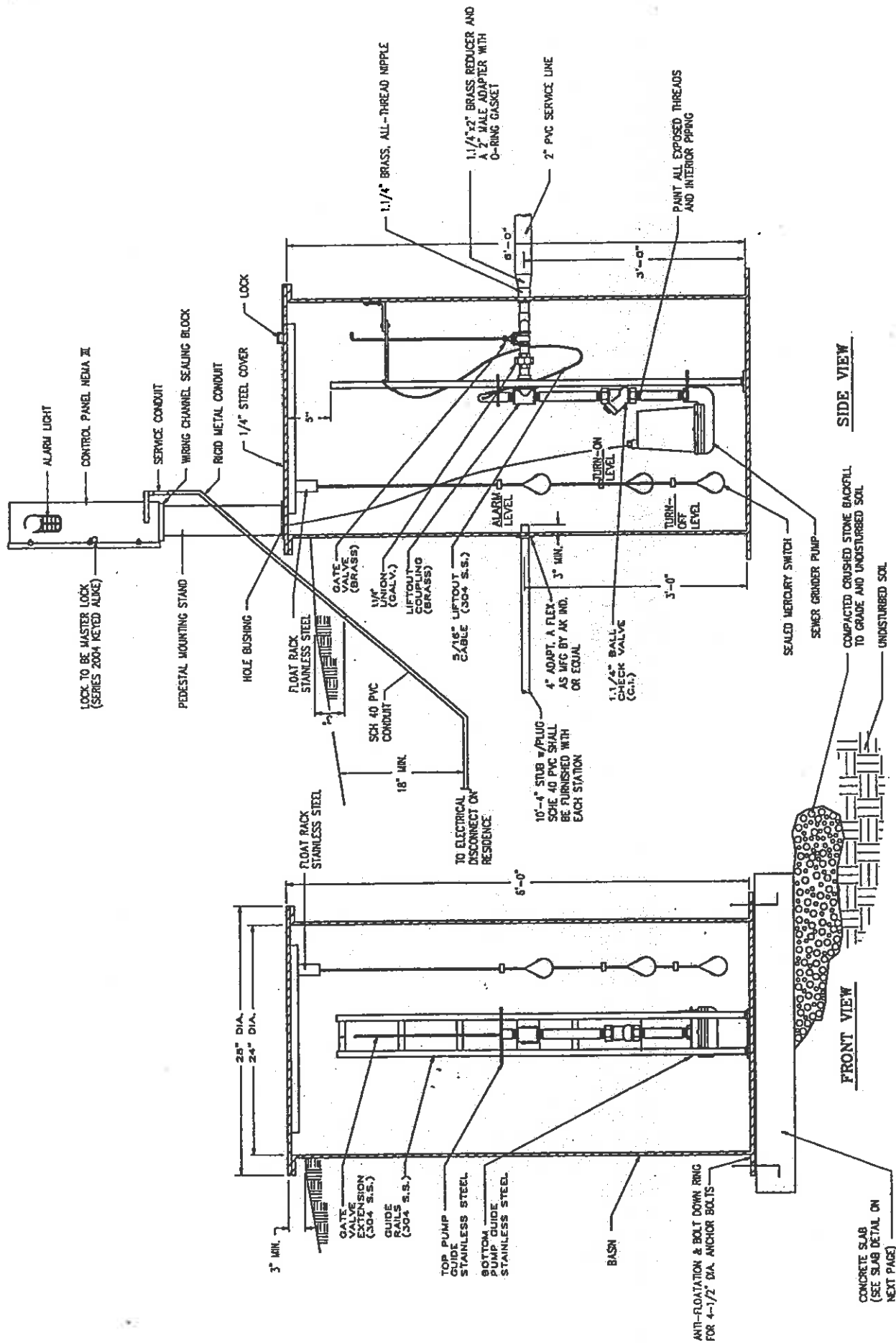
# TYPICAL PLAN AND PROFILE OF A PRESSURE SEWER SYSTEM

NOT TO SCALE



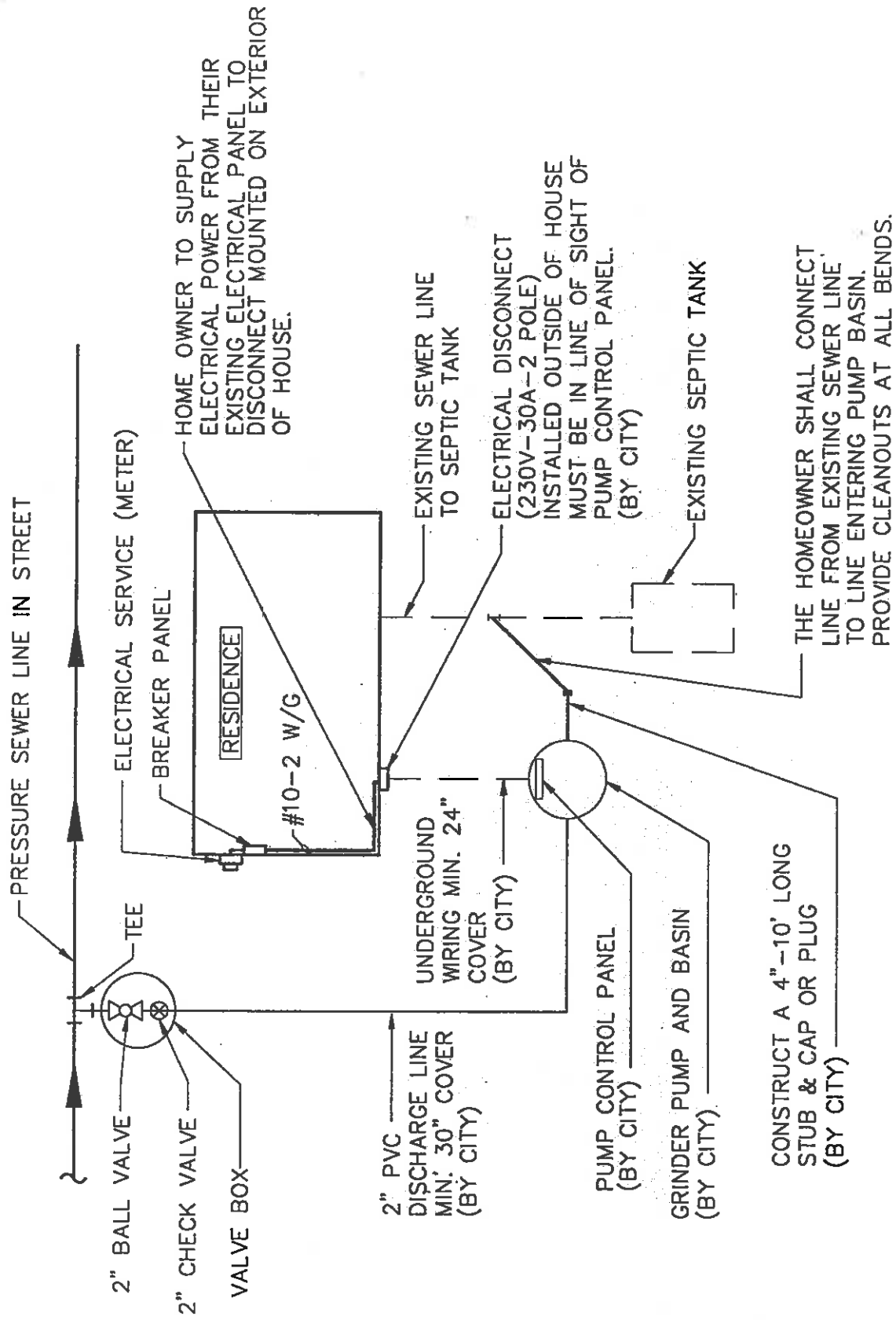
## TYPICAL APPLICATION OF GRINDER PUMP SYSTEMS

NOT TO SCALE



## 2 HP SIMPLEX GRINDER PUMP PAGE 1 OF 2

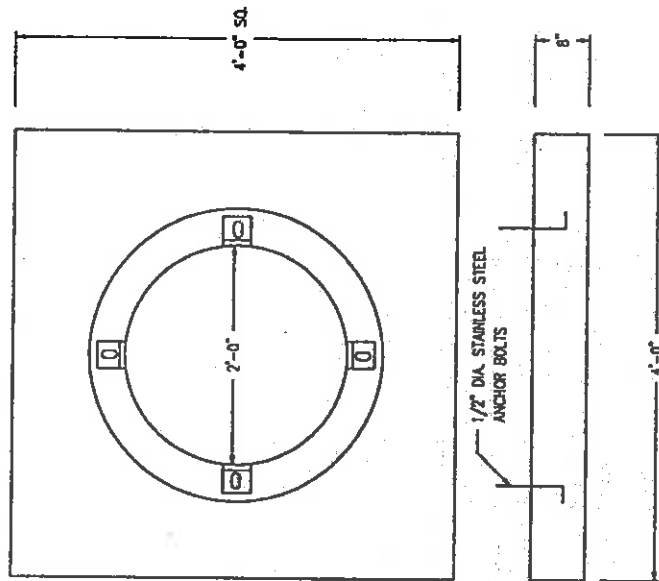
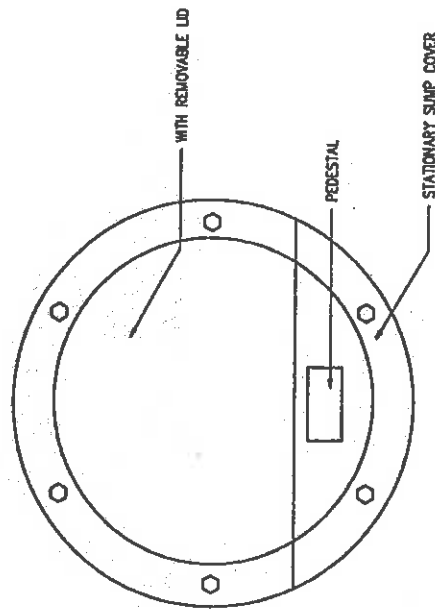
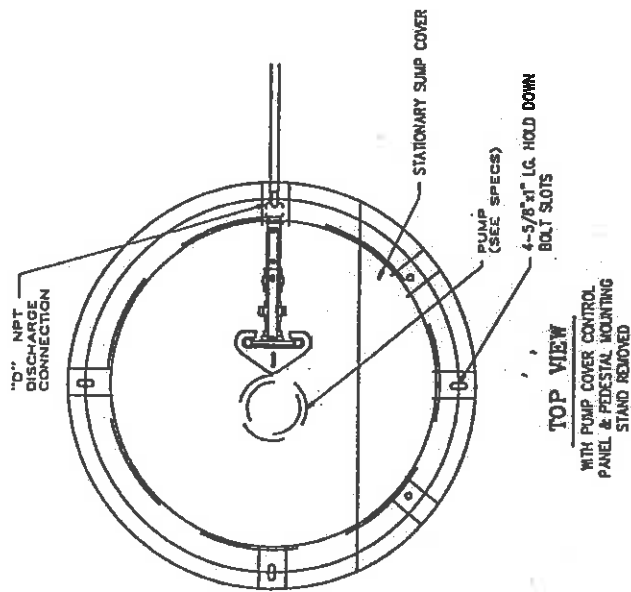
NOT TO SCALE



# TYPICAL GRINDER PUMP INSTALLATION

NOT TO SCALE





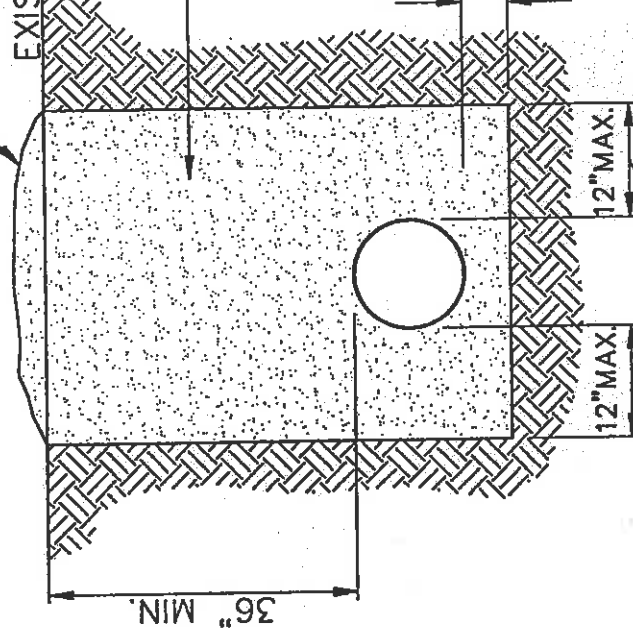
CROWN 3" ON TRENCH 0'-4'  
6" ON TRENCH OVER 4'

EXIST. GROUND

BACKFILL WITH SELECTED  
EXC. MATERIAL TO EXISTING  
GRADE. COMPACT BY WHEEL  
LOADING AND CROWN.

4" MIN. IN EARTH  
6" MIN. IN ROCK

MINIMUM SHALL NOT BE  
LESS THAN DIAMETER OF  
PIPE.



# TYPICAL PRESSURE PIPELINE TRENCH

NOT TO SCALE

DAVIS #D-112 BOX  
(OR EQUAL)

2" CLEAR  
ALL AROUND

2" MIN.  
LAP

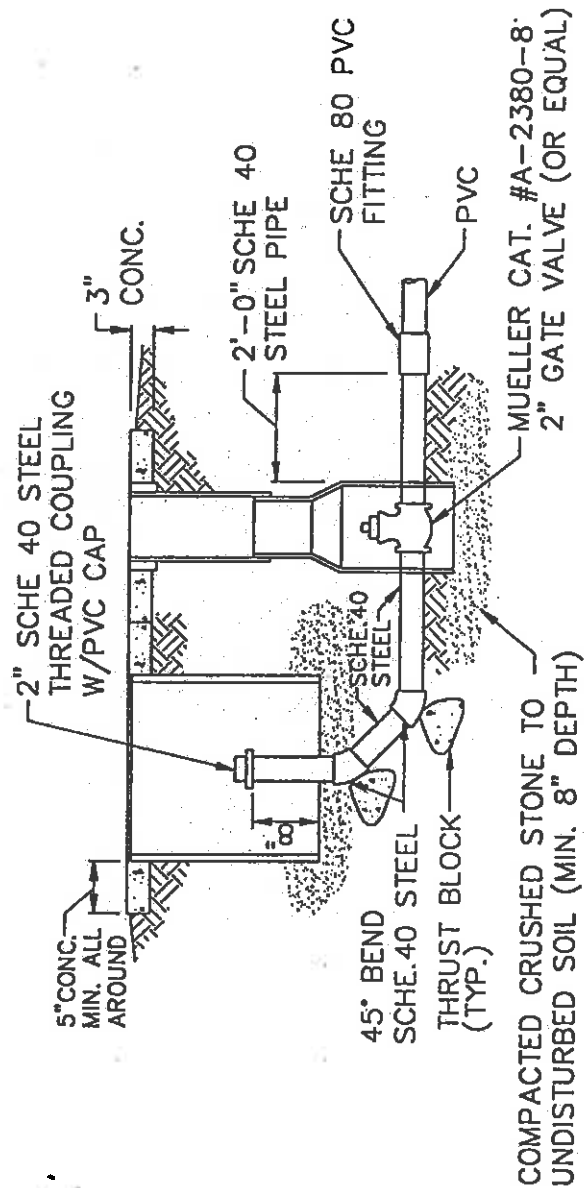
2" CLEAR  
ALL AROUND

3" MIN.  
LAP

#3 BARS

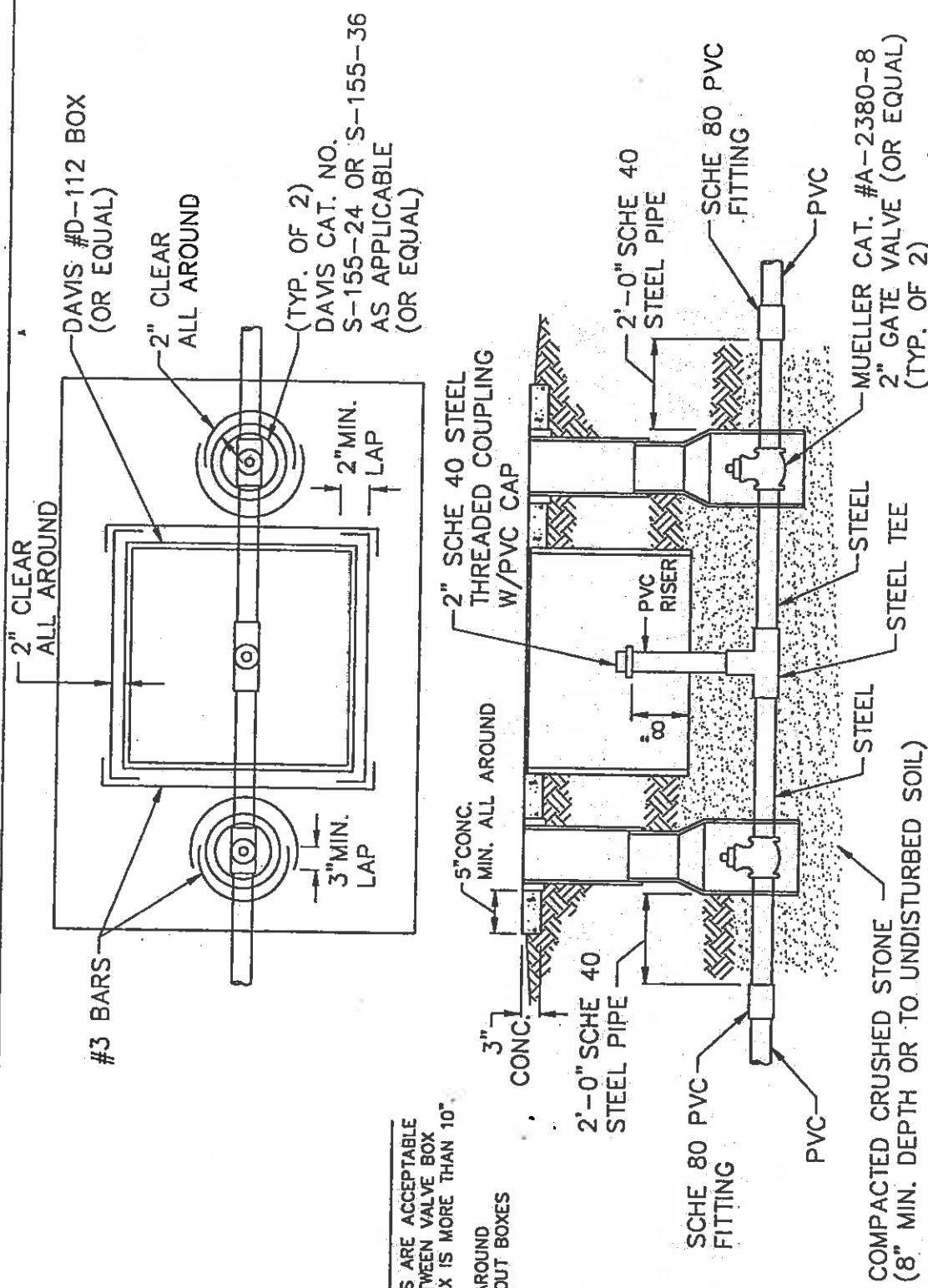
(TYP. OF 2)  
DAVIS CAT. NO.  
S-155-24 OR S-155-36  
AS APPLICABLE (OR EQUAL)

MIN. 5" CONC. AROUND  
VALVE & CLEANOUT BOXES.



# VALVES & CLEANOUT ARRANGEMENT AT END OF PRESSURE MAIN

NOT TO SCALE

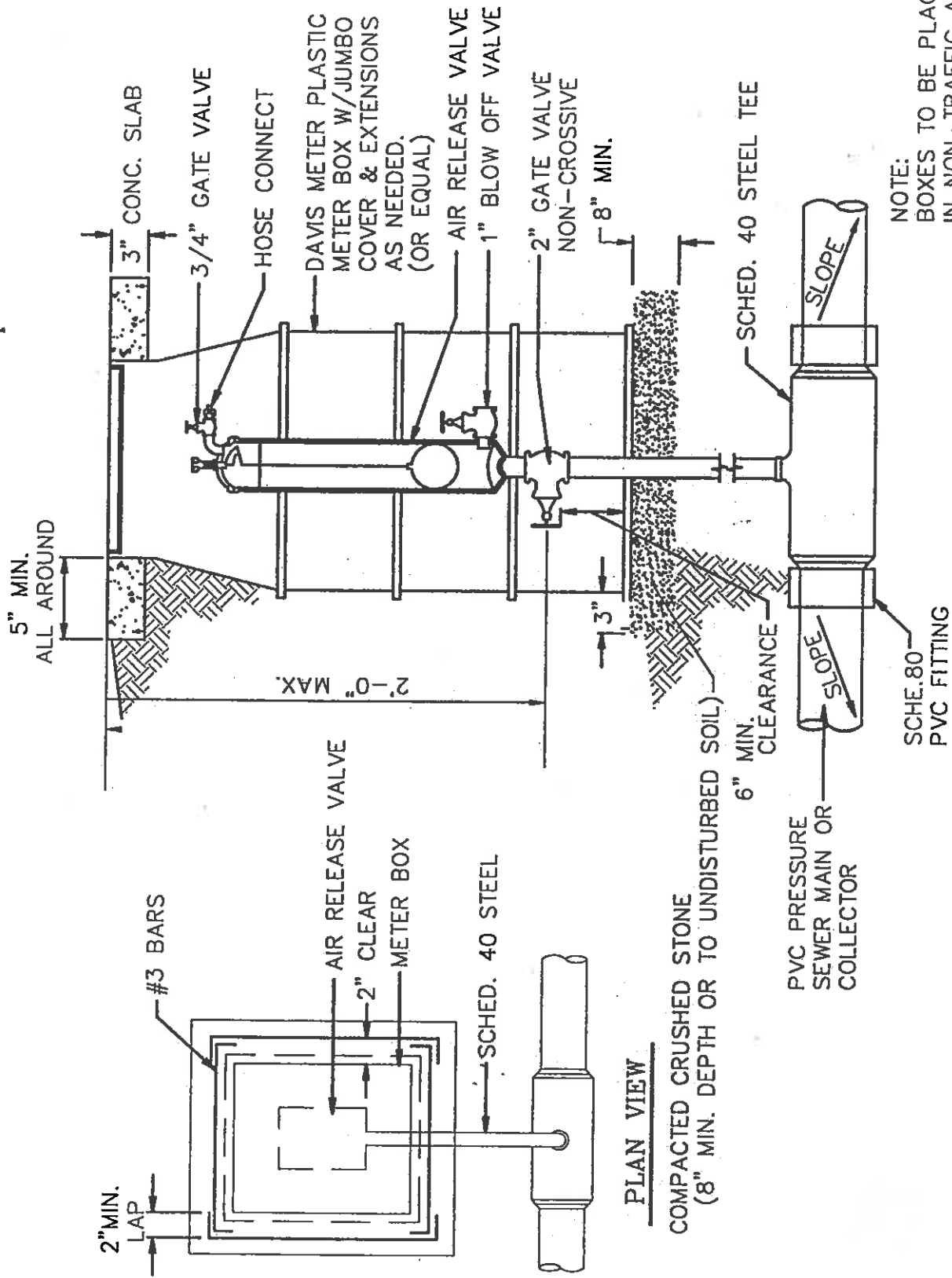


NOTE:  
SEPARATE SLABS ARE ACCEPTABLE  
IF DISTANCE BETWEEN VALVE BOX  
& CLEANOUT BOX IS MORE THAN 10".  
MIN. 5" CONC. AROUND  
VALVE & CLEANOUT BOXES

# VALVES & CLEANOUT ARRANGEMENT ALONG STRIGHT RUNS CHANGES IN DIRECTION

NOT TO SCALE





NOTE:  
BOXES TO BE PLACED  
IN NON-TRAFFIC AREAS AND  
CENTERED OVER VALVE.

# SEWAGE AIR RELEASE DETAIL

NOT TO SCALE