HENDERSONVILLE UTILITY DISTRICT
OF
SUMNER COUNTY, TENNESSEE

STANDARD WSASTEWATER SPECIFICATIONS
FOR SUBDIVISIONS AND GENERAL SYSTEM ADDITIONS

April 2022

Commissioners

W. C. Boyers, President
Ronald E. Flowers, Treasurer
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General Manager

Joe Rewa

WPN 22.0267
Hendersonville Utility District Standard Specifications

APPROVED FOR CONSTRUCTION

THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

Adrian Baboun

05/04/2022

THIS 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.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

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DIVISION 1

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STANDARD SEWER SPECIFICATIONS

SECTION 1 - GENERAL

1.01 DEFINITIONS

Sewer Department - Hendersonville Utility District of Sumner County, Tennessee

City - City of Hendersonville, Sumner County, Tennessee

Planning Commission - Hendersonville Regional Planning Commission

Developer - Owner of a proposed development in which sewer lines are to be located.

Contractor - Contractor who is installing sewer lines in a proposed development or project.

Engineer - One who has prepared the construction drawings and specifications for the installation of sewer lines in a proposed development. As provided by the laws of the State of Tennessee, he must be a registered professional engineer and drawings, specifications, and calculations must bear his official seal.

State Regulatory Authority - Tennessee Department of Environment & Conservation Division of Water Pollution Control

1.02 SCOPE OF REGULATIONS

These regulations shall apply to any persons, developer, firm, business or entity interested in and desiring to construct additional sewer lines or to extend or replace existing sewer lines within the Hendersonville Utility District's service boundaries or to construct additional sewer lines or extend or replace existing sewer lines in a way that affects the sewer service provided by the Hendersonville Utility District.

1.03 PLAN REVIEW PROCEDURE

Before any connection is made to a sewer line of the Sewer Department, a Developer, or other party, through their Engineer shall submit and receive approval of a proposed plan. The submittal shall consist of neat, scaled drawings and specifications and at least two (2) copies for review and mark-up. Sewer Department will retain one (1) copy. Once noted changes have been corrected, Engineer is to submit eight (8) sets of plans to Sewer Department for approval stamp. Sewer Department will retain one set of stamped drawings with the remainder to be returned to the Engineer. Drawings will not be deemed approved until the Sewer Department's stamp of approval has been affixed to the cover sheet of the drawings and specifications. A copy of the preliminary plat or overall drawing showing the total site and location of the site shall be provided with the drawings.

The approval of the Sewer Department must be obtained before submittal of the drawings and specifications to the State Regulatory Authority. Both approvals must be obtained before construction is started. Evidence of State Regulatory Authority approval must be furnished to the Sewer Department before beginning construction. Approval of drawings for proposed sewer line construction for new subdivisions and other developments must be obtained from the Sewer Department before final approval for such developments will be granted by the Planning Commission. Approval of drawings shall be valid for one (1) year from the date of approval. Contractor shall retain one set

of approved drawings from Sewer Department and the State of Tennessee with approved stamps on job site during construction.

The Contractor's attention is directed to the requirement for executing a Notice of Intent (NOI) for storm water discharges upon award of this project. This NOI, which is included in the Agreement Section, must be executed by the Contractor after award of project. The Owner/Developer will pay any required fee and transmit the NOI package to the State for review and approval. This NOI must be approved by the State of Tennessee prior to beginning work on this project.

It shall be the responsibility of the Contractor to fully comply with all requirements and regulations of the NOI, storm water discharge regulations, and all other requirements contained herein. Final approval of storm water permits shall be issued by the City of Hendersonville Public Works Department.

Plan submittal procedure shall be as follows:

1. All drawings shall be submitted to the Sewer Department with a letter of transmittal and a check for the plan review fee.

2. Drawings will be returned to the Sewer Department by their Engineers and will be stamped and signed as to approval, then returned to the Design Engineer or Developer for submittal to the State Regulatory Authority.

3. Commencement of utility construction activity shall not occur until all approvals have been obtained. Contractor is responsible for all construction notifications prior to start of project.

In addition to sewer main plans submitted drawings shall include existing and finished grades for the roadways, rights-of-way, easements, curbs, gutters, sidewalks and ground as well as the location, size and invert elevation of other utilities and drainage structures. The drawings shall also include the latest revision date, if applicable.

For off-site sewers or force mains existing topo shall be shown, including roadway paving, property lines, rights-of-way, easements, existing overhead and underground utilities and any other features which could affect construction.

STATE APPROVED PLANS

One set of the plan document stamped "APPROVED FOR CONSTRUCTION" and with the approved stamp from the State of Tennessee, Division of Environmental Protection shall be available at the job sites at all times during construction. The Engineer or a person qualified other than the contractor or his representative, and approved by the public sewer system shall provide continuous adequate inspection during construction to assure that all work is done in accordance with approved plan documents. The Department's representative shall have access to the project at any time during construction. If the Department Representative observes work being done in a manner that does not conform to the approved plan documents or District Standards, he shall have the authority, through the Engineer's representative, the sewer system's agent or directly to the contractor to order the cessation of all work affected by the nonconformity until such discrepancies are rectified.

1.04 DESIGN FEATURES

Sewer system design features shall generally conform to good municipal practice and to requirements of the Tennessee Department of Environment and Conservation.

The following criteria will generally apply:

Per Capita Wastewater Flow (PE)	100 GPCD Peak Flow Factors (PFF)
PE	PFF
0 - 500	5.0
500 - 1,000	4.0
1,000 - 10,000	3.25
10,000 - 50,000	2.5
Over 50,000	2.0

Minimum velocity at design flow	2.0 fps
Maximum velocity at design flow	15.0 fps

Basis of Hydraulic Design:

Kutter's Formula with "n" =	0.013
Minimum Size	
Collector	8"
Service *	6"

* The minimum size service line (lateral line running from the collector sewer to the point at which the sewer customer is to tie in) shall be 6 inches in diameter

All conventional gravity sewers shall be designed and constructed to give mean velocities when flowing full of not less than 2.0 feet per second. The following minimum slopes should be provided; however, slopes greater than these are desirable.

Sewer Size Inches	Minimum Slope (feet per 100 feet)
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05
42	0.042

Sewer system design shall allow a drop in elevation through each manhole of at least 0.1 foot unless approved otherwise by the Hendersonville Utility District.

Pumping stations shall, where possible, be designed to utilize equipment similar to that already utilized by the Sewer Department. Design discharge velocities shall be such as to create self-cleaning conditions in the force main. Suitable air release valves shall be utilized at all points in the force main to prevent an accumulation of air or gases released from the sewerage. The Contractor shall furnish and apply to the interior of wet wells an epoxy based material to be used to form the sprayed monolithic liner covering all interior surfaces of the wet wells including benches and inverts. The material shall be as approved by the Hendersonville Utility District. The finished liner shall conform to the minimum requirements listed in the Materials section.

Pumping facilities will be required to have full standby capacity, emergency pump 6" connection Cam-lock hookup (tee, valve and suction line with plug on force main), high water/power failure alarm system, alarm light, pump alternator, seal failure alarm, pump failure alarm. lightning arrestor, flow meters in some cases and elapsed time meters for all pumps in all cases, water supply for maintenance, and remote pump monitoring system as manufactured by Advantis®, and other items as determined in reviews for individual installations. Pump stations must be provided with all-weather hard surface roads for access by maintenance vehicles. Hard surface roads are defined to be asphalt or other surface equivalent to City of Hendersonville road specifications or subdivision regulations. Pump station site plan and pump station plan and elevation drawing shall be drawn to scale.

Pump operation shall be accomplished by the use of a digital level controller and a liquid level transducer.

Electrical service to the pumping station shall be placed underground. Conduit shall be PVC. Electrical work shall be permitted, inspected and approved by the State Electrical Inspector. Electrical service shall connect to bottom of junction box.

All pump stations are to have a main disconnect at electrical junction box for portable generator hook-up.

All pumping stations shall include an influent cut-off valve outside the pumping station and an effluent force main cut-off valve outside the pumping station. The influent line shall have a tee after entering the wet well and effluent cut-off valves shall be contained within a lockable valve pit or lockable valve box to prevent tampering by unauthorized personnel. Piping shall be Class 52 ductile iron pipe.

Odor control facilities will be required as determined by the Sewer Department.

Submersible pumps shall be explosion-proof as manufactured by Barnes, Gorman-Rupp, or as approved by Sewer Department.

In general, the combined weight of the pump and motor shall not exceed 1,000 pounds; suitable lifting devices must be furnished with the pump station; pump station depth shall not exceed 20 feet; and all items inside the pump chamber shall be made of corrosion-resistant and explosion-proof material.

Preliminary discussions concerning pump station design are encouraged before preparation of preliminary drawings so specific design requirements can be established.

Pipe Material shall be designated on approved construction drawings and shall conform to applicable specifications included in Section 2 of these Standard Specifications. The Engineer shall, therefore, designate pipe materials on all construction drawings.

Separation of Water Mains and Sewers shall be maintained in accordance with the following guidelines:

For parallel installations, line separation is to be at least 10 feet edge to edge. If this cannot be obtained the bottom of the water line shall be at least 18 inches above the top of the sewer. If this condition is also unobtainable the sewer line is to be constructed of materials and have a joint design equivalent to water main standards as approved by the Water Department and shall be pressure tested to 50 psi to assure water tightness.

Where the water line crosses house sewers, storm sewers, or sanitary sewers, a separation of at least 18 inches shall be provided between the bottom of the water line and the top of the sewer. If this separation cannot be obtained sewers within 10 feet of the water line shall be constructed of materials and have a joint design equivalent to water main standards as approved by the Water Department. Such sewer lines shall be pressure tested to 50 psi to assure water tightness. In addition to the above sewer line construction water mains passing under sewers shall be protected by providing: at least 18 inches between the bottom of the sewer and the top of the water line; adequate structural support of the sewer to prevent excessive joint deflection or damage to the water line; centering of the water line section to result in the water line joints being removed from the sewer line to the maximum possible extent.

No water line shall pass through or come into contact with any part of a sewer or sewer manhole.

Sanitary Sewer Services - Sewer services shall not enter manholes except in the cases of terminal manholes.

Easements - All sewers constructed in easements shall be C900 DR-14 PVC pipe. A dedicated water and sewer easement as listed below, unless approved otherwise by the Hendersonville Utility District. When sanitary sewers are constructed outside a public right-of-way, easements must be provided to the Hendersonville Utility District using the following:

Sewer Depth (feet) *	Easement Width Required (minimum)
0 - 12	20 feet
12 - 20	30 feet

* No sewer is allowed less than 36-inches deep or deeper than 20 feet without special approval by the Hendersonville Utility District. Also any section of sewer which is less than 4-feet or over 12 feet deep to the invert at any point or will not be readily accessible is to be constructed using C900 PVC pipe from manhole to manhole. Force mains shall be in accordance with this division and Division 3 of the Standard Specifications.

1.05 INSPECTION

All projects shall be subject to inspection during and upon completion of construction by an authorized representative of the Sewer Department. Inspection may consist of full-time resident inspection or part-time inspection at the sole discretion of the Sewer

Department. Presence or absence of the inspector during construction does not relieve the Developer and/or Contractor from adherence to approved drawings and specifications.

The work shall, at all times, be subject to the inspection of authorized representatives of the Sewer Department and materials and/or workmanship found not meeting requirements of approved drawings and specifications shall be immediately brought into conformity with said drawings and specifications.

An authorized representative of the Sewer Department shall make a final inspection of the project after completion to determine acceptability of the work. Before this final inspection can be made the Engineer responsible for the project shall notify the Sewer Department in writing that the work has been completed in accordance with approved drawings and specifications.

An authorized representative of the Tennessee Department of Environment and Conservation shall have the right to inspect the construction work and shall be notified of the final inspection date on the work.

Final acceptance of the work shall be accomplished as described in Paragraph 1.06.

1.06 FINAL ACCEPTANCE

When facilities qualify as public facilities the Sewer Department will accept ownership of the completed facilities when the work has passed the final inspection and when final drawings are submitted to the Sewer Department reflecting actual "AS BUILT" conditions. The "AS BUILT" drawings shall be complete and show final location of sewer lines, manholes, services, easements and other items appurtenant to the system. One (1) set of acceptable "AS BUILT" drawings, and cost of installation shall be submitted to the Sewer Department before final acceptance of the work is made.

"As built" drawings shall consist of the following:

1. Finished Invert elevation of each manhole and top finished grade elevation of each casting

2. Each manhole, tee, clean out, valve box, and fittings shall be GPS located with XYZ coordinates to integrate with HUD GIS system. Each located point shall be included in a Comma Separated Value (.csv), Microsoft Excel spreadsheet (.xls), or approved file format. The CSV file shall include, at minimum, the following information:

Position/Column	Description
1	Point Reference Number
2	X Coordinate (Easting)
3	Y Coordinate (Northing)
4	Z Coordinate (Elevation)
5	Point Type (Manhole, Valve, Meter, Fire Hydrant, etc.
6	Point Description

3. All services shall be located (in feet) from the nearest downstream manhole of each section and include the length and depth of service.

4. Final televised digital log sheet that include the distance to each clean out and house and/or lot number on DVD, or CD of each sewer section. (2 Each)

5. One set of Mylar prints and a Portable Document Format (.pdf) file.

6. Tee location form in digital format shall include the line designation, station number, distance in feet from the nearest downstream manhole, length, depth of service and lot number.

Final acceptance by the Sewer Department will be made in writing upon satisfactory completion of the project including final inspection, submittal of acceptable "AS BUILT" drawings and payment of all fees due. The Developer/Contractor shall guarantee the work for a period of one year from the date of final acceptance and shall immediately correct any deficiencies in the work due to materials and/or workmanship which occur during the guarantee period. The date of final acceptance shall be that date on which the Developer/Contractor has fulfilled all conditions necessary for final acceptance including passing a final inspection, submittal of acceptable "AS BUILT" drawings, and payment of all fees due.

* * *

SECTION 2 - MATERIALS

2.01 GENERAL

All materials to be incorporated in the project shall be first quality, new, and undamaged material conforming to all applicable portions of these Specifications.

2.02 CONCRETE

Cement - Cement shall be Portland cement of a brand approved by the Engineer and shall conform to "Standard Specifications for Portland Cement," Type 1, ASTM Designation C-150, latest revision. Cement shall be furnished in undamaged 94- pound, one cubic foot sacks and shall show no evidence of lumping.

Concrete Fine Aggregate - Fine aggregate shall be clean, hard uncoated natural sand conforming to ASTM Designation C-33, latest revision, "Standard Specifications for Concrete Aggregate."

Concrete Coarse Aggregate - Coarse aggregate shall consist of clean, hard, dense particles of stone or gravel conforming to ASTM Designation C-33, latest revision, "Standard Specifications for Concrete Aggregate." Aggregate shall be well graded between 1-1/2-inch and #4 sieve sizes.

Water - Water used in mixing concrete shall be clean and free from organic matter, pollutants, and other foreign materials.

Ready-Mix Concrete - Ready-mix concrete shall be secured only from a source approved by the Engineer and shall conform to ASTM Designation C-94, latest revision, "Specifications for Ready-Mix Concrete." Before any concrete is delivered to the job site the supplier must furnish a statement of the proportions of cement, fine aggregate, and coarse aggregate to be used for each mix ordered and must receive the Engineer's approval of such proportions.

Class "D" Concrete - Class "D" concrete shall have a minimum compressive strength of 4,500 pounds per square inch in 28 days and shall contain not less than 5.5 sacks of cement per cubic yard.

Class "C" Concrete - Class "C" concrete shall have a minimum compressive strength of 2,000 pounds per square inch in 28 days and shall contain not less than 4.5 sacks of cement per cubic yard.

Metal Reinforcing - Reinforcing bars shall be intermediate grade steel conforming to ASTM Designation A-615, latest revision, "Standard Specifications for Billet Steel Bars for Concrete Reinforcement." Bars shall be deformed with a cross-sectional area at all points equal to that of plain bars of equal nominal size.

2.03 CRUSHED STONE

Crushed stone for pipe bedding shall meet the quality requirements of ASTM D-692 and the grading requirements of AASHTO M-43 for size 67. Crushed stone for backfill shall meet the quality requirements of ASTM D-692 and the grading requirements of AASHTO M-43 for size 67.

2.04 MANHOLE FRAMES & COVERS

Manhole castings shall conform to ASTM Designation A-48, latest revision, Class 30, and shall be free from scale, lumps, blisters, sandholes, and defects of every nature which would impair their use. Castings shall be well cleaned with a smooth tough asphaltic coating. Covers shall be of the solid-indented type with the words "SANITARY SEWER" cast in raised letters thereon. Bearing surfaces of frames and covers shall be machined to provide a solid bearing and prevent rocking. Pattern drawings and weights of castings shall be submitted for the approval of the Engineer.

Vented lids shall be furnished and installed at ends of lines and at approximately 1,400 feet along line segments. Locations of all vented lids shall be at locations determined by the Engineer.

Manhole frames and covers (minimum clear openings to be 24 inches) shall be equal to those listed below for particular applications.

NON-TRAFFIC (Standard)	John Bouchard No. 1155
TRAFFIC	Same as Non-Traffic type specified above
WATERTIGHT	To be used where manhole casting is subject to flood or submergence by surface runoff John Bouchard No. 1123
WATERTIGHT INSERT	To be used as directed by Engineer. Manhole frame and cover to be same as non-traffic type as specified above. Insert to be Sewer Guard as manufactured by Preco Industries Ltd. or equal.

Exceptions to the above shall be noted on the Construction Drawings.

2.05 MANHOLE STEPS

Steps shall be aluminum, equal to #15295 by Alcoa or plastic encapsulated steel equal to No. PS 1-45 as manufactured by M.A. Industries, Inc., East Point, Georgia.

2.06 PRECAST MANHOLES

Precast manholes shall conform to the latest revision of ASTM C-478, latest revision. Drawings of manhole sections proposed for use on this project must be submitted to the Engineer for approval prior to use. Steps shall be furnished in accordance with Paragraph 5 of this Section and care must be taken to assure a firmly embedded step with no cracks from mortar shrinkage which will allow leakage. Loose steps and shrinkage cracks passing through manhole walls shall be cause for rejection.

All manholes constructed and installed shall be cast with XYPEX® Admix C-1000 in the concrete for waterproofing and corrosive protection. The manufacturer's recommended addition rate for Concentrate C-1000 is 3% by weight of cement. XYPEX® C-1000 shall be as supplied by Tom Williams; 1231 Antioch Pike; Nashville, Tennessee. Precast

manholes with XYPEX® C-1000 Admix shall be as manufactured by Cloud Concrete Products of Lavergne, Tennessee or Engineer approved equal.

Manhole sections showing evidence of cracking, crazing, honeycombing, crumbling, or excessive roughness will not be acceptable. Sections with improper cut-outs, misalignments or other defects shall not be utilized in the project.

Manhole sections shall be steam or water cured and shall not be delivered to job site until at least 7 days old. Each section shall be marked in a permanent manner with date of manufacture, manufacturer's mark, and manhole location or manhole number. Manhole sections to receive pipes shall be furnished with appropriate cut-outs with resilient connectors for installation of pipe.

On precast manhole sidewall an approved flexible plastic gasket equal to RAM-NEK shall be applied to the joint surface to placement of next manhole section. The placement of this gasket shall also be required under all manhole castings and adjustment rings for castings. All joints shall be wiped with Portland cement and brushed to a smooth finish

Testing and Inspection of precast manhole sections shall be done at the site of manufacture in accordance with ASTM C- 478, latest revision by the manufacturer. Compression tests shall be run on specimens obtained from each day's production: a minimum of 2 cylinders or cores per day's run but no less than the maximum number designated by ASTM C-478, latest revision. The absorption test shall be run on a minimum of two randomly selected manhole sections per each day's production. Three (3) copies of certified test reports shall be submitted to the Engineer.

In addition to testing required of the manufacturer as described above the Owner may provide an independent testing laboratory to make visual inspections of manhole sections produced from selected sections. The random samples will be selected by the Owner's testing laboratory and will be taken from stock on the manufacturer's yard intended for use on this project. Core samples shall be cut from designated sections amounting to no more than 4% of the total production in order to run compressive strength and absorption tests. The manufacturer shall cut the cores and seal the holes but this testing shall be done by the Owner's testing laboratory and paid for by the Owner. In the event the samples fail to conform to the Specifications the manufacturer may furnish additional test specimens to the extent permitted by the Specifications. Testing done by the Owner's testing laboratory shall be in accordance with ASTM C-478, latest revision.

2.06.1 MANHOLE SEALING AND PROTECTIVE COATING

Manhole sealing involves materials to be used for sealing existing manhole sidewalls and benches.

For manholes needing protective coating for structural integrity and resistant to sulfide corrosion, the Contractor shall furnish and apply to the interior of manholes a multi-layer protective lining system consisting of a polyurea adhesion coating, polymer surface layer and final polyurea armor layer. The material shall consist of OBIC Polyurea System, SpectraShield® Liner Systems and Warren Environmental® epoxy liner to the required thickness specified in the unit price bid item. The finished liner shall conform to the minimum requirements listed below:

The liner system armor layer shall provide 100% solids, no volatile organic compound (VOC), moisture tolerant, elastomeric polyurea coating to provide infiltration and corrosion protection. Material shall be capable of curing properly given the project site
conditions and temperatures conforming to the following minimum physical requirements:

Property	Value
Hardness	D-48
Tensile Strength, D-412	3315 psi
100% Modulus, D-412	1668 psi
200% Modulus, D-412	1960 psi
300% Modulus, D-412	2650 psi
Tear strength, DIE-C, D-624	417 pli
Ultimate elongation, D-412	395%
Abrasion Resistance (cs17 wheels, 1000g, 1000 cycles, D-4060	15 mg loss
ASTM G210-13 Severe Wastewater Analysis Testing	Pass

The liner system surfacer layer shall provide 100% solids, no volatile organic compound (VOC), moisture tolerant, elastomeric polyurethane coating to provide infiltration and corrosion protection. Material shall be capable of curing properly given the project site conditions and temperatures conforming to the following minimum physical requirements:

Product Type	Polyurethane	
Core Density	ASTM D 1622	6 lb/ft3
Compressive Strength 1"	ASTM D 1621	130-180 psi
Closed Cell Content		>94%

Manufacturer and Applicator warrant the liner system against failure for a period of 10 years. "Failure" will be deemed to have occurred if the protective lining fails to prevent the internal deterioration or corrosion of the structure or prevent groundwater infiltration. If any such failure occurs within 10 years of initial completion of work on a structure, the damage will be repaired at no cost to the Owner. "Failure" does not include damage resulting from mechanical or chemical abuse or act of God. Mechanical or chemical abuse means exposing the lined surfaces of the structure to any mechanical force or chemical substance not customarily present.

The finished manholes shall be corrosion resistant to: Hydrogen Sulfide; 20% Sulfuric Acid; 17% Nitric Acid; 5% Sodium Hydroxide as well as other common ingredients of the sanitary sewerage environment.

Note: All sealing and coating of interior manhole and invert surfaces shall be by the spray applied method only.

2.07 RESILIENT CONNECTORS

All connections of pipes to manhole sidewalls shall be made with resilient connectors. Resilient connectors for connection of pipes to manhole sidewalls shall be Kor-N-Seal or approved equal.

Openings in the manhole sidewall shall be so constructed as to include the resilient connector such that it is an integral part of the sidewall and to provide for the required size and location of the pipe to connect to the manhole. The sidewall opening shall be manufactured to allow for lateral and vertical movement as well as angular adjustments through 20 degrees. The resilient connector shall be Kor-N-Seal as manufactured by NPC, Inc. or approved equal. The resilient connector shall meet all physical and performance requirements as set forth by ASTM C-923, latest revision.

2.08 DUCTILE IRON PIPE (ONLY ALLOWED WHEN REQUIRED BY UTILITY DISTRICT DUE TO UNDERGROUND CONDITIONS)

Ductile iron pipe for gravity lines shall conform to USA Standard A21.52, latest revision for centrifugally cast pipe. The pipe shall be manufactured of iron having acceptance values of 60-42-10.

Pipe shall be furnished in lengths of 18 feet to 20 feet and, unless otherwise indicated, shall be provided with a compression type slip joint equal to the Fastite joint as manufactured by American. Gaskets and lubricants shall be furnished with the pipe. Ductile iron pipe installed within 100 feet of underground fuel tanks shall be installed with Viton joint gaskets or approved equal.

Pipe shall be furnished with Protecto 401 ceramic epoxy lining with standard thickness on the inside as recommended by manufacturer. Lining shall conform to ASTM D 714 Standards, latest revision. The exterior of the pipe shall be clearly marked to indicate the manufacturer, date of manufacture, the pipe class and weight. Exterior markings shall also positively identify the pipe as being Ductile Iron.

Ductile iron pipe shall be furnished with wall thickness in accordance with the following schedule (or heavier), unless noted otherwise on the Drawings (Thickness Class 52).

Nominal Pipe Diameter	Minimum Wall Thickness
6"	0.31"
8"	0.33"
10"	0.35"
12"	0.37"
16"	0.40"
18"	0.41"
20"	0.42"
24"	0.44"
30"	0.47"
36"	0.53"

Ductile iron pipe for force mains shall be at least Thickness Class 52 unless shown otherwise on the Drawings.

Ductile iron pipe on piers or in tunnel/bore shall be at least Thickness Class 52 unless shown otherwise on the Drawings.

All ductile iron pipe shall be first quality with manufacturer's identification and pipe class clearly shown on each section.

Pipe manufacturer shall furnish, upon request, the test date for quality control during the manufacturing period for pipe furnished on the project. Testing and inspection shall be in accordance with ASA A.21.51, latest revision. Tests to include hydrostatic test (500 psi - 10 sec.); tensile test; impact test; one sample to be taken during each casting period of approximately 3 hours.

2.09 POLYVINYL CHLORIDE (PVC) SEWER PIPE

PVC sewer pipe may be used for 18-inch gravity sewer lines or smaller. PVC sewer pipe shall be SDR 35, or heavier, manufactured in accordance with ASTM D-3034, latest revision, for type PSM sewer pipe and fittings, 6-inch through 15-inch; ASTM F-679 (wall thickness T-1), 18-inch through 27-inch. For sewer pipe to be installed at depths greater than 12-feet, PVC pipe C-900, DR14 shall be used. Pipe shall be furnished with integral bells. Gaskets and lubricants shall be furnished by the pipe manufacturer. Pipe and fittings shall be made of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D-1784, latest revision.

Joints shall be compression type utilizing an elastomeric gasket providing a positive seal against groundwater and root intrusion as well as sewage leakage and shall be in accordance with ASTM D-3212,latest revision. Gaskets shall comply with physical requirements specified in ASTM F-477, latest revision. Lubricant shall be furnished with the gaskets and shall be entirely compatible with gasket and pipe material.

Joints shall show no signs of leakage when tested as follows (supersedes ASTM D-3034): Typical joint assembly shall be subjected to internal hydrostatic pressure of 10.8 psig for 10 minutes without leakage; assembly shall also be subjected to internal vacuum of 22 inches of mercury or external pressure of 10.8 psig for 10 minutes without leakage. The above internal pressure and vacuum (or external pressure) tests shall be run on a typical joint assembly in concentric alignment and in a position of angular deflection to at least 3.

Testing and inspection of all pipes shall be done at the factory with a certified copy of test results furnished to the Engineer prior to any pipe being installed. Tests shall be done in accordance with ASTM D-3034 or ASTM F-679, latest revision and shall include: Pipe and Fitting Dimensions; Pipe Flattening; Impact Resistance; Pipe Stiffness; Joint Tightness; and Extrusion Quality. At least 1% of the production of each size furnished for this project shall be tested.

Each pipe section shall be marked with the following information:

6-inches to 15-inches:	Manufacturer's name or trademark; nominal pipe size; PVC cell classification; Legend "Type PSM Dr 35 PVC Sewer Pipe"; ASTM D-3034, latest revision.
16-inches or greater:	Manufacturer's name or trademark; nominal pipe size; PVC cell classification; Legend "PS 46 PVC Sewer Pipe"; ASTM F-679, latest revision.

2.10 POLYVINYL CHLORIDE (PVC) PRESSURE SEWER FORCE MAIN PIPE

AWWA C-900 PVC force main pipe (4-inch through 12-inch) shall be DR-14; 305 PSI; w/cast iron pipe equivalent OD's and shall conform to ANSI / AWWA C-900 manufactured in accordance with ASTM D1784, latest revision. All pipe shall be manufactured from Class 12454-B Polyvinyl chloride plastic (PVC 1120) as defined in ASTM D-1784. The pipe shall have NSF approval. The following test shall be performed for each machine and on each size and type of pipe being produced with test results furnished to the Engineer prior to any pipe being installed.

Flattening Test - Once per shift in accordance with ASTM D-2412, latest revision. Upon completion of the test, the specimen shall not be split, cracked, or broken.

Acetone Test (Extrusion Quality Test) - Once per shift in accordance with ASTM D-2152, latest revision. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the tests.

Quick Burst Test - Once per 24 hours in accordance with ASTM 1599.

SDR	Pressure Rating	Minimum Bursting Pressure, psi
14	305	985

Wall Thickness and Outside Dimensions Tests - Once per hour in accordance with ASTM D-2122.

Bell Dimension Test - Once per hour in accordance with ASTM D-3139, latest revision.

In addition to the above, the pipe manufacturer shall furnish a certificate stating that he is fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these Specifications and further stating that he has manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these Specifications.

All pipe shall be manufactured in the United States of America. All pipe for any one project shall be made by the same manufacturer.

The pipe may be furnished in the manufacturer's standard laying lengths of 20 feet. The Contractor's methods of storing and handling the pipe shall be approved by the Engineer. All pipe shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed water line routes will not be allowed.

Certain information shall be applied to each piece of pipe. At the least, this shall consist of:

Normal Size
Type of material
SDR or class

Manufacturer
NSF Seal of Approval
AWWA C-900

Pipe that fails to comply with the requirements set forth in these Specifications shall be rejected.

Pressure Class at 73.4° shall be 235 PSI (DR 18). Joints shall be compression type conforming to ASTM D-3139 and F-477. Latest revision shall be used for 4-inch or larger. All joints shall be designed to withstand the same pressure as required for the pipe.

Furnish detection tape and trace wire as per specifications in this Section.

Fittings for C-900 force main pipe 4-inch through 12-inch shall be compact ductile iron conforming to USA Std. A21.53-84, latest revision. Fittings shall have interior lining and exterior coating as specified for ductile iron pipe. Fittings for 12-inch and smaller pipe may be either cast iron or ductile iron.

2.11 PIPELINE DETECTION TAPE AND TRACER WIRE

Detectable pipeline location tape shall be plastic composition film containing one layer of metalized foil laminated between two layers of inert plastic film specifically formulated for prolonged use underground. Tape shall be a minimum of 5.5 mils thickness and continuously printed in permanent ink to indicate caution for a buried sewer line below.

All pressure sewers and force mains not constructed of ferrous material shall be installed with detectable tape and tracer wire.

Detectable tape shall be 3 inches wide and shall be an inert, bonded layer plastic with a metalized foil core and shall be highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The tape shall be brightly colored (Green) to contrast with soil and shall bear the imprint "CAUTION -- SEWER LINE BURIED BELOW." Tape shall be Terra-Tape as manufactured by Reef Industries, Inc. or approved equal.

Additionally, the Contractor shall provide and install a 14-gauge insulated copper wire on top of the newly installed PVC force main or pressure sewer main. (See Special Detail in Contract Drawings.)

2.12 SEWER FITTINGS AND ADAPTERS

Fittings and adapters for use with PVC pipe shall be manufactured in accordance with the Specifications for the respective types of pipe.

Note: Special coupling adapters for point repairs on sewer lines and/or joining sewer lines shall provide for shear / differential settlement protection and shall be Mission Flex-Seal ARC sewer couplings as manufactured by Mission Rubber Company or Owner-approved equal.

2.13 IRON PIPE FITTINGS

All fittings shall be compact ductile iron, lined with Protecto 401 ceramic epoxy lining, manufactured in accordance with ASTM D714 Standards, latest revision, unless

otherwise indicated or directed. Minimum pressure rating shall be 350 psi. Mechanical joint fittings shall be used unless indicated otherwise on the drawings.

Fitting manufacturer shall furnish certificates that fittings were manufactured in compliance with ASTM standards, latest revision.

2.14 AUTOMATIC AIR RELEASE VALVES FOR PRESSURE SEWERS (FORCE MAINS)

Automatic air release valves shall be ARI Valves, Model D-025 (w/attachments) SAAR short version or approved equal as per special detail on the Contract Drawings. Air release valve shall be installed in eccentric manhole with required protective coatings in accordance with these specifications and details and as directed by HUD personnel. All air release valves shall be manufactured in stainless steel.

2.15 BALL VALVES

Valves on pressure sewers 1½-inch through 3-inch shall be PVC ball valves of true union design with permanently lubricated teflon seats and elastomer "O"-ring seals. The valves are to be opened and closed with a quarter turn. Working pressure at 70 degrees F shall be 150 pounds per square inch.

2.16 PRESSURE SEWER SERVICE, 2-DIRECTIONAL CLEAN-OUTS, AIR RELEASE VALVE BOXES, AND COVERS

Typical sewer boxes shall be as indicated on the Contract Drawings or as set forth below:

The box shall be a minimum of 16" x 10-3/4" x 12" and 6-inch extensions made of injection molded plastic meeting ASTM D-2853-70, Class 1212, as manufactured by Brooks Products, Inc. or approved equal. The cover shall be green with "SEWER" imprinted on the top. The box and lid shall have UV stabilizer additive to assure resistance to material degradation from ultraviolet light. A 2½-inch diameter, 16-gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection.

If the valve box must be located in a roadway or roadway shoulder subject to traffic the valve box shall be constructed of cast iron in accordance with the following:

Valve Boxes - Valve boxes are to be made of pre-cast concrete sections measuring 11" x 13-1/4" inside dimensions and 17" x 19-1/4" outside dimensions with the height of 12 to 15 inches. Reinforcement shall be placed and shall conform to the requirements of ASTM A-15 and ASTM A-305 for intermediate grade.

Footing blocks for standard concrete valve boxes are to be pre-cast in blocks measuring 12" x 12" x 4". No reinforcing steel is required in footing blocks.

Valve Box Frames and Covers shall be made of heavy cast iron and shall meet the requirements of ASTM A-48, Class 40.

All casting shall be made accurately to the required dimensions and shall be sound, smooth, clear and free of blemishes of other defects. Defective castings which have been plugged or otherwise treated to remedy defects shall be rejected. Contact surfaces of frames and covers to be machined so that the covers rest securely in the frames with no rocking. The cover shall be in contact with the frames for the entire perimeter of the contact surface.

The valve box frames and covers shall be as manufactured by Bouchard No. 8006, Roadway Type, Nashville Standard or equal. The cover shall be marked "SEWER."

2.17 SEWER SERVICE CLEAN-OUTS, WYES, BOXES, AND COVERS

Typical sewer service clean-outs (6-inch Minimum) shall be installed as per Standard Details. The clean-out shall consist of a sanitary tee (a long sweep wye is also acceptable). The 6-inch plug or cap shall be contained in a plastic (meter type) box. Sewer Service Clean-outs shall be installed on all sewer services at the property line and right-of-way or easement line. It is the responsibility of the property owner to maintain the clean-out. Any existing service replaced or repaired shall have clean-outs installed per the requirements of this section. The customer shall own and maintain all service lines, including the clean-outs, on the customer's property and the District shall not maintain same in any way except for inspection. The District shall maintain the service line from the clean-out at the property line to the sewer main or from the clean-out ten (10) feet from the sewer main if the sewer service is in an easement. Clean-out at the property / easement line shall be the responsibility of the customer.

The box shall be a minimum of 16" x 10-3/4" x 12" and 6-inch extensions made of injection molded plastic meeting ASTM D-2853-70, Class 1212, as manufactured by Brooks Products, Inc. or approved equal. The cover shall be green with "SEWER" imprinted on the top. The box and lid shall have UV stabilizer additive to assure resistance to material degradation from ultraviolet light. A 2½-inch diameter, 16-gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection. If the valve box must be located in a roadway or roadway shoulder subject to traffic the valve box shall be constructed of cast iron in accordance with the following:

Valve Boxes - Valve boxes are to be made of pre-cast concrete sections measuring 11" x 13-1/4" inside dimensions and 17" x 19-1/4" outside dimensions with the height of 12 to 15 inches. Reinforcement shall be placed and shall conform to the requirements of ASTM A-15 and ASTM A-305 for intermediate grade.

Footing blocks for standard concrete valve boxes are to be pre-cast in blocks measuring 12" x 12" x 4". No reinforcing steel is required in footing blocks.

Valve Box Frames and Covers shall be made of heavy cast iron and shall meet the requirements of ASTM A-48, Class 40.

All casting shall be made accurately to the required dimensions and shall be sound, smooth, clear and free of blemishes of other defects. Defective castings which have been plugged or otherwise treated to remedy defects shall be rejected. Contact surfaces of frames and covers to be machined so that the covers rest securely in the frames with no rocking. The cover shall be in contact with the frames for the entire perimeter of the contact surface.

The valve box frames and covers shall be as manufactured by Bouchard No. 8006, Roadway Type, Nashville Standard or equal. The cover shall be marked "SEWER."

2.18 CASING PIPE

Where noted on the Drawings or required by these Specifications, roadway, railroad, or other crossings shall be made utilizing carrier pipe within a casing pipe. Sizes of carrier pipe and casing pipe shall be as noted on the Drawings or described in these Specifications. Casing pipe joints shall be of leak proof construction either steel (in accordance with the following table) or bituminous-coated corrugated metal (conforming to AREA specifications), unless specifically shown otherwise on the Drawings or in the Specifications describing construction requirements at a particular casing location.

Casing shall extend to the points indicated on the Drawings. The ends of the casing shall be protected against the entrance of foreign material but not tightly sealed in a manner approved by the Engineer.

In situations where the bore method is utilized with a steel casing pipe the carrier pipe shall be secured inside the steel casing pipe with casing chocks (minimum three per joint) as manufactured by Powerseal Pipeline Products Corporation of Wichita Falls, Texas, or Engineer approved equal. Where casing chocks are used inside steel casing pipes the requirement for sand or pea gravel backfill can be eliminated. Additionally, the ends of the steel casing pipe shall be sealed with casing pipe "End Seals", "Link-seal", or Engineer approved equal.

TABLE OF MINIMUM WALL THICKNESS
FOR STEEL CASING PIPE
(COOPER E-80 LOADING)

Casing Diameter, inches	Wall Thickness with approved protective coating, inches	Wall Thickness without approved protective coating, inches
Under 14	0.188	0.251
14 & 16	0.219	0.282
18	0.250	0.313
20	0.281	0.344
22	0.312	0.375
24	0.344	0.407
30	0.406	0.469
36	0.469	0.532
42	0.500	0.563

The Contractor shall provide all materials to properly secure carrier pipe inside casing pipe in a manner approved by the Engineer.

The carrier pipe (water or sewer main) shall be secured inside the steel casing pipe by the use of casing chocks (three per joint) as manufactured by Powerseal Pipeline Products Corporation of Wichita Falls, Texas, or Owner / Engineer approved equal.

2.19 TUNNEL LINER PLATE

The steel lining shall consist of 8-gauge steel plates conforming to ASTM A-569, latest revision not to exceed 18 inches wide. Each circumferential ring shall be composed of the number and length of plates to complete the required diameter. The Contractor shall submit details of the lining for approval.

The strength of the casing or tunnel lining will be determined by its section modulus. Thickness of the metal for these steel plates shall not be less than 8-gauge allowing for standard mill tolerance conforming to AASHTO M-167.

All plates shall be punched for bolting on both longitudinal and circumferential seams, shall be of the lap type with offset equal to gauge of metal for full width of plates including flanges and shall have staggered-bolt construction so fabricated as to allow the cross-section of the plate to be continuous through the seam. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

The new material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first class in every respect. After the plates are formed to shape and after all holes are punched, the plates shall be galvanized conforming to ASTM A-123, latest revision. Plates shall then be bituminous coated conforming to AASHTO M-190.

All nuts and bolts shall be galvanized and conform to ASTM A-307, Grade A and ASTM A-153.

Plates shall be fabricated with grout holes to facilitate grouting above and around the tunnel liner. These grout openings shall be 2-inch I.P.T. half couplings welded into a hole in the center corrugation of a plate and a galvanized C.I. plug shall be provided for each opening to permit tight closure after grout holes so that the spacing of holes will be on a maximum spacing of 18-inch centers at the top of the tunnel and at the top quarter points staggered with holes at the top.

Field coating material shall be asphaltic mastic Trumball 5X, or approved equal, and shall be applied with hydraulic spray equipment using a minimum of 2,400 pounds pressure at the nozzle tip. The material shall be supplied at spraying consistency and shall be applied both to the outside and inside of the liner plates. Plates may be hot-dipped to produce a similar coating.

2.20 TUNNEL LINER GROUT

The grout shall consist of Portland cement, water, sand and 2% approved additive (Bentorite, Septamine Seax, Hydrocide liquid, etc.). One part Portland cement with additive shall be combined to four parts clean sand and sufficient water added to provide a grout having the consistency of thick cream when well mixed.

2.21 TUNNEL BACKFILL

Material used to backfill the tunnel/bore shall be pressure grout as approved by the Engineer.

2.22 RIP-RAP

Rip-Rap stone material shall be sound, durable, free from cracks, pyrite intrusion and other structural defects. Wear shall not exceed sixty by the Los Angeles Method. When crushed aggregate is subjected to five alternations of the sodium sulfate soundness test the weighted percentage of loss shall not be more than fifteen. At least 90 percent of the stone shall not be less than 8 inches wide by 12 inches long by 12 inches deep and shall be approximately rectangular in shape.

* * *

SECTION 3 - CONSTRUCTION

3.01 TRENCH EXCAVATION

3.01.1 General - Trenching must be done in a neat and workmanlike manner maintaining proper vertical and horizontal alignment. Alignment shall be maintained by the use of offset hubs and batter boards at maximum 50-foot intervals or with laser device or with other methods approved by the Sewer Department. The Engineer shall check all cut sheets before construction begins.

Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material, and appurtenances. Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions but, in general, shall not include more than 300 feet of continuous open trench at any time. The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill and clean-up and, in event of failure to do so, may be prohibited from opening additional trenches until such work is completed.

The Contractor shall plan his operations so as to cause a minimum of inconvenience to property owners and to traffic. No road, street or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

1. Permit is secured from appropriate State, County or Municipal authorities having jurisdiction.

2. Fire and Police Departments are notified before road is closed.

3. Suitable detours are provided and are clearly marked.

No driveways shall be cut or blocked without first notifying the occupants of the property. Every effort shall be made to schedule the blocking of drives to suit the occupants' convenience and, except in case of emergency, drives shall not be blocked for a period of more than 8 hours. The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for the protection of public safety. Flagman shall be provided as required on heavily traveled streets to avoid traffic jams or accidents.

Trench width shall be held to a minimum consistent with proper working space for the assembly of pipe. Maximum trench width up to a point one foot above top of pipe shall be limited to the outside pipe diameter plus 16 inches. Boulders, large stone, shale, and rock shall be removed to provide clearance of 6 inches below and on each side of the pipe. Trench walls shall be kept as nearly vertical as possible with due consideration to soil conditions encountered and when necessary, sheeting or bracing shall be provided to protect life and property. Where unstable soil conditions are encountered at the trench bottom the Contractor shall remove such additional material as may be directed by the Engineer and replace the excavated material with approved backfill or otherwise provide stable bedding for pipe as directed by Engineer and approved by Sewer Department.
The Contractor shall excavate by hand wherever necessary to protect existing structures or utilities from damage or to prevent overdepth excavation in the trench subgrade.

Excavated material shall be stored safely away from the edge of trench and in such a way as to avoid encroachment on private property.

3.01.2 Rock Excavation - Where rock excavation is encountered in trenches the excavation shall be carried to a depth of 12 inches below the bottom of the pipe. The rock shall also be removed to a width of at least 12 inches beyond the outside of the pipe on each side so that no rock is left within 12 inches of the outside wall of the pipe. Where rock is excavated in the bottom of the trench, the trench shall be brought back to grade by the use of crushed stone which shall be compacted to form a stable base for the pipe laying operation. If track drills are used for drilling rock water must be provided and used with the drilling operation to control dust.

The Contractor shall exercise all necessary precautions in blasting operations. Suitable blasting mats shall be provided and utilized as required. Blasting shall be done only by experienced personnel. Careless shooting, resulting in the ejection of stones or other debris during blasting, shall be corrected immediately by the Contractor's representative.

No blasting shall be done unless the Contractor has taken out the necessary insurance to fully protect the Owner from all possible damages resulting from the blasting operations. The blasting shall be done in accordance with all recognized safety precautions and in accordance with regulations of authorities having jurisdiction. In addition, the Contractor shall exercise the necessary care to safeguard the storing of blasting materials on the property.

Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas the Contractor shall remove the rock in a manner that will ensure protection of these structures. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting. In general, blasting shall not be done within 25 feet of the completed pipeline or any existing structure.

Excavated rock that cannot be utilized in trench backfill as permitted under Paragraph 4 of this Section shall be removed from the site and disposed of as directed by the Engineer.

3.01.3 Sheeting and Shoring - The Contractor shall provide such bracing, sheeting, or shoring as may be necessary for the protection of life and property. Sheeting will be required where necessary to restrict the trench width to acceptable limits above the top of pipe.

Sheeting, shoring, or bracing shall conform to applicable safety codes and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above top of pipe. The bracing or sheeting may then be removed in an approved manner unless the Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place, either at the direction of the Engineer or option of the Contractor, the sheeting shall be cut off at least 18 inches below the finished ground level.

Care shall be taken in removing sheeting to avoid weakening the trench, increasing the backfill load, or endangering adjacent property. Voids left by the

removal of sheeting shall be filled in and compacted with suitable material using tamps intended for this purpose.

3.01.4 Surface Obstructions - All buildings, walls, fences, poles, bridges, railroads, trees, and other property improvements encountered shall be carefully protected from all injury and, in the event that any of the foregoing are damaged or removed during the process of the work, shall be repaired or replaced in a satisfactory manner. Special care must be exercised in trenching under or near railroads in order to avoid or minimize delays or injuries resulting therefrom. Where it is necessary to cross beneath railroad tracks the Contractor shall make such installations in a casing of larger diameter as approved by the railroad company, the Engineer(s) and the Water Department.

3.01.5 Subsurface Obstructions - In excavating, backfilling, and laying pipe care must be taken not to remove, disturb, or injure other pipes, conduits, or structures without the approval of the utility. If necessary the Contractor, at his own expense, shall sling, shore up, and maintain such structures in operation and, within a reasonable time, shall repair any damage done thereto. Repairs to these facilities shall be made to the satisfaction of the utility.

The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any other pipe, conduit, etc. and shall abide by their regulations governing such work. In the event subsurface structures are broken or damaged in the prosecution of the work the Contractor shall immediately notify the proper authorities and shall be responsible for any damage to persons or property caused by such breaks.

When pipes or conduits providing service to adjoining buildings are broken during the progress of the work the Contractor shall have them repaired at once. Delays, such as would result in buildings being without service overnight or for needlessly long periods during the day, will not be tolerated and the HUD reserves the right to make repairs at the Contractor's expense without prior notification. Should it become necessary to move the position of a pipe, conduit or structure, such work shall be done by the Contractor in strict accordance with instructions given by the Engineer or the utility involved.

3.02 INSTALLATION OF SEWER PIPE AND ACCESSORIES

3.02.1 General - The Contractor shall use only experienced men in the final assembly of pipe in the trench and all pipes shall be laid in accordance with these Specifications and the recommended practice of the pipe manufacturer. Trench bottoms shall be carefully prepared, shall be free of water, and bedding, as specified, shall be in place.

Care shall be exercised to ensure that pipe of the proper strength or classification, meeting the Specifications in every respect, is provided at the site of pipe laying operations. Recommended tools, equipment, lubricant, and other accessories needed for proper assembly or installation of the pipes shall be provided at the site of the work. Any damaged or defective pipe discovered during the pipe laying operations shall be discarded and removed from the site of the pipe laying operations.

Alignment and grade shall be carefully maintained during the laying operations. The method used for maintaining grade and alignment must be acceptable to the

Engineer and must produce the desired results. The top of the bedding material must be brought to the exact grade and must be shaped so as to provide effective support for the bottom quadrant of the pipe except at the bells.

The Contractor shall exercise care in the storage and handling of pipe both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be carefully lowered into the trench piece by piece. Pipe and fittings shall be carefully inspected for defects and for dirt or other foreign material immediately before placing them in the trench. Suitable swabs shall be available at the site of laying operations and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench.

Whenever water lines cross over or under sewer lines the water line is to be encased in concrete. Minimum vertical separation between water and sewer is to be 18-inches.

3.02.2 Pipe Bedding and Envelope - Trench width from a point 1 foot above the top of the pipe (top of "pipe zone") down to bottom of trench shall be held to a minimum consistent with the provision of necessary space for proper assembly of the pipe. In general, the trench width shall not exceed the outside pipe diameter plus 16 inches.

A minimum of 6 inches of #67 crushed stone bedding shall be placed in the bottom of the trench to provide continuous support of the bottom quadrant of the pipe. The Contractor shall bring the crushed stone bedding up to the level required to provide support of the bottom quadrant and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe.

After the bedding has been shaped and the pipe has been installed the pipe shall be carefully backfilled with crushed stone bedding material placed by hand and compacted up to a level 12 inches above the top of the pipe.

The pipe bedding and envelope shall consist of clean, crushed stone, free from debris and other objectionable materials, placed in even layers simultaneously on each side of the pipe, and shall be thoroughly consolidated to completely fill the haunches of the pipe. Consolidation by jetting will not be allowed.

3.02.3 Pipelaying - After the pipe has been cleaned and inspected for defects and lowered into the trench the mating surfaces of the compression joint shall be wiped clean and coated with lubricant of a type supplied by the pipe manufacturer. The pipe shall then be assembled with due care being taken to ensure that the spigot end of the pipe is shoved home and that the pipe is left in proper grade and alignment.

Whenever pipe laying operations are to be discontinued for a period of time exceeding 2 hours the end of the pipe shall be carefully secured to avoid displacement or misalignment and a tight fitting plug or stopper shall be placed in the line. Upon resumption of laying operations the plug or stopper shall not be removed from the line until any water, mud or other debris has been removed to avoid entry into the completed section of the sewer.

Installation of sewer pipe shall conform to provisions of these Specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The proper gaskets and lubricants shall be furnished by the pipe manufacturer and lubricants shall be delivered to the job site in properly labeled unopened containers.

Wye branches or tees and other fittings shall be placed in the sewer line as shown on the drawings, or as directed by the Engineer, as pipe laying progresses. The Contractor shall keep accurate records of their location. Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions, the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave smooth end at right angles to the axis of the bore and the end shall be beveled or finished as required to make the joint without risk or damage to the gasket.

a. Laying Sewage Force Mains - Sewage force mains shall be constructed of C-900 DR-14 PVC pressure pipe as described in these specifications and as shown on the Construction Drawings.

   Trenches for sewage force mains shall be deep enough to provide no less than 30 inches of cover for installed pipe. The bottom of the trench shall be carefully graded to provide continuous support for the bottom quadrant of the pipe except at bell joints where bell holes shall be dug down to an elevation 6 inches below the outside of the pipe and 6 inches beyond the outside diameter of the pipe on the sides. The trench bottom shall be brought back to grade using crushed stone where excavation is removed from the bottom of the trench.

   The Contractor will be required to exercise care to maintain satisfactory grades and alignments and avoid unnecessary kinks, sags, or high points. Exact grades or centerline elevations are not indicated or required but grades shall be such as to provide a continuous upward slope to discharge point or other summit point where facilities for release of air shall be provided. In trenching for sewage force mains the Contractor will be required to excavate far enough ahead of pipe laying to be made. Should the Contractor fail to observe this precaution and encounter an obstruction necessitating adjustment in pipe grade or alignment he shall remove and replace such joints of pipe already laid as may be necessary in order to accomplish the desired correction without humps or sags.

   Changes in grade or alignment may be made by means of deflection in pipe joints provided that the recommended deflection as shown in published tables supplied by the pipe manufacturer are not exceeded and that the work required for the installation of the line does not encroach on adjoining property not within the granted easement. The Contractor shall have on hand at the site of work a table showing the permissible deflections whenever the pipe laying is in progress.

Assembly of the pipe joints shall be in accordance with the manufacturer's instructions using gaskets and lubricants supplied by the pipe manufacturer. Pipe fittings shall be supplied by the pipe manufacturer. Pipe fittings shall be provided as indicated on the Drawings as directed by the Engineer. Fittings shall be suitably braced in accordance with standard details to avoid the pipe from being blown apart due to internal pressure. Bracing shall be sufficient to withstand normal operating pressure plus 50 psi with due allowance for the character of soil against which the braces will be placed.

Detectable pipeline location tape shall be plastic composition film containing one layer of metalized foil laminated between two layers of inert plastic film specifically formulated for prolonged use underground. Tape shall be a minimum of 5.5 mils thickness, green in color, and continuously printed in permanent ink to indicate caution for a buried sewer line below.

All pressure sewers and force mains not constructed of ferrous material shall be installed with detectable tape and tracer wire.

Detectable tape shall be 3 inches wide and shall be an inert, bonded layer plastic with a metalized foil core and shall be highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The tape shall be brightly colored (Green) to contrast with soil and shall bear the imprint "CAUTION -- SEWER LINE BURIED BELOW." Tape shall be Terra-Tape as manufactured by Reef Industries, Inc. or approved equal.

Additionally, the Contractor shall provide and install a 14-gauge insulated copper wire on top of the newly installed PVC force main or pressure sewer main.

b. Laying PVC Sewer Pipe - Installation of the pipe shall be in strict accordance with ASTM Designation D-2321, Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe. Due precautions must be taken in placing the backfill under the pipe haunches and on the sides of the pipe to ensure proper support of the pipe and at the same time avoid any misalignment. Attention is called to the fact that these Specifications limit pipe diametric deflection to 5%.

After the pipe has been placed and brought to grade the pipe shall be held in place while crushed stone is carefully worked in around the pipe for firm support of bottom and sides. Extreme care shall be taken in backfilling around the pipe to avoid raising the pipe above the grade line but at the same time provide the required support. The crushed stone shall be placed in small quantities and distributed by hand up to the top of the pipe. Backfill shall be compacted on the sides by means of small hand tamps or vibrators but excessive tamping over the top of the pipe should be avoided.

Should the bottom or sides of the trench be unstable to the extent that firm support cannot be provided for the bottom or sides of the pipe the Engineer shall be notified so that suitable corrective measures may be authorized.

PVC pipe shall pass a go/no-go mandrel inspection sized to 95% of the pipe diameter of the actual pipe diameter after the pipe is in place and completely backfilled. No testing shall be performed on PVC pipe until after backfilling (see testing specifications).

c. Connections to Structures - Connections of pipes to manholes or other large structures shall be made using *Kor-N-Seal* or approved equal.

d. Connections to Existing System - No pipe shall be connected to the existing sewage system until all new upstream construction has been completed, tested, and is free of foreign materials and obvious defects have been corrected. In addition, approval must be given by the Sewer Department for connections. New lines must remain disconnected from the existing system by actual physical separation, by plugs of a type approved by the Sewer Department, or by other means approved by the Sewer Department. A note on the construction drawings stating this requirement shall be required for the approval of the drawings.

3.03 MANHOLES

Individual riser sections shall be furnished for the exact conditions to be encountered in the field. A maximum of 16-inches below casting will be allowed. Misalignment of pipe openings with the "cast in" resilient connectors or steps within the section or with other sections shall be cause for rejection.

Precast manhole sections shall be joined with male and female ends joined together to provide a smooth uniform joint which shall be structurally sound and watertight. A flexible, acid and alkali-sewage and water-resistant sealant equal to Ram-Nek as manufactured by K.T. Snyder Company, Inc. shall be applied to the joint surface for placement of the next manhole section, casting ring, or casting. A maximum of 3 precast manhole castings rings may be used to adjust the casting to final grade. All joints shall be wiped with Portland cement and brushed to a smooth finish

Manholes shall be constructed on Class "D" concrete slabs with flow channel. Flow channels shall consist of smooth uniform cross sections conforming to the cross section of the pipe so as to provide a minimum of turbulence and avoid deposition of solids. Flow channels shall have at least equal to ½ the pipe diameter. The finished flow of the manhole shall have a slope of approximately ½ inch from wall to channel to provide for proper drainage but, at the same time, offer a safe footing for workmen. A minimum fall of 0.1 foot shall be maintained across the manhole.

Manhole frames and covers and steps shall conform to Section 2 of these Specifications.

Manholes shall have diameters as indicated on the Drawings. Where 5-feet or larger diameter manholes are called for the diameter of the upper part of the barrel may be reduced to 4-feet when the specified diameter is maintained up to a point 5 feet above invert of incoming sewer or up to a point 2 feet above top of pipes entering or leaving manhole, whichever is greater. Manholes where air relief valves are installed shall have eccentric manholes and shown on the construction drawings or as directed by the engineer or sewer department.

Drop connections shall be provided whenever an incoming sewer enters the manhole 26-inches above the outlet to permit the use of the drop connection fittings. The top tee shall be ductile iron and the first joint extending from the tee shall be ductile iron. The ductile iron shall be tied into the PVC pipe with transition fittings. Drop connections shall be one size smaller than the incoming sewer except that the minimum size drop shall be 8 inches in diameter. Where drop connections are required the manhole base slab shall be extended to support the drop pipe and the entire drop pipe assembly shall be encased in Class "C" concrete having a minimum cover of 8 inches outside the pipe.

On precast manhole sections no pipe opening may be cut or enlarged by use of sledge hammer or other impact-type tool which could cause structural damage to the riser section.

Connections of pipes to manholes or other large structures shall be made using *Kor-N-Seal* or approved equal

Where shown on the Construction Drawings, or where directed by the Engineer, the Contractor shall install vents with odor control systems, where required, at manholes to provide for ventilation of the sewer line. Vents shall be installed in accordance with Standard Detail Drawings. Vent pipe shall be 4-inch ductile iron connected to the manhole as high as practicable while maintaining adequate cover on the vent pipe and vented at a minimum of 1-foot above 100 year flood elevation or as directed by the Engineer or Sewer Department.

Vent pipe shall have at least a 2-foot bury, sloped to drain from the support pole to the manhole, and be connected through the manhole wall with a non-shrink grout. Vent pipe shall be painted with 2 coats of bitumastic paint as approved by the Sewer Department.

For existing manhole sidewalls and/or inverts to be sealed, a Portland cement based hydraulic cement as manufactured by Preco Industries Ltd., Plainview, New York or equal shall be used for voids, brickwork joints, leaks, and/or invert.

See "Section 2 - Materials" regarding the requirement for XYPEX® C-1000 concrete admix for waterproofing and corrosive protection for all manholes.

For manholes located along or near creeks and Old Hickory Lake, all wetwells located within the system, or as directed by the Sewer Department the Contractor shall furnish and apply to the interior of manholes a resin based material to be used to form the sprayed monolithic liner covering all interior surfaces of the manhole including benches and inverts. The material shall be SprayWall as manufactured by Sprayroq or approved equal.

For materials to be used for sealant applications see Section 2 - Materials. The Contractor shall submit materials to be used to the Sewer Department for review and approval.

3.04 SERVICE CONNECTIONS

Sewer service lines shall be provided as shown on the Drawings or as directed by the Design Engineer. The service connection shall be made in the manner as directed with the size and type pipe as indicated. Service pipe shall be laid on a minimum slope of 1/4-inch per foot unless otherwise directed in writing. Excavation, laying and backfilling for service lines shall conform to applicable specifications for main sewer.

NOTE: 90° Bends are not permitted.

Service line connection shall include the furnishing and installation of 6-inch connection openings for riser pipes for existing and/or future house services. Opening shall be "Y" branches. The connection shall be plugged either at the "Y" connection, or at the end of the 6-inch service line.

Pipe stoppers for ductile iron service and main line pipe shall consist of standard cast iron bell and spigot caps and plugs.

Pipe stoppers for PVC service line pipe shall consist of 6-inch plastic quick caps w/stainless steel clamps as manufactured by Fernco, or approved equal.

Sewer service shall be installed to the property line, right-of-way, or easement line.

In the event that it should be necessary to install a service connection where a tee has not been provided, a new tee must be installed on the main line for the sewer service connection. New tee shall be installed using Shear Guard coupling or approved equal. No saddles shall be attached to the main sewer for service connection unless approved by HUD.

Excavation, laying and backfilling for service lines shall conform to the applicable specifications.

"As-Built" drawings submitted to the Sewer Department shall contain length, depth, distance from downstream manhole to service and shown on the drawings. A digital copy of the "AS-BUILT" drawings is to be provided to the Sewer Department upon completion of sewer installation and prior to final acceptance by the Sewer Department. All sewers must be televised and a copy furnished to the Sewer Department in either CD or DVD format. GPS location requirements as per section 1.06 Final Acceptance.

3.05 BACKFILL

General - Backfilling above the pipe envelope shall be carried out as expeditiously as possible but shall not be undertaken until the Engineer has been given the opportunity to inspect the work. The Contractor must carry out all backfilling operations with due regard to: the protection of pipes, structures and appurtenances; the use of prescribed backfill materials; and procedures to obtain the desired degree of compaction. No equipment or method may be used which will result in damage to or misalignment of the pipe.

Where crushed stone backfill is required the crushed stone shall be No. 67 size as designated by Tennessee Department of Transportation Standards for crushed stone used in road surfacing.

3.05.1

Backfill For Trenches - Backfill up to the spring line of the pipe shall be placed as pipe laying progresses in order to maintain proper grade and alignment. Additional backfill shall not be placed until after the pipe has been inspected by the Engineer or Sewer Department and approved for backfill.

Backfill to the spring line of pipe and to a depth of 12 inches above the top of pipe (pipe zone) shall be crushed stone placed by hand to avoid damage or misalignment of the pipe. Additional backfill may be placed by means of front-end loaders, bulldozers, or other suitable mechanical equipment subject to a 9-inch limitation of maximum thickness of layers placed before compaction.

In highways, streets, drives, or other paved or traveled areas or within 3 feet of these areas and where called for on the Drawings, the Contractor shall backfill entire trench with crushed stone which shall be placed in layers or lifts not exceeding 9 inches in thickness. After placing in layers, crushed stone shall be carefully compacted to maximum density or minimum volume. Stone backfill in areas other than as described above, and where directed by the Engineer or Sewer Department, shall be designated as crushed stone backfill.

Where the trench is located in open country or on public right-of-way more than 3 feet from the roadway or shoulder the backfill up to a point 12 inches above the top of the pipe shall be placed as specified under Pipe Bedding and Envelope. Above this point the backfill may consist of excavated material provided such material is selected to exclude rocks larger than 6 inches in any dimension. No rocks larger than 1-1/2 inches may be used in the top 6 inches in any dimension.

In wide, deep trenches the Engineer may, at his discretion, permit the use of rock larger than 6 inches in the backfill provided such rock is carefully placed in such a manner that the final position of the rock will not be within the vertical prism lying directly over the pipe or within 9 inches on either side of the pipe.

Sufficient care must be exercised to avoid leaving any holes or voids over, around, or under stones, boulders, or other backfill materials which may later be filled by leaching or settlement of surrounding material thereby causing future trench settlement. Where the Contractor desires to use excavated rock for backfill material and such rock meets the dimensional requirements as specified herein the Contractor shall provide additional backfill material of a suitable mature to fill the voids as required.

The Contractor shall be responsible for and shall protect all sewers, storm sewers and electric, telephone, water or other pipes or conduits against danger or damage while the trenches are being backfilled and from future settlement of the backfill. Where such damage should occur as a result of the Contractor's operations he shall repair such damage promptly to the Engineer's satisfaction.

The Contractor's attention is called to the fact that he will be held completely responsible for any damage to pavement, sidewalks, curbs, gutters, meter or valve boxes, street inlets, or other structure or appurtenances as a result of the Contractor's operations. It should be specifically noted that the Contractor shall be responsible for damage even though the character or nature of the original pavement or structure was such that it was not capable of carrying the load of the construction equipment regardless of the construction methods used.

3.05.2 Backfill at Manholes and Other Structures - Backfill around manholes located in highways, streets, or other traveled areas shall consist of #67 stone and shall be placed completely around the manhole to a point 12-inches above the sewer pipe. Backfill around manholes, piers, or other structures in locations not subject to traffic may consist of excavated material subject to the following restrictions:

1. No rock larger than 6 inches in any dimension shall be placed within 6 inches of the manhole walls or pipes entering or leaving the manhole.

2. No rock larger than 6 inches in any dimension shall be placed in the vertical prism above and extending 9 inches outside of the pipe lines.

3. Crushed stone shall be used under, around, and up to a point 12 inches over the tops of any pipes entering or leaving the manholes. This requirement shall include the inlet pipe for drop manholes.

4. Excavated material used for backfill shall be carefully placed in layers not exceeding 9 inches and compacted in such manner as to fill all voids and prevent excessive settlement.

3.05.3 Backfill for Force Mains - Backfill around sewage force mains of ductile iron areas shall consist of selected excavated material or fine dry earth placed by hand around both sides of the pipe and tamped to eliminate voids and provide firm support for the pipe. The selected backfill shall be compacted in 4 inch layers and shall be continued in this manner until the backfill has been placed to a finished depth of 12 inches over the top of the pipe. No rocks or stone larger than 2 inches shall be included in the selected backfill around the pipe. Where PVC pipe is permitted by the Sewer Department backfill shall consist of hand-placed crushed stone placed in 4-inch to 6-inch layers and worked into place around pipe to a finished depth of 12 inches over the top of the pipe.

After the backfill has been placed and compacted in layers to a depth of 12 inches above the top of the pipe the remainder of the backfill may be placed by machine and compacted by running suitable wheel type construction equipment along the ditch provided that no rock larger than 6 inches in any dimension is included within the backfill and no rock larger than 1-1/2 inches is included in the top 6 inches. Should the Contractor fail, refuse, or neglect to systematically exclude or remove oversize rock from the backfill material he may be required to place and compact the backfill by other suitable methods which will permit the rocks to be detected and removed.

In areas subject to light traffic or under temporary type pavement the backfill shall be the same as provided above except that the backfill must be placed and compacted in 12-inch layers all the way to the top of the trench.

Under highways, roadways, streets or parking lots having permanent type pavement or heavy traffic, when indicated on approved construction drawings, the backfill shall consist of crushed stone placed in 4-inch to 6-inch layers and thoroughly compacted up to the top of the trench.

3.06 PAVEMENT REMOVAL

Where existing paved streets, roads, parking lots, drives, or sidewalks must be disturbed during construction of the project the Contractor shall take necessary steps to minimize damage. Permanent type pavement shall be cut or sawed in a straight line before removal and care shall be taken during excavation to avoid damage to adjacent pavement. Where trucks or other heavy equipment must cross curbs or sidewalks such areas shall be suitably protected. A Street Cut Permit shall be obtained from the City of Hendersonville Public Works Department prior to commencement of any work within the right-of-way.

3.07 PAVEMENT REPLACEMENT

In paved roads or where sidewalks, curbs, gutters or driveways have been damaged by the Contractor and where replacement of surfaces or damaged items is required, items shall be repaired or replaced without any needless delay in the best workmanlike manner with same kind of materials as were removed or damaged in the construction operation. Underlying foundation courses of roads, finished surface, etc. shall conform to undisturbed portions of damaged items and shall, in every respect, be equal to quality materials and workmanship in original undisturbed item. Decision of the Engineer shall be final as to classification of any form of pavement or surfacing not specified on project drawings or any forms of pavement or surfacing where classification is at all doubtful. Should Contractor fail or refuse to repair any damage after receiving directions of the Engineer the Sewer Department may, after 24 hours written notice, employ such force and furnish such materials as may be necessary to do the work with cost to be billed to Contractor. Final acceptance of the repair(s) shall be the responsibility of the City of Hendersonville Public Works Department. All asphalt repairs must be approved by the City of Hendersonville Public Works Director.

3.08 CLEAN-UP PROCEDURES AND REQUIREMENTS

The Contractor shall not remove from the line of work any excavated material which may be suitable for backfilling or surfacing until the excavation has been refilled and surfaced without the permission of the Engineer or Sewer Department.

Upon completion of backfilling and when in areas of existing development, the Contractor must at once begin the removal of all material except that actually necessary to provide for the settlement of the fill. Contractor shall also remove all the pipe and other material placed or left on the street except material needed for the replacement of paving and the street shall be opened and made passable for traffic. Following the above work the repairing and complete restoration of the street surfaces, bridges, crossings, and all places affected by the work shall be done as promptly as possible.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable conditions. Contractor will be required to re-grass lawns or neutral grounds where trenches are excavated in these locations or where Contractor has damaged lawns or neutral grounds by his operations.

The Engineer or Sewer Department shall be sole authority in determining when rough and final clean-up shall occur. Rough clean-up shall consist of removal of rocks larger than one foot in any dimension, grading of excess backfill material over pipe line or removal of sand material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or roadway and restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same. In general rough clean-up shall commence no later than one day after pipe laying and backfilling or no farther behind pipe laying operations than 1,000 feet, whichever time limit is shortest. Final clean-up consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking with seeding, strawing, etc. of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items shall, in general, be prosecuted no later than 2 to 3 weeks after pipe has been laid and backfilled.

3.9 SLOPE PROTECTION AND EROSION CONTROL

The City of Hendersonville Public Works Department is the responsible party for compliance with all applicable standards of Stormwater Pollution Control. Developers/Contractors are directed to obtain information and approval(s) from the Public Works Department.

Note: The Developer/Contractor's attention is directed to the fact that a permit from the Division of Water Pollution Control might be required for aquatic resource alteration for work in and/or around streams.

3.10 SEWER LINE VIDEOTAPING

A remote controlled, adequately lit camera that will travel the length of each section of gravity sewer at a rate of no more than 30 feet per second from manhole to manhole shall be used to televise all newly installed sewers. The camera shall be of design and manufacture for the express purpose of televising sanitary sewer mains. The camera's path shall be recorded with an on-screen display of footage traveled. Auditory notations by the camera operator regarding locations of service connections, pipe defects, indications of faulty installation and all other important points of interest shall be recorded as a permanent record. Video quality of the recording shall be such that the condition of all interior sections of the sewer main and service laterals on that section shall be easily identifiable. Audio quality shall be adequate to clearly understand remarks by the camera operator. The camera shall allow for articulation that enables a clear view of service laterals in a direction perpendicular to the direction of the sewer main and at a variety of vertical angles to allow viewing of laterals at varying slopes. The image must be clear to the test cap or first bend and clean-out on the service lateral.

The contractor or developer shall deliver to the Hendersonville Utility District on CD-ROM or DVD media two (2) copies of digital files that represent the videotaping of all sewer mains in a project or development. The disk and its jacket shall be clearly labeled with the name of the of the project or development and its phase or section as well as the installation date. The video record of each section of the sewer main between manholes shall be represented by a separate MPEG format digital file. Each file shall be labeled according to a naming convention provided by the Sewer Department. All references to manholes and sewer mains with regard to videotaping shall be by the same naming convention as that shown on construction plans approved by the Sewer Department. An index file shall be provided with each disc that explains the meaning of each file name and the company that produced it. Additionally, two (2) sets of hard copy printouts of the sewer main noting distances to services, the downstream manhole and other defects or points of interest shall be provided.

3.11 GPS LOCATION REQUIREMENTS

The Contractor shall be required prior to closeout of the project to provide GPS XY coordinates for all new manholes and clean-outs. The GPS data shall be of high accuracy mapping quality, capable of reliability delivering sub-meter accuracy. All data shall be provided to the Engineer for inclusion with the Record Drawings. All costs associated with this requirement shall be merged into unit price bid items for new manholes and cleanout assemblies.

3.12 MANHOLE SEALING AND PROTECTIVE COATING

Manhole sidewall, invert, and bench sealing and rehabilitation shall be performed on existing manholes indicated or as directed by the Engineer. The sealing of sidewalls and inverts in the manhole shall conform to the following specifications and Section 2 - Materials.

The manhole coating and sealing materials as allowed in Section 2 - Materials shall be applied in strict accordance with manufacturer's recommendations and as approved by the Engineer. Covers are to be placed over the invert to prevent extraneous material from entering the sewer lines prior to cleaning.

Safety regulations and precautions set out by the manufacturer and OSHA shall be strictly observed.

All foreign material shall be removed from the manhole wall and bench using a high-pressure water spray (minimum 3000 psi). Unusual conditions such as heavy grease build-up or residues of industrial or processing wastes may require sand-blasting or chemical cleaning. Loose and protruding brick, mortar, and concrete shall be removed using a masons hammer and chisel and/or scrapper. Any large voids shall be filled with the specified quick patching mix Strong-Seal® QSR. Active leaks shall be stopped using quick setting mix Strong-Plug or Hendersonville Utility District approved equal according to manufacturer's recommendations. Some leaks may require weep holes to localize the infiltration during the application. Then weep holes are to be plugged with approved quick setting material prior to the application of the final coat.

Invert repair shall be performed on all inverts with visible damage or where infiltration is present or when vacuum testing is required. After blocking flow through manhole and thoroughly cleaning invert, the quick setting patch material shall be applied in the invert in an expeditious manner and in such a thickness as to not alter the slope across the manhole. The material shall be trowled uniformly onto the damaged invert at a minimum thickness at the invert extending out onto the bench of the manhole sufficiently to tie into the structural monolithic liner to the spray applied. The finished invert surfaces shall be smooth and free of ridges. Flow shall be re-established in the manhole within 30 minutes after placement of the material.

This work shall be done in complete accordance with the manufacturer's recommendations. For material requirements see Section 2 - Materials.

Materials shall be spray applied up to one (1) inch thick in one or more passes from the bottom of the frame; however, minimum total thickness shall not be less than ½ inch. The surface shall then be trowled to a relatively smooth finish being careful not to over trowel. A brush finish shall be applied to the trowel-finish surface. Manufacturer's recommendations shall be followed whenever more than 24 hours have elapsed between applications. Benches shall be sprayed with materials mixed per specifications and spray applied in such a manner that a gradual slope is produced from the walls to the invert with the thickness at the invert to be no less than ½ inch. The wall / bench intersection shall be rounded to a uniform radius the full circumference of the intersection. All Mixing shall be as per the manufacturer's recommendations.

The sealant coatings shall be applied and be capable of withstanding a hydrostatic pressure of 7 psi (16 feet of water).

This sealing and waterproofing procedure shall be applied to the sidewalls, base, invert, and benches. As necessary to accomplish this work, the Contractor shall control the sewage flow through the manhole.

No application shall be made if the ambient temperature is below 40 degrees Fahrenheit. No application shall be made to frozen surfaces or if freezing is expected to occur within the substrate within 24 hours after application. Precautions shall be taken to keep the mix temperatures at time of application below 90 degrees Fahrenheit. Water temperature shall not exceed 80 degrees Fahrenheit.

After all sealing, the Engineer and Contractor shall inspect the sealed manholes after rainfall events have sufficiently raised the ground water table. See Section 4 - Testing and Acceptance for other requirements including vacuum testing.

This inspection shall be scheduled at a time to be determined by the Engineer.

Pre-construction and post-construction photographs required for all manholes rehabilitated on this Project.

All manholes which do not pass this inspection / testing shall be resealed to Owner's satisfaction.

This inspection shall be scheduled at a time to be determined by the Owner.

See Special Condition to Contract for requirements of the Contractor to provide pre-construction and post-construction photographs for all manholes rehabilitated on this Project.

Manholes which do not pass this inspection / testing shall be resealed and re-inspected.

* * *

SECTION 4 - TESTING

4.01 GENERAL

Testing and inspection of the completed work shall be accomplished by one or more of the following methods:

1. Visual and Video Inspection
2. Air Pressure Testing
3. Infiltration Test (Leakage Tests)
4. Roundness Testing
5. Vacuum Testing of Manholes

Prior to testing and final inspection of the completed work by the Sewer Department an inspection and testing fee as established by the Hendersonville Utility District must be paid by the contractor or developer to the Hendersonville Utility District.

Upon completion of construction the Contractor shall remove all sand, dirt, brick and other foreign materials from the sewers and shall conduct his own inspection to locate any defects and determine when the sewers are ready for final inspection, testing, and acceptance by the Engineer. After all apparent defects have been corrected the Contractor shall notify the Engineer and request a final inspection.

No sewer line shall be allowed to discharge into the existing sewage system until said line is free of foreign materials and obvious defects have been corrected. New lines, then, must remain disconnected from the existing sewer system by actual physical separation, by plugs of type approved by the Sewer Department, or by other means approved by the Sewer Department.

Testing of the system before final inspection by the Sewer Department shall consist of visual observation and leakage tests conducted by the Engineer and observed by the Sewer Department. The Sewer Department will not conduct a final inspection until receiving written notification from the Engineer that the construction is completed in accordance with approved drawings and specifications. This notification shall include a report of the results of the visual observation and leakage tests. Upon final inspection and testing of the proposed sewer additions the contractor or developer shall deliver to the Hendersonville Utility District on CD-ROM or DVD media two (2) copies of digital files that represent the videotaping of all sewer mains in a project or development.

4.02 VISUAL AND VIDEO INSPECTION

The Engineer or Sewer Department shall make visual inspection of pipe, fittings, and other materials to be incorporated into the work before they are installed. Items found to be defective or otherwise not in accordance with Drawings and Specifications shall be immediately removed from the site of the work.

Visual inspection of pipe, joints, manholes, etc. will proceed as work is being done and no backfill shall be placed until this is accomplished unless otherwise approved by the Engineer or Sewer Department. Acceptance of work at this stage in no way relieves Contractor of responsibility and does not preclude testing by any of the following methods at the discretion of the Engineer or Sewer Department.

On completion of the work, all sewers and manholes will be inspected for foreign matter, including sand and mud brought in by infiltration or inflow, and any such matter shall be

removed before final acceptance of lines. If visual and/or video inspection of lines, manholes, or other items reveals leaks, structural failures, or other defects, the Contractor shall repair such immediately. Any sags, humps, bends, or other evidence of misalignment - regardless of the type of pipe - if in the opinion of the Engineer or Sewer Department is detrimental to the operation of the system, shall be cause for rejection. Inspection will include observation of clean-up, property restoration, pavement replacement, etc. Any defects must be corrected to a satisfactory condition before acceptance.

4.03 AIR PRESSURE TEST

Air pressure tests shall be required for all lines. Equipment shall be top quality, in good condition, and approved by Engineer or Sewer Department for use on this Project. Plugs should have a sealing length equal to or greater than the diameter of pipe being tested. External bracing of the plugs should not be required in order for the plug to hold against internal air pressure. The test equipment shall include accurate pressure gages to monitor test pressure, safety relief valve(s), and quick-release air bleed valve(s).

1. The procedure for air pressure testing shall conform to ASTM C-828 unless modified herein.

2. After backfilling cleaning the line (including flushing if necessary), completing a 30 day waiting period, insuring all service plugs are adequately braced against internal pipe pressure and checking air test equipment including pipe plugs (suitably graded against internal pipe pressure if necessary) the sewer line section to be tested shall be pressurized to 5 psig (pounds per square inch-gauge) greater than the average back pressure of any groundwater that may be over the pipe (2.31 feet of water - 1 psig). At least 2 minutes shall be allowed for air pressure to stabilize. After the stabilization period and with 3.5 psig minimum pressure in pipeline air supply shall be disconnected and the time observed which results in a 1 psig pressure drop.

3. The portion of line being tested shall be termed "Acceptable" if the time required for the pressure to drop from the stabilized 3.5 psig to 2.5 psig (greater than the average back pressure of any groundwater over pipe) is more than or equal to minimum calculated test time as determined by using the following table:

PIPE DIA. inches	TIME minutes	LENGTH* feet
8	4.2	350
10	4.7	275
12	5.7	225
15	7.0	175
18	8.5	150
21	9.9	125
24 or Larger	11.3	125

* Shorter or longer test length shall have test time modified in accordance with Engineer or Sewer Department's decision.

4. If the pipe is tested in a "dry" condition and fails to meet the test specifications allow for the pipe to be wetted and tested in that condition. Initial testing may be in the "dry" or "wet" condition at the Contractor's option.

5. Observe safety precautions during test. Caution all workers to remain clear of test plugs which can blow out under considerable force at any time the line is pressurized.

4.04 ROUNDNESS TEST

Sewers constructed of PVC pipe shall pass a go/no-go mandrel sized to 95% of the actual pipe diameter with the pipe in place and backfill completed.

Contractor shall provide a suitable ball or mandrel having a diameter equal to 95% of the actual inside pipe diameter which he shall pull through each section of pipe while the Engineer observes the test. Any section of sewer showing a deflection of more than 5% of the actual inside diameter shall be considered to have failed and shall be re-laid to correct the condition. Mandrel shall be pulled without mechanical pulling devices and shall not be performed until a minimum of 30 days after backfilling operations.

4.05 INFILTRATION TEST (LEAKAGE TESTS)

In addition to any other testing which may be required any infiltration observed in any section of sewer shall be measured by using flow weirs. The weir test shall be made on the flow of water from sewers in not over 1,000 foot sections at any one time when, in Engineer's opinion, groundwater level is at highest point during a normal year. Contractor shall furnish all weirs, other materials, and labor required for such test. Weirs shall be in good condition and approved for the intended use by the Engineer. Engineer shall be responsible only for direction, reading, recording data, and calculating infiltration rates.

Maximum allowable infiltration shall be 25 gallons per mile per inch diameter per 24 hour period but in no case shall exceed 1,500 gallons per mile of pipe per day for pipe 30 inches in diameter or larger. Joints shall be tight and leakage in excess of that specified herein shall be repaired.

The Infiltration Test shall not be relied on as the sole indicator of leakage if groundwater is determined to be less than 2 feet over the top of the pipe.

If the quantity of infiltration is in excess of the maximum quantity specified above the joints shall be remade, the sewer re-laid, or other work performed by and at the expense of the Contractor in order to reduce the amount of leakage to an amount within the limits specified. The test will be repeated until the section of sewer passes the test requirements.

All visible leaks in pipes and manholes must be corrected regardless of the amount of infiltration.

4.05.1 Exfiltration Test - In case period of year of highest groundwater is not available before sewer is needed by the Owner exfiltration testing may be used by the Contractor if approved by the Engineer.

Such testing shall be done between manhole segments by plugging the incoming lines on the downstream manhole and the upstream manhole. The method of filling the sewer with water shall be approved before use by the Engineer and extreme care shall be used in conducting the test to avoid damage to the main sewer, service laterals, and service plugs. The line shall be filled slowly in such a

manner to allow exhausting of air from the line as it fills. Suitable methods of measuring leakage rate shall be utilized as approved by the Engineer. Generally exfiltration testing will not be used on line segments where the water elevation at the upstream manhole is more than 5 feet above the invert elevation at the downstream manhole so that pipe joints will not be subject to excessive internal pressures.

Maximum allowable exfiltration rate shall be 25 gallons per mile per inch diameter per 24-hour period but in no case shall exfiltration exceed 1,500 gallons per mile per day for pipe 30 inches in diameter or larger.

If the quantity of exfiltration is in excess of the maximum quantity specified above the joints shall be remade, the sewer re-laid, or other work performed by and at the expense of the Contractor in order to reduce the amount of leakage to an amount within the limits specified. The test will be repeated until the section of sewer passes the test requirements.

4.06 VACUUM TESTING OF MANHOLES

All new manholes and all existing manholes which are rehabilitated/ waterproofed and sealed on this project will be required to pass a vacuum test of at least 10" Hg. prior to acceptance. All test shall be done in accordance with ASTM C1244, latest edition for manhole testing requirements. This test shall be considered acceptable if the vacuum remains at 10" Hg. or drops to no less than 9" Hg. within one (1) minute. If the manhole fails the initial test, the Contractor shall locate the leak and make appropriate repairs acceptable to the Engineer in preparation for additional tests.

It is also called to the Contractor's attention that he will be required to furnish all equipment necessary for this test including the manhole sealing apparatus, gauges, pump, plugs, and operating personnel.

The cost of this work shall be merged into the unit price bid for manholes or manhole rehabilitation/sealing, and no additional payment will be allowed.

If testing is done prior to backfilling around the manhole, then the following test time apply. Minimum Test times for Various Manhole Diameters in Seconds are shown in following Table #1:

	Diameter, in.					
Depth (ft)	36	48	60	72	84	96
<4	7	10	13	16	19	23
6	11	15	20	25	29	34
8	14	20	26	33	38	45
10	18	25	33	41	48	56
12	21	30	39	59	57	67
14	25	35	46	57	67	78
16	29	40	52	67	76	89
18	32	45	59	73	86	100

20	35	50	65	81	95	111
22	39	55	72	89	105	122
24	42	59	78	97	114	133
26	46	64	85	105	124	144

If testing is done after backfilling around manhole is done, then the testing time requirements are as follows:

MANHOLE DEPTH	DIAMETER	TIME TO DROP 1" HG
10 feet or less	4 feet	75 seconds
10 feet to 15 feet	4 feet	90 seconds
15 feet to 25 feet	4 feet	105 seconds

For manholes 5 feet in diameter, add an additional 15 seconds; for manholes 6 feet in diameter, add an additional 30 seconds; and for 7 feet in diameter, add an additional 45 seconds, to the time requirements for 4-foot diameter manholes.

It is also called to the Contractor's attention that he will be required to furnish all equipment necessary for this test including the manhole sealing apparatus, gauges, pump, plugs, and operating personnel. All vacuum testing is to be done after binder has been installed.

4.07 TESTING FORCE MAINS AND PRESSURE SEWERS

Before final acceptance force mains shall be pressure tested by suitably closing the end of the main with a test plug of approved design suitably braced against the internal pressure to prevent blowout and possible injury to personnel. Contractor shall furnish all labor, materials, and equipment for testing the force main including, but not limited to, water for testing, test pump, pressure gauges, test plugs, etc. Test shall be performed by the Contractor and witnessed by the Owner or his authorized representative.

The force main shall be filled with water taking care to eliminate air from the high points. A positive displacement test pump shall be used to pump clean water into the main to build up a test pressure equal to the normal system pressure plus 50 psi with a maximum test pressure of 100 psi. Test pressure will be determined by the Engineer. The test pump shall then be valved off from the system and the pressure shall be observed over a period of one hour. A drop in pressure of 5 psi or more during the one-hour test period shall be taken as an indication of leakage. In the event leaks are found and corrected the Contractor shall repeat the pressure test using the same procedure described above. Should the Contractor be unable to obtain a satisfactory pressure test over a duration of one hour he shall then be required to perform a leakage test using a water tap and standard water meter to measure the leakage in the test section at system pressure over a period of 24 hours. Leakage during the 24-hour period must not exceed the allowable leakage for mechanical or push-on joints as shown in AWWA C600, latest revision. Leakage shall not exceed the quantity determined by the formula: $L = (SDP^{.5})$ divided by 133,200 where L is the allowable leakage in gallons per hour; S is the length of pipe tested, in feet; D is the nominal pipe diameter in inches; and P is the average test pressure during the leakage test in pounds per square inch.

Should the system fail to pass the leakage test the Contractor will be required to locate and correct the leaks and to retest the system until satisfactory results can be obtained.

The Contractor shall provide suitable first quality pressure gauges with 5 lb. or smaller graduations and a standard 3/4 x 5/8-inch water meter in the event the meter is required for the leakage test. Pressure gauges and water meter shall be in good condition and shall be subject to such tests for proof of accuracy as the Owner or his authorized representative may require.

4.08 TESTING OF VALVES

Upon completion of the work the Contractor/Developer shall operate all buried valves in the presence of the Engineer or Sewer Department to verify proper operation of each valve.

* * *

SECTION 5 - GREASE TRAP, SAND/GRIT, OIL/WATER POLICY - (ONLY REQUIRED FOR COMMERCIAL AND INDUSTRIAL CUSTOMERS)

5.01 GENERAL

All commercial and industrial customers that generate fats, oils, or grease shall install a grease trap or grease trap interceptor as required by the Hendersonville Utility District. The purpose of the grease trap, grease trap interceptor, or grease and oil interceptor) is to create conditions that allow separation and retention of suspended grease from wastewater prior to the wastewater entering the sanitary sewer system. Proposed designs with specifications, sources or certification shall be submitted for review and approval by the Hendersonville Utility District.

The successful removal of grease from wastewater is the responsibility of the owner/user of the grease trap. Damages and blockages sustained by the public sewer system resulting from inadequate or improper removal of grease from the wastewater are the liability of the owner/user of the grease trap. Routine cleaning and/or pumping at prescribed intervals shall be required.

Owners/users of the grease trap shall maintain dated records of these operations in an accessible location in ready view and shall make such records available upon request to officials of the Hendersonville Utility District. Owners/users of grease trap(s) shall comply with the current Hendersonville Utility District's policies, regulations, and procedures.

Trapzilla® type grease traps can be used at existing structures only or for upgrades upon approval by Hendersonville Utility District personnel. They are not permitted for use at any new buildings.

5.02 PRE-CAST CONCRETE GREASE TRAP INTERCEPTOR SIZING

The minimum volume of a pre-cast concrete interceptor shall be 2,000 gallons. Installation of grease trap interceptors in series shall be required when the required effective capacity of the grease interceptor is greater than 2,000 gallons. All grease interceptors shall have a H-20 rating.

5.03 PIPING

The inlet and outlet piping shall have a clean-out tee installed.

Inlet piping shall enter the receiving chamber 2-1/2 inches above the invert of the outlet piping. On the inlet pipe inside the receiving chamber, a 4 inch inside diameter sanitary tee in the vertical position with the top unplugged shall be provided as a turndown. To provide air circulation and to prevent "air lock", a pipe (nipple) shall be installed in the top of the tee and extend to a minimum of 6 inches of clearance from the interceptor ceiling, but not less than the inlet pipe diameter. A pipe shall be installed in the bottom of the tee to extend to a point 24 inches below the water level. (See Detail)

The outlet piping shall be the same size as the inlet piping, but in no case smaller than 4 inches inside diameter. The outlet piping shall start 12 inches above the floor of the interceptor. Outlet piping shall contain a tee installed horizontally with the top opening containing a removable plug to receive a cleaning snake to the downstream direction (See Detail).

5.04 BAFFLES

Grease interceptors shall have a concrete baffle the full width of the interceptor, extending from the floor to within 6 inches of the ceiling. The baffle shall have an inverted 90 degree sweep fitting at least equal in diameter size to the inlet piping, but not less than 4 inches inside diameter. The bottom of the sweep shall be placed in the vertical position in the inlet compartment 12 inches above the floor. The sweep shall rise to the horizontal position and extend through the baffle to the outlet compartment. The baffle wall shall be sealed to the sweep. (See Detail)

The inlet compartment shall be 2/3 of the total liquid capacity with the outlet compartment at 1/3 the liquid capacity of the interceptor. The minimum depth of the liquid capacity shall be 42 inches.

5.05 MANHOLES (ACCESS OPENING)

Access to grease interceptors shall be provided by two (2 manholes with 24-inch minimum dimensions terminating 1 inch above finished grade with a H-20 cast iron frame and cover. "Sewer" shall be cast in the cover. An 8-inch thick concrete pad extending a minimum of 12 inches beyond the outside dimension of the manhole frame shall be provided. One manhole shall be located above the inlet tee and the other manhole shall be located above the outlet tee. A minimum of 24 inches of clear opening above each manhole access shall be maintained to facilitate maintenance, cleaning, pumping and inspections.

Access openings shall be sealed water and gas tight to contain odors and bacteria, and to exclude insects, vermin and ground water.

5.06 LOCATION AND OPERATION

Grease traps or oil and grease separators shall be located so as to be readily accessible for cleaning, maintenance and inspections. Grease traps should be located close to the fixture(s) discharging greasy water.

Grease traps shall be cleaned routinely at prescribed intervals. Removal of grease from wastewater routed to public or private sanitary sewer system is the responsibility of the user /owner of the grease trap/

5.07 GREASE TRAP MATERIAL

Grease interceptors shall be constructed of sound durable materials, not subject to excessive corrosion or decay, and shall be water and gas tight. Each interceptor shall be structurally designed to withstand any anticipated load to be applied on the interceptors such as vehicular traffic in parking or driving areas.

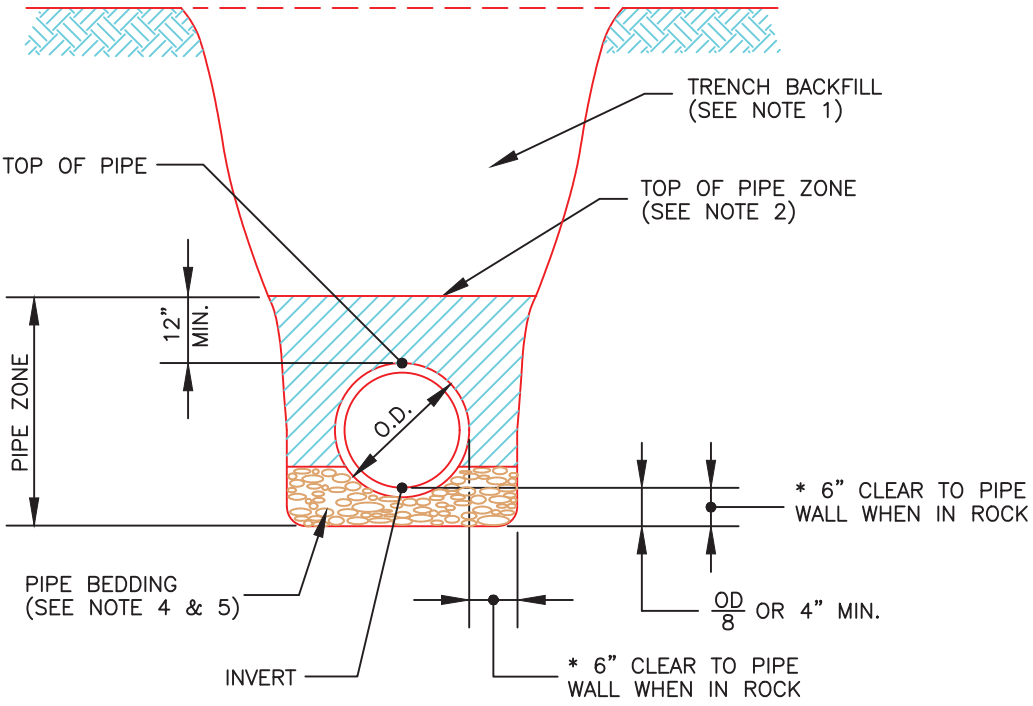
5.08 OIL / GRIT AND OIL / WATER SEPARATORS

All new businesses or industries that wash cars shall be required to install sand/grit and oil/water separators in accordance with the standard details shown at the end of this Division – 2. For all new businesses or industries that use petroleum base products in their day to day activities will be required to install and oil/water separator if they operate with an open floor drain in accordance with the standard details shown at the end of this Division – 2.

* * *

NOTES:

1. SEE STANDARD SPECIFICATIONS FOR BACKFILL REQUIREMENTS.
2. "PIPE ZONE" EXTENDS TO 12" ABOVE TOP OF PIPE AND BACKFILL IS TO BE CRUSHED STONE, GRAVEL OR OTHER GRANDULAR MATERIAL AS APPROVED BY THE ENGINEER.
3. LIMIT TRENCH WIDTH AT TOP OF PIPE ZONE TO O.D. + 16" UNLESS PERMITTED OTHERWISE BY ENGINEER.
4. PIPE BEDDING IS TO BE CRUSHED STONE, GRAVEL OR OTHER GRANDULAR MATERIAL AS APPROVED BY ENGINEER. DEPTH UNDER BOTTOM OF PIPE IS TO BE 1/8 O.D. OF PIPE OR 4", WHICHEVER IS GREATER *.
5. PIPE IS TO BE CONTINUOUSLY SUPPORTED ALONG LENGTH OF PIPE BARREL EXCEPT AT BELLS. BELL HOLES ARE REQUIRED SUCH THAT NO BEARING LOAD IS TAKEN BY THE BELL.



TYPICAL SEWER INSTALLATION

NOT TO SCALE

CONSTRUCTION NOTES

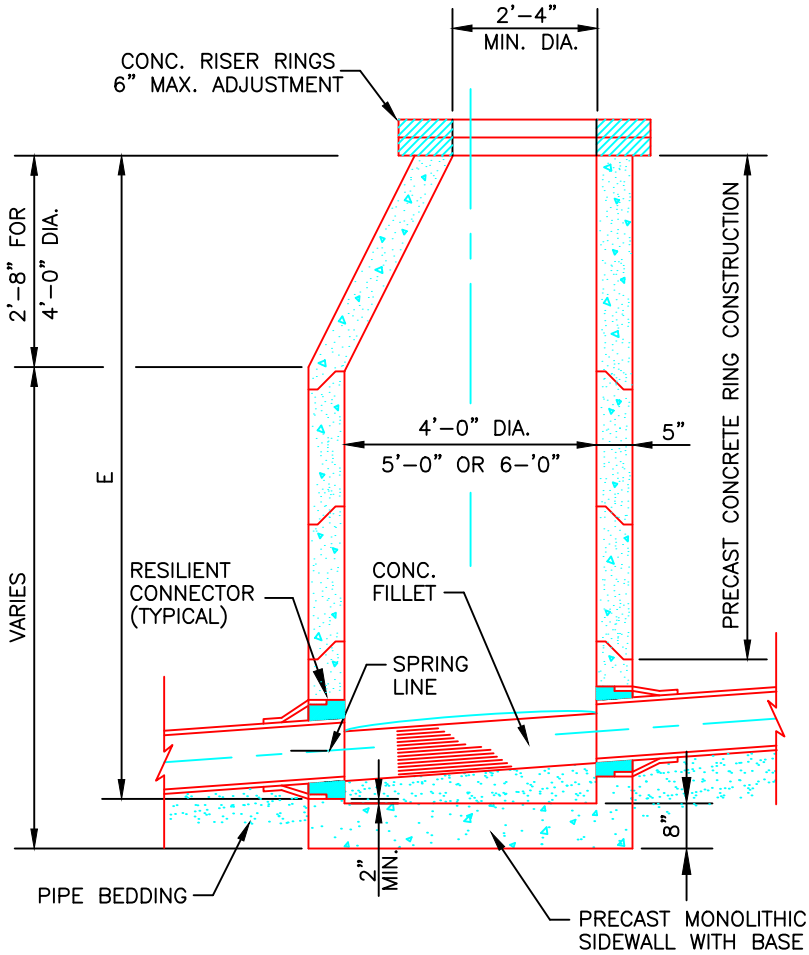
CYLINDRICAL SECTIONS OF ALL MANHOLES SHALL BE CONSTRUCTED OF PRECAST CONCRETE RINGS AS DESIGNED IN THE PROJECT SPECIFICATIONS OF THE CONTRACT DOCUMENT.

ECCENTRIC CONES SHALL BE USED ON PRECAST CONCRETE AND CONCRETE UNITS.

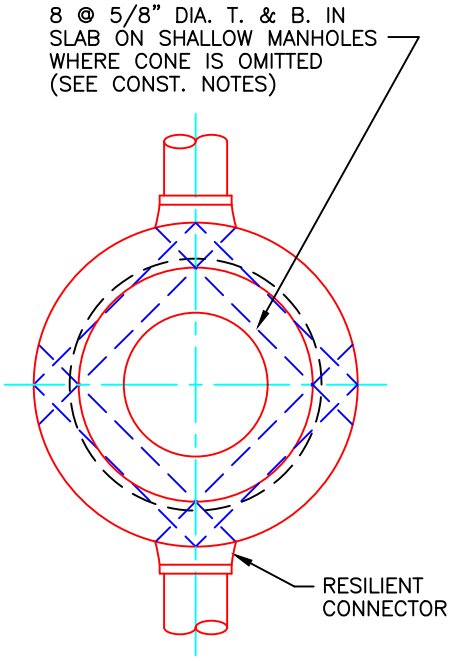
DIMENSION "E" VARIES. WHEN LESS THAN 5-FEET OMIT CONE AND EXTEND CYLINDRICAL MANHOLE SIDEWALL SECTION TO AN ELEVATION 8-INCHES BELOW BOTTOM OF ADJUSTING RING. CONSTRUCT 8-INCH THICK CONCRETE SLAB ON TOP OF CYLINDRICAL SECTION REINFORCED WITH 5/8-INCH DIA. BARS AS SHOWN. PROVIDE 28-INCH DIAMETER OPENING IN SLAB FOR MANHOLE'S FRAME AND ADJUSTMENT RINGS AS ON CONED MANHOLE REQUIRED IN DEAD END MANHOLES, ALTHOUGH BOTTOM TO BE PROPERLY DISHED.

NOTE: ALL 72-INCH PRECAST MANHOLES WHICH ARE OF SUFFICIENT DEPTHS SHALL BE INSTALLED UTILIZING A 72-INCH DIAMETER TO 48-INCH DIAMETER MANHOLE TRANSITION SECTION WITH THE TOP PORTION OF SIDEWALL INCLUDING THE ECCENTRIC CONE SECTION BEING 48-INCH DIAMETER. THE COST OF THE 72"x48" TRANSITION SECTION SHALL BE MERGED INTO THE UNIT PRICE BID FOR 48-INCH DIAMETER MANHOLE SIDEWALL.

NOTE: GRANULAR BACKFILL MATERIAL SHALL BE PLACED ADJACENT TO MANHOLE IN AREAS WHERE SWELLING CLAY EXIST.



SECTION

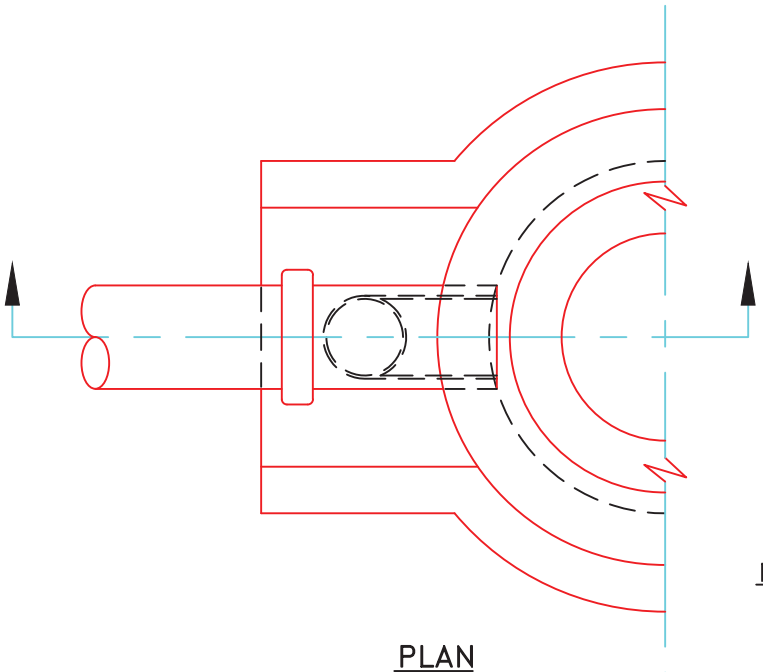


PLAN

STANDARD MANHOLE

NOT TO SCALE

HENDERSONVILLE UTILITY DISTRICT	STANDARD DETAIL	S-2



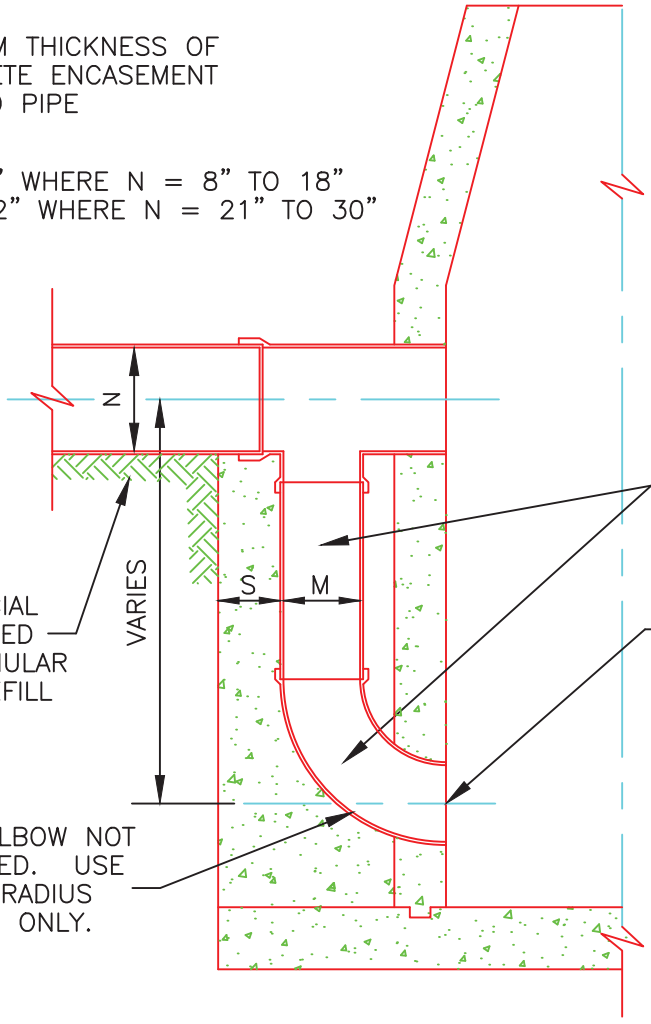
PLAN

NOTE:

DROP TEE SHALL BE DUCTILE IRON. ONE FULL JOINT OF D.I.P. SHALL BE LAID OUT OF DROP TEE. IF PVC PIPE IS USED FOR THE LINE A FULL BODY SLEEVE WILL BE USED FOR THE TRANSITION.

S = 8"
MINIMUM THICKNESS OF CONCRETE ENCASEMENT AROUND PIPE

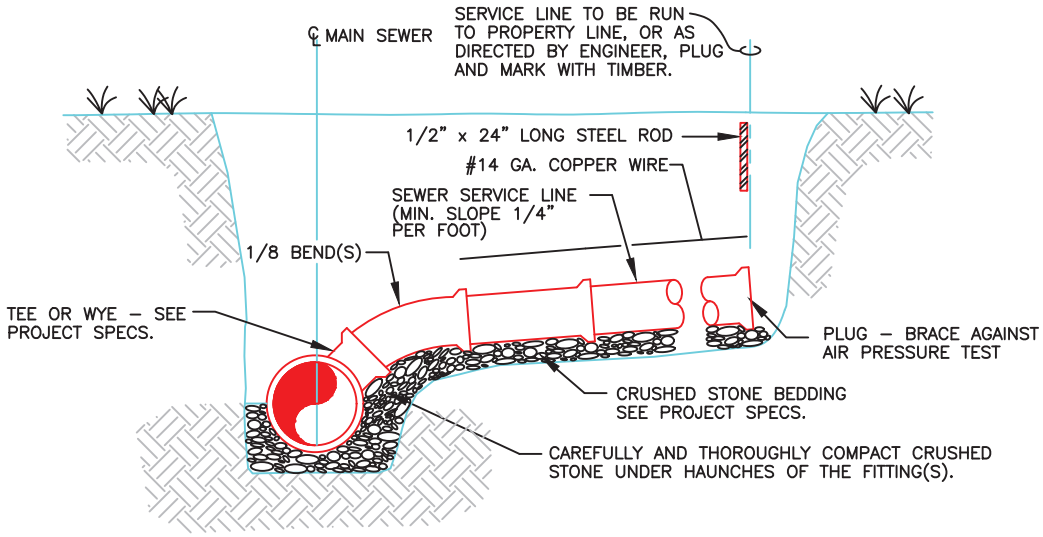
M = 8" WHERE N = 8" TO 18"
M = 12" WHERE N = 21" TO 30"



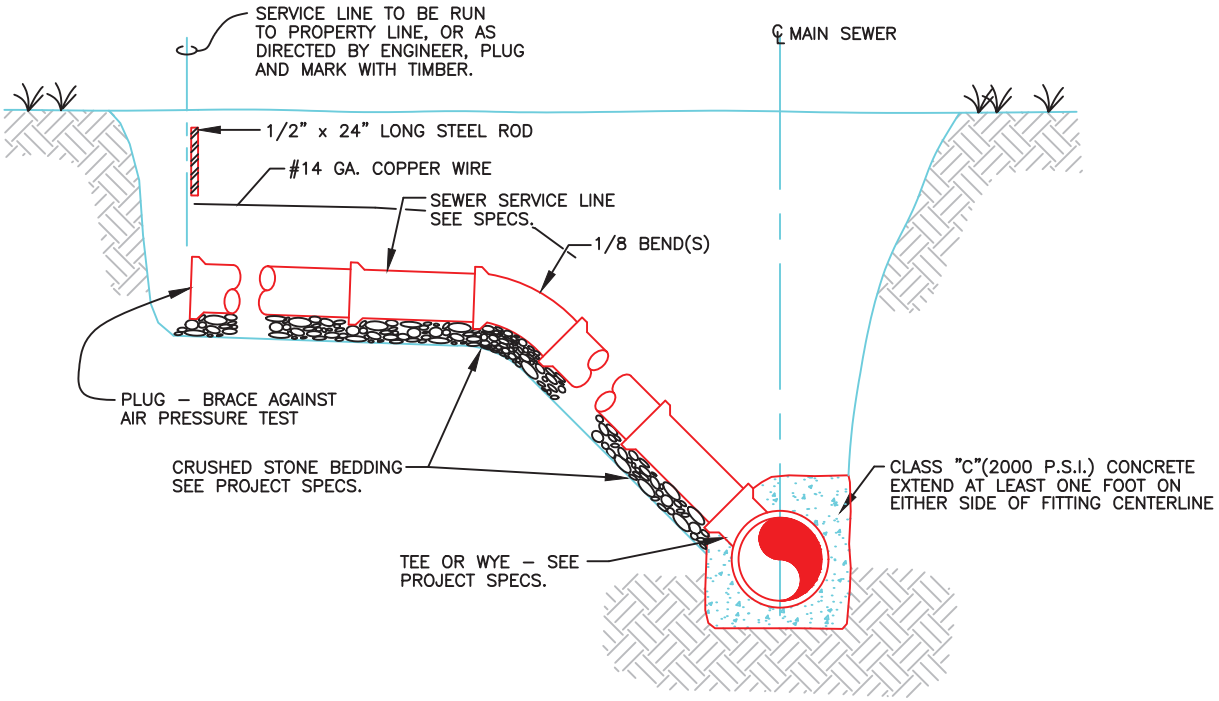
SECTION

DROP PIPE FOR STANDARD MANHOLE

NOT TO SCALE



NORMAL DEPTH SERVICE



DEEP SEWER SERVICE

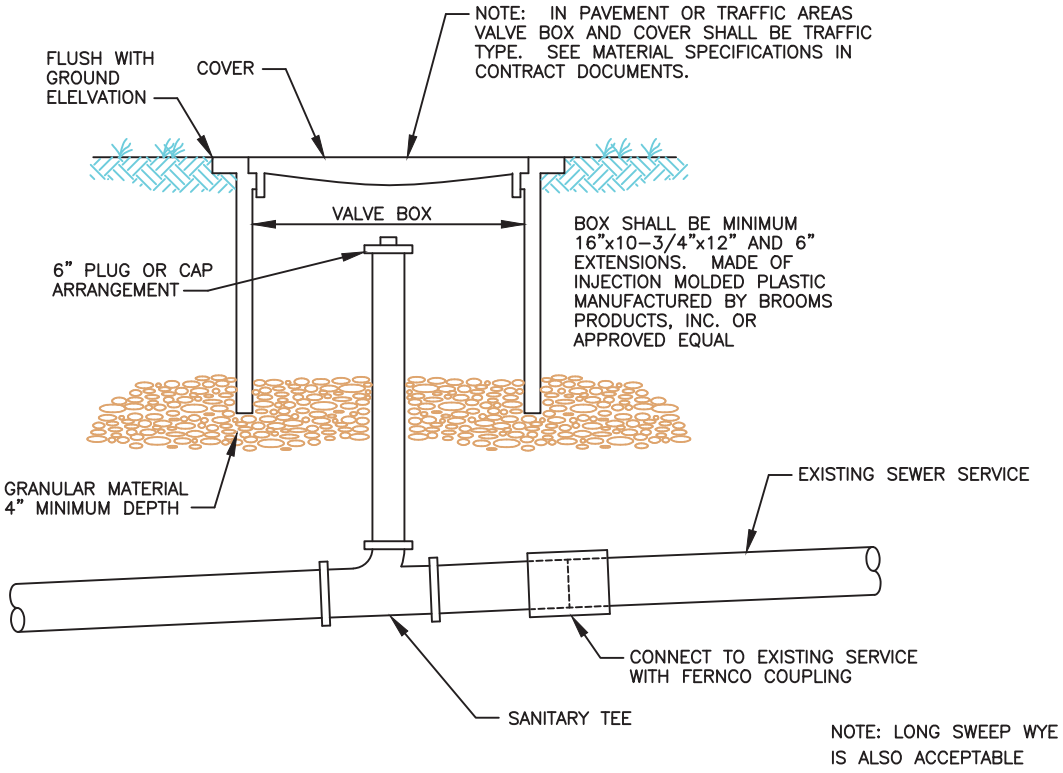
USE WHERE DIRECTED BY ENGINEER

SERVICE SERVICE

NOT TO SCALE

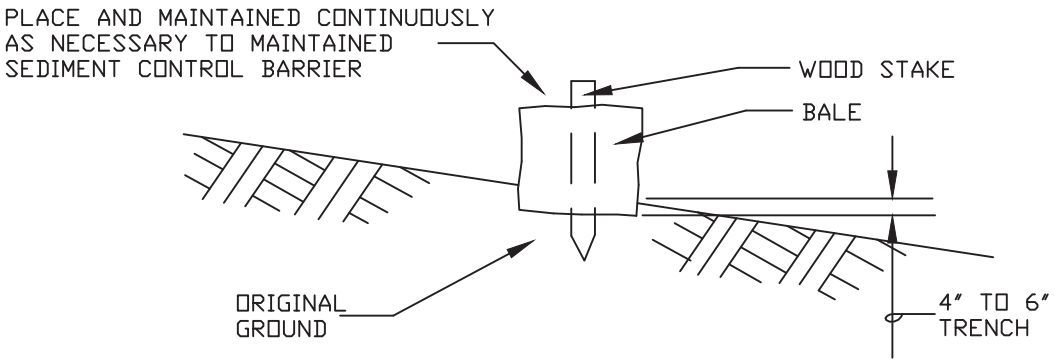
HENDERSONVILLE UTILITY DISTRICT	STANDARD DETAIL	S-4

THE CUSTOMER SHALL OWN AND MAINTAIN ALL SERVICE LINES, INCLUDING THE CLEAN-OUTS, ON THE CUSTOMER'S PROPERTY AND THE DISTRICT SHALL NOT MAINTAIN SAME IN ANY WAY EXCEPT FOR INSPECTION. THE DISTRICT SHALL MAINTAIN THE SERVICE LINE FROM THE CLEAN-OUT AT THE PROPERTY LINE TO THE SEWER MAIN OR FROM THE CLEAN-OUT TEN (10) FEET FROM THE SEWER MAIN IF THE SEWER SERVICE IS IN AN EASEMENT. CLEAN-OUT AT THE PROPERTY / EASEMENT LINE SHALL BE THE RESPONSIBILITY OF THE CUSTOMER.



TYPICAL CLEANOUT ASSEMBLY

NOT TO SCALE

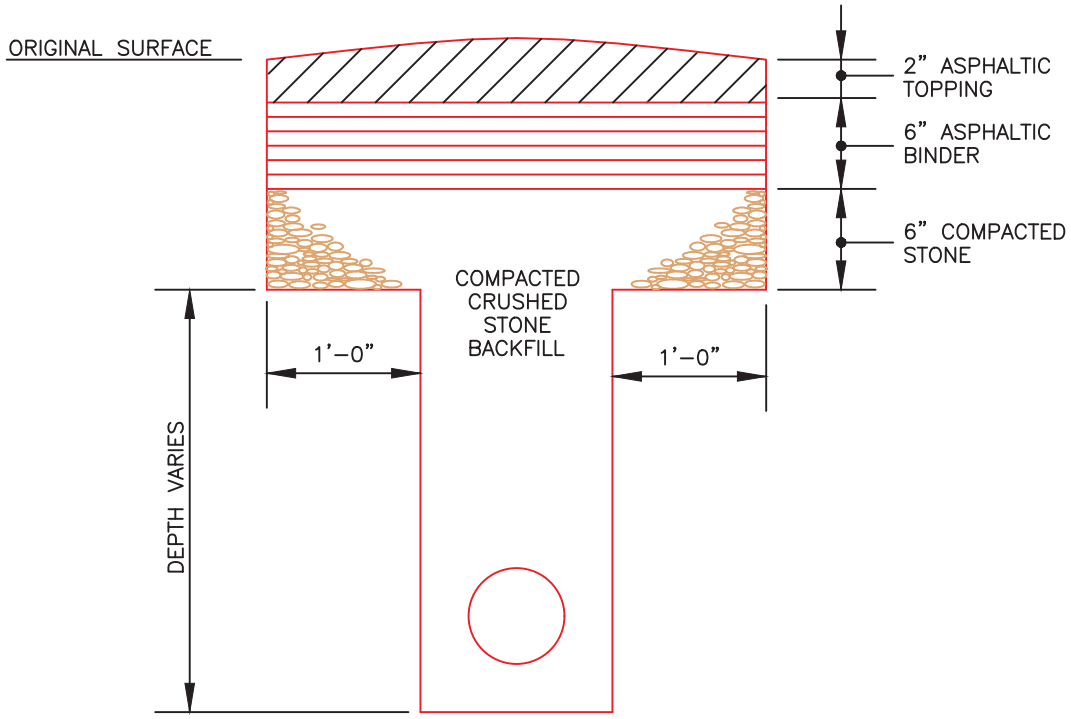


STRAWBALE SEDIMENT CONTROL BARIER DETAIL

NOT TO SCALE

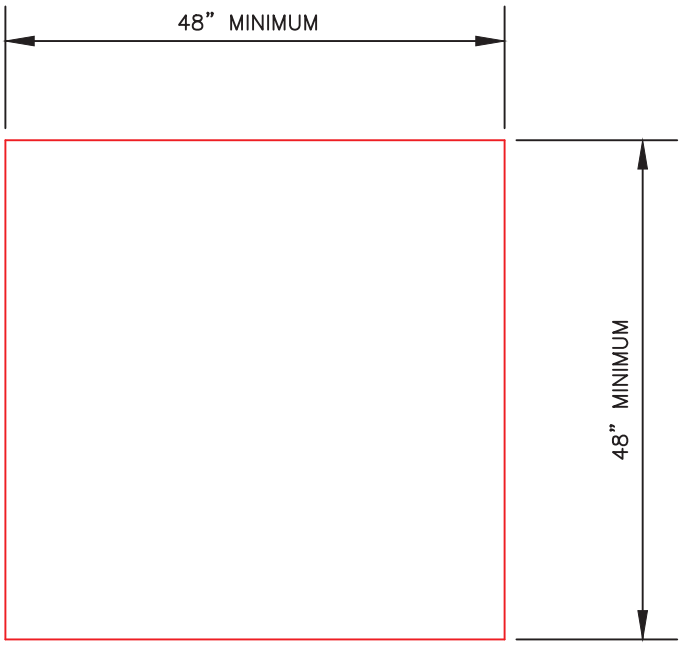
*CONTRACTOR SHALL CONTACT THE CITY OF HENDERSONVILLE PUBLIC WORKS DEPARTMENT BEFORE PLACING ANY ASPHALT LAYERS

ALL SURFACES SHALL BE SMOOTH CUT. THE CUT SHALL BE A MINIMUM OF FORTY–EIGHT (48) INCHES. THE CROWN SHALL NOT EXCEED A HALF AN INCH IN HEIGHT.

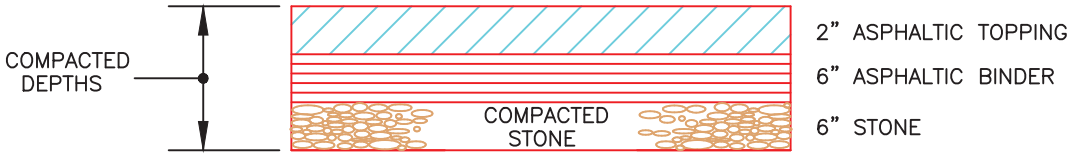


ROAD CUT CONSTRUCTION

NOT TO SCALE



PLAN



PROFILE

±NOTE:

*1. CONTRACTOR SHALL CONTACT THE CITY OF HENDERSONVILLE PUBLIC WORKS DEPARTMENT FOR INSPECTION BEFORE PLACING ANY ASPHALT LAYERS.

2. ALL CUTS SHALL HAVE SMOOTH EDGES.

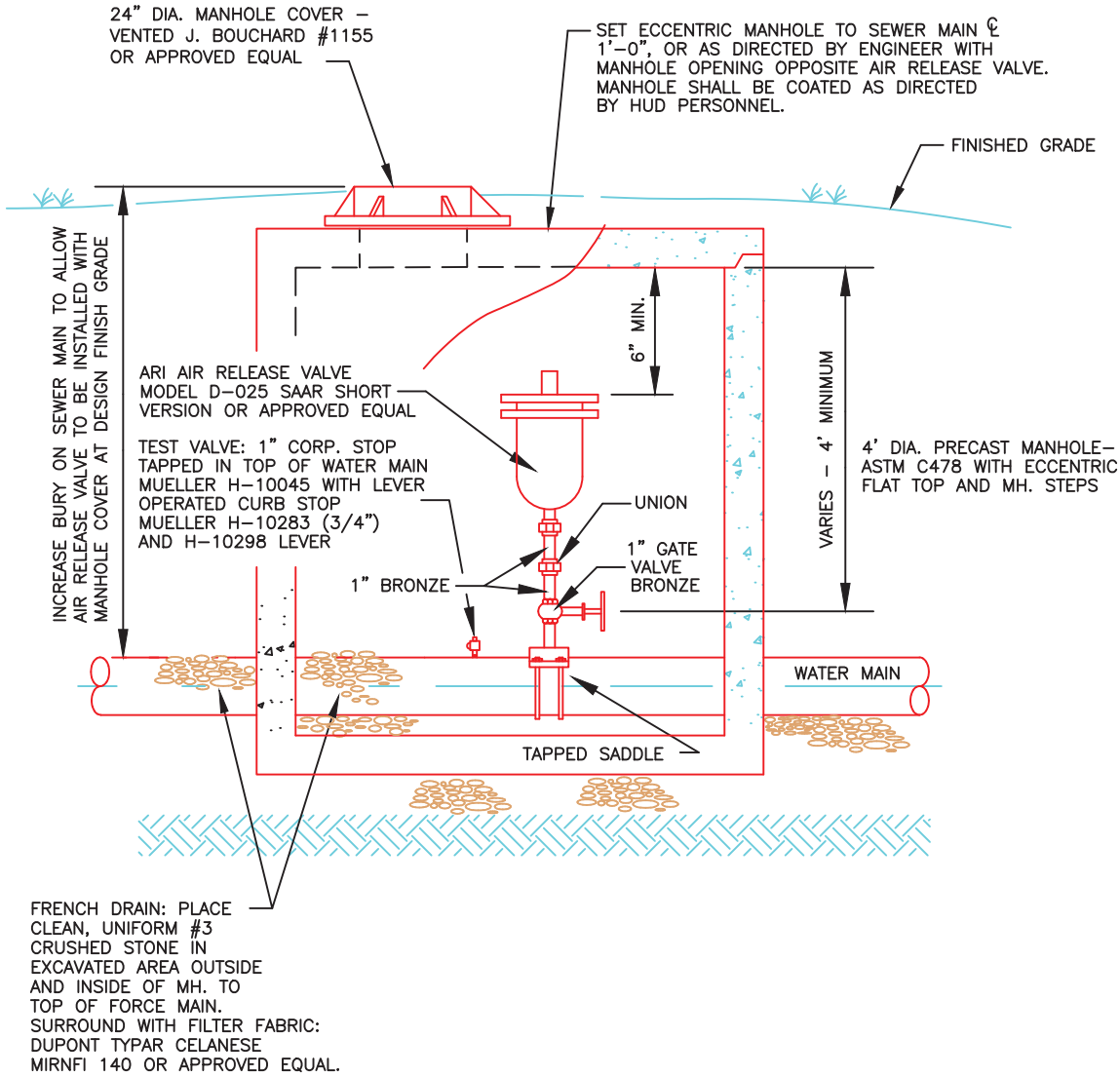
3. THE PATCH SHALL BE A MINIMUM OF 48–INCHES BY 48–INCHES.

4. THE PATCH SHALL HAVE A CROWN NOT TO EXCEED A HALF–INCH IN HEIGHT FOR SETTLING PURPOSES.

5. CUT SHOULD BE DEEP ENOUGH TO ALLOW FOR COMPACTION.

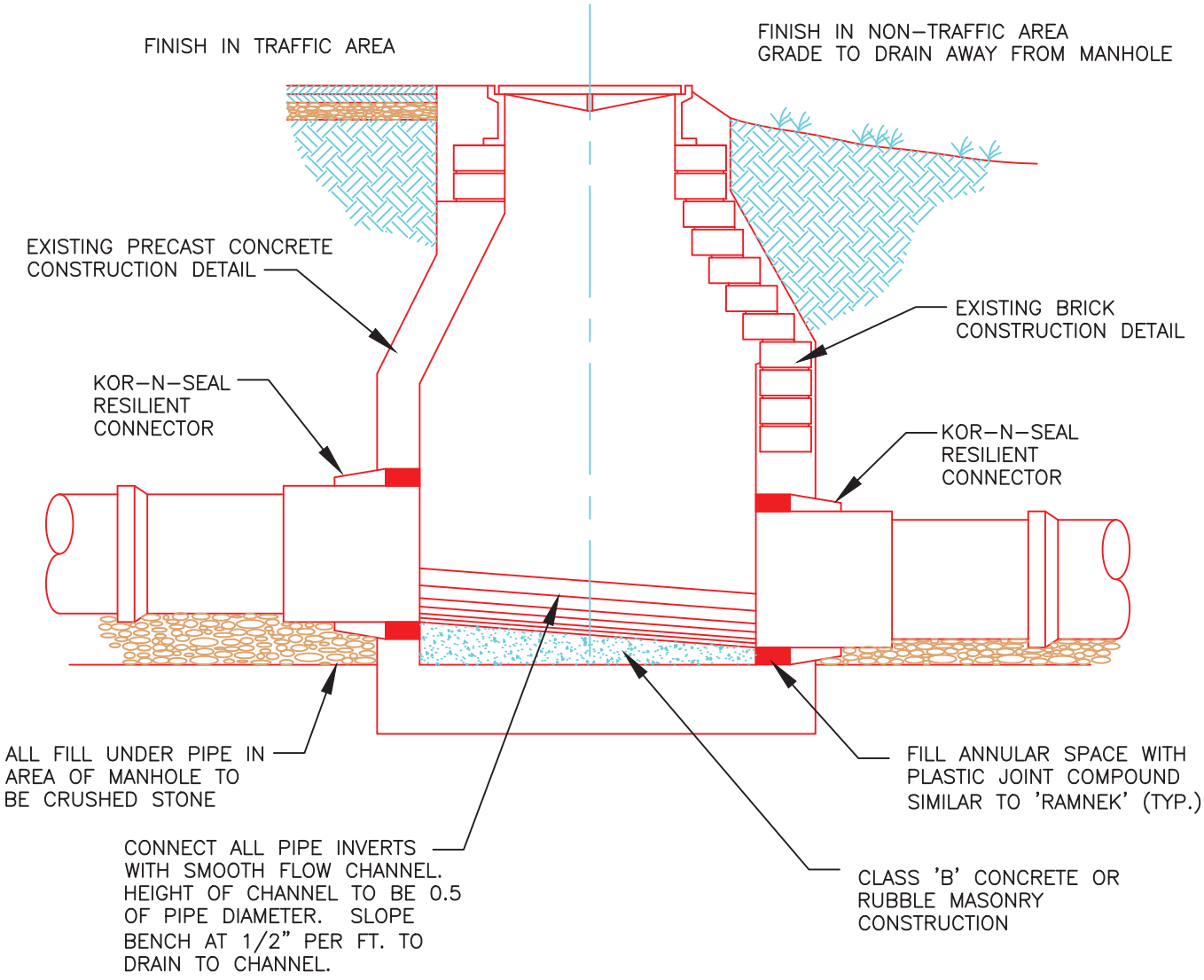
ROAD CUT CONSTRUCTION – PATCHWORK

NOT TO SCALE



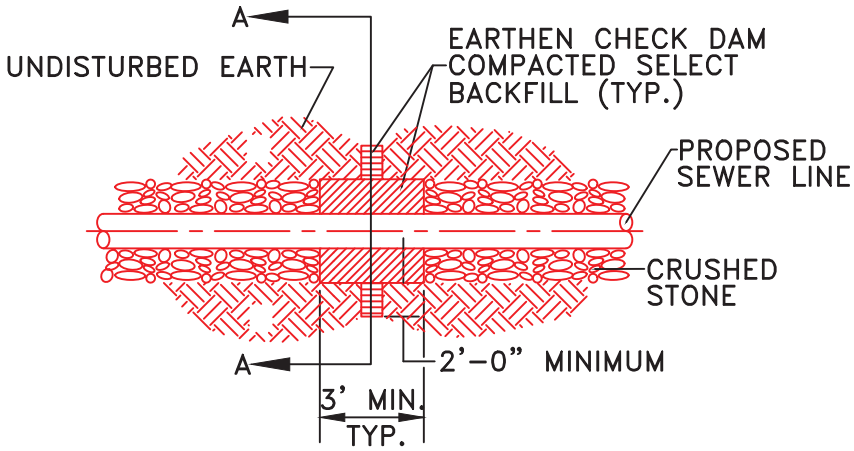
TYPE A
AIR RELEASE MANHOLE ASSEMBLY

NOT TO SCALE

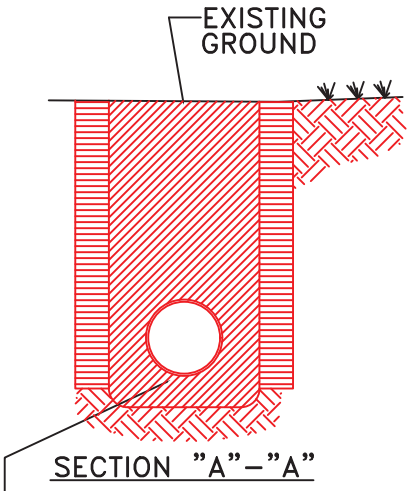


CONNECTION TO EXISTING MANHOLE

NOT TO SCALE



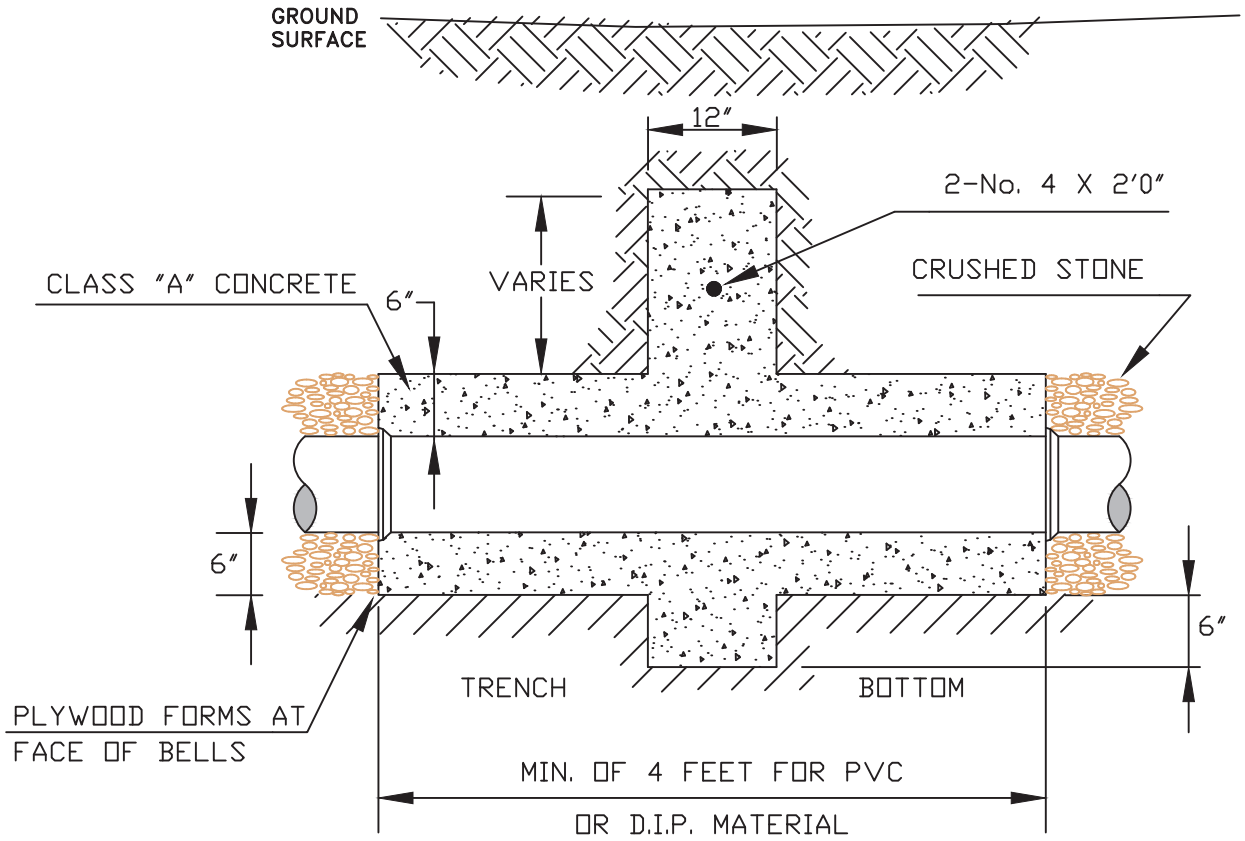
IN AREAS DESIGNATED FOR "EARTHEN CHECK DAM", BEDDING & BACKFILL WITHIN THE PIPE ZONE AND FOR A DISTANCE OF 3 FEET ALONG THE PIPE CENTERLINE SHALL BE SELECTED CLAY SOIL PLACED IN LIFTS OF 6 INCHES± AND COMPACTED TO AT LEAST 80% MINIMUM DENSITY (STANDARD PROCTOR)

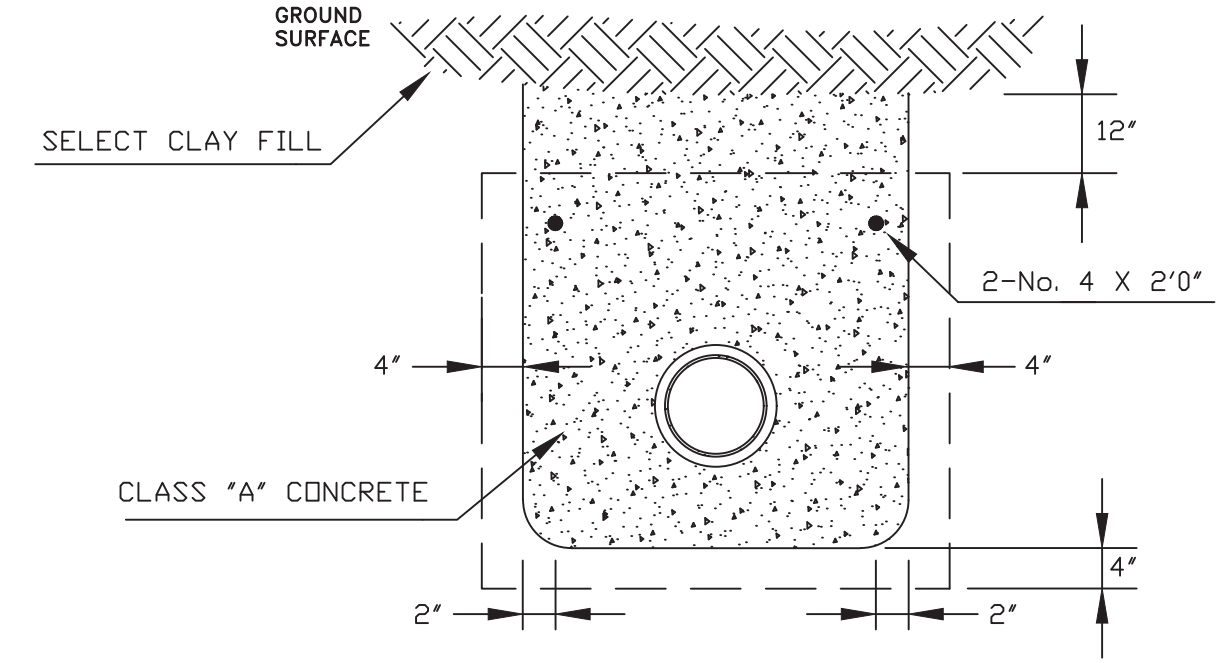


SPECIAL CARE MUST BE USED TO PLACE AND COMPACT CLAY SOIL UNDER THE HAUNCHES OF THE PIPE TO PROVIDE UNIFORM SUPPORT UNDER THE PIPE.

EARTHEN CHECK DAM

NOT TO SCALE

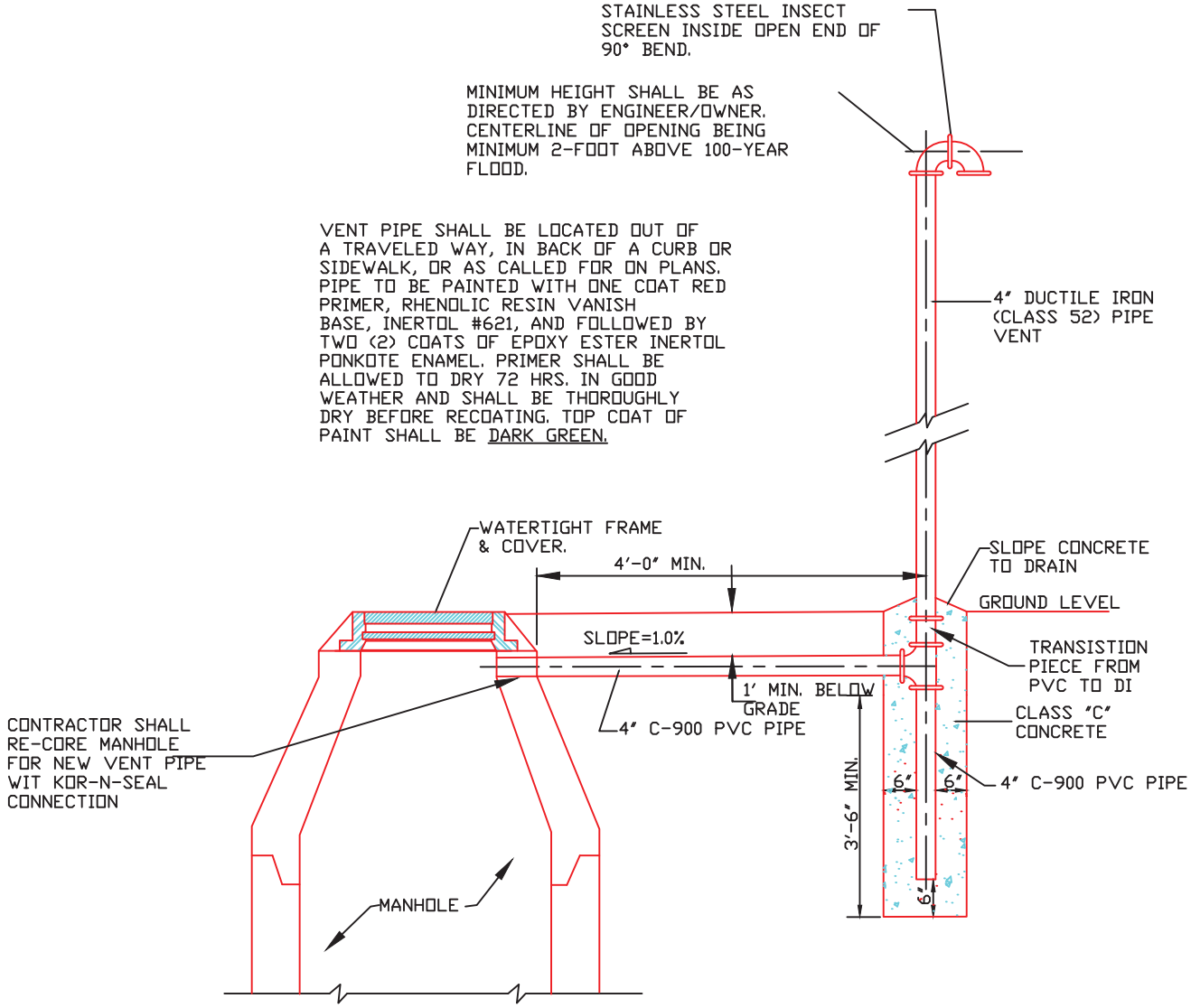




NOTE: A 4–INCH KEYWAY SHALL BE CUT IN DIRT EXCAVATION. FRACTURED AND SHOT ROCK SHALL BE REMOVED TO CLEAN SOLID ROCK IN ROCK TRENCHES. THIS IS REQUIRED ON SIDES IN ADDITION TO BOTTOM. IF BOTTOM IS OVERSHOT MUST BE CLEANED TO SOLID UNFRACTURED ROCK.

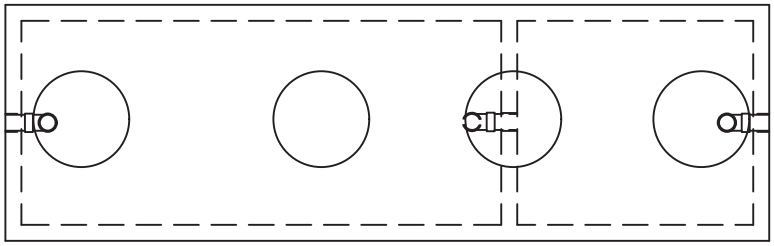
CONCRETE CHECK DAM

NOT TO SCALE

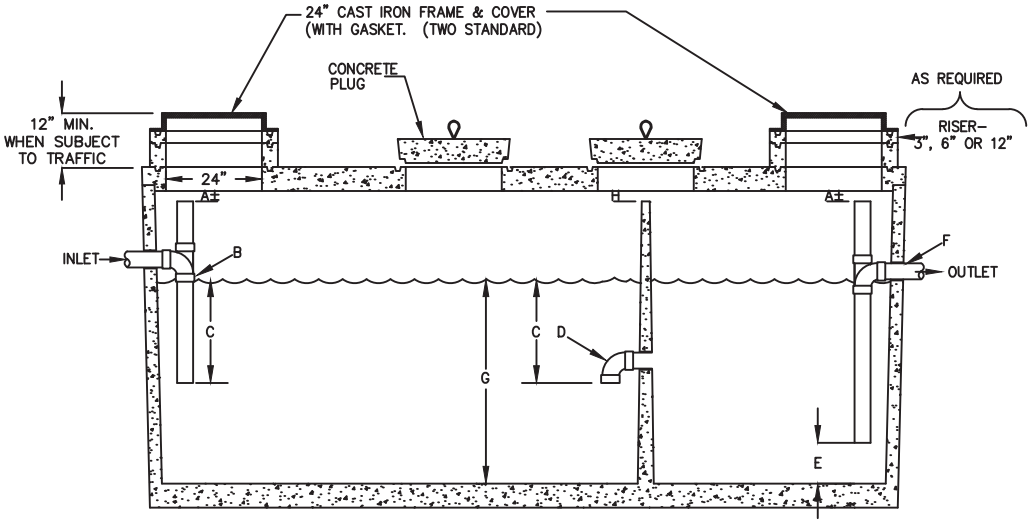


VENT PIPE ASSEMBLY

NOT TO SCALE



PLAN VIEW



A – MINIMUM 6", BUT NOT LESS THAN PIPE DIAMETER
B – INLET PIPE INVERT TO BE 2–1/2" ABOVE LIQUID SURFACE
C – INLET PIPE TO TERMINATE 2/3 DEPTH OF WATER LEVEL
D – 90° SWEEP, MINIMUM SIZE 6" AND SAME DEPTH AS INLET PIPE
E – 12" FROM FLOOR TO END OF OUTLET PIPE
F – OUTLET PIPE NO SMALLER THAN INLET PIPE, MINIMUM 4"
G – MINIMUM DEPTH OF LIQUID CAPACITY = 42"
H – MAXIMUM DISTANCE FROM CEILING = 6"

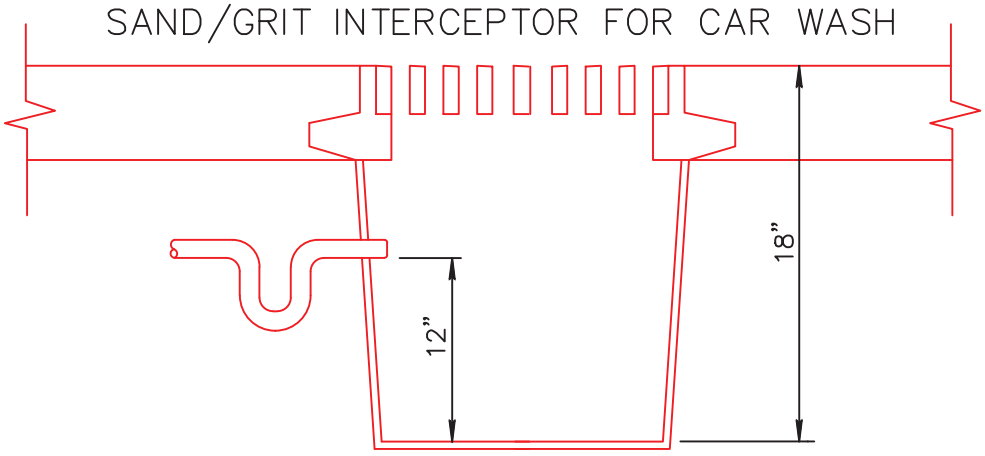
SECTION

NOTES:
1. MINIMUM TOP THICKNESS = 6–INCHES
2. MINIMUM TOP THICKNESS IN PAVED AREAS = 8–INCHES
3. MINIMUM GREASE INTERCEPTOR CAPACITY = 2.000 GALLONS
4. WHEN A LARGER CAPACITY GREASE INTERCEPTOR IS REQUIRED, 2,000 GALLON TANKS SHALL BE INSTALLED IN SERIES.

GREASE TRAP DETAIL

NOT TO SCALE

INTERCEPTOR SIZING GUIDELINES
SAND/GRIT INTERCEPTOR FOR CAR WASH



FLOOR DRAINS ARE PRIMARILY USED FOR INSIDE LOCATIONS WHERE THE FLOW RATE INTO THE DRAIN CAN BE ANTICIPATED. DRAINS SHOULD BE SELECTED WITH SUFFICIENT TOP SIZE AND GRATE FREE AREA TO PASS THE ANTICIPATED FLOW. GRATE FREE AREA IS DEFINED AS "THE TOTAL AREA OF THE DRAINAGE OPENINGS IN THE GRATE." THE DRAIN OUTLET SHOULD BE SIZED LARGE ENOUGH SO THAT IT WILL SAFELY PASS THE MAXIMUM FLOW THROUGH THE GRATE, WITHOUT CREATING WATER BUILDUP,

SIZING AND LOCATION:

THE GRATE FREE AREA SHOULD EQUAL THE TRANSVERSE AREA OF THE CONNECTING PIPE. THE NUMBER AND LOCATIONS OF DRAINS ARE BASED ON THE CONFIGURATION OF THE FLOOR PLAN, TYPE OF OPERATION AND LOCATION OF EQUIPMENT. LOCATION AND NUMBER REQUIRED OF FLOOR DRAINS CAN BE DETERMINED ONLY AFTER CAREFUL REVIEW OF THE PLAN AND ANTICIPATED BUILDING USE.

NOMINAL PIPE SIZE, IN.	TRANSVERSE AREA OF PIPE, SQ. IN.	MINIMUM FLOW REQUIREMENTS (INTERIOR AREAS), SQ. IN.
1-1/2"	2.04	3.06
2	3.14	4.71
3	7.06	10.59
4	12.60	18.90
5	19.60	29.40
6	28.30	42.45
8	50.25	75.38

USE THE FOLLOWING FORMULA TO DETERMINE G.P.M.:

G.P.M.= .0104x Rx A
G.P.M.= GALLONS PER MINUTE
R= INTENSITY-INCHES/HOUR
A= AREA-SQUARE FEET
.0104= CONVERSION FACTOR

SAND / GRIT INTERCEPTOR FOR CAR WASH

NOT TO SCALE

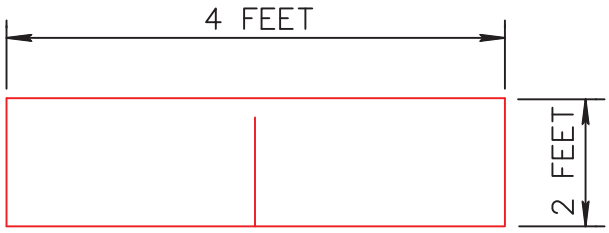
INTERCEPTOR SIZING GUIDELINES
SAND INTERCEPTOR

ALL NEW BUSINESSES OR INDUSTRIES THAT USE OR DEAL WITH METALS, SAND, OR DIRT IN THEIR DAY TO DAY ACTIVITIES WILL BE REQUIRED TO INSTALL SAND INTERCEPTORS.

THE FOLLOWING GUIDE LINES SHALL BE FOLLOWED WHEN SIZING SAND INTERCEPTORS.

ALL SAND INTERCEPTORS WILL BE A MINIMUM OF 50 GALLONS, BAFFLED AND SET IN SUCH A WAY THAT THE LENGTH IS GREATER THEN THE DEPTH.

EXAMPLE:

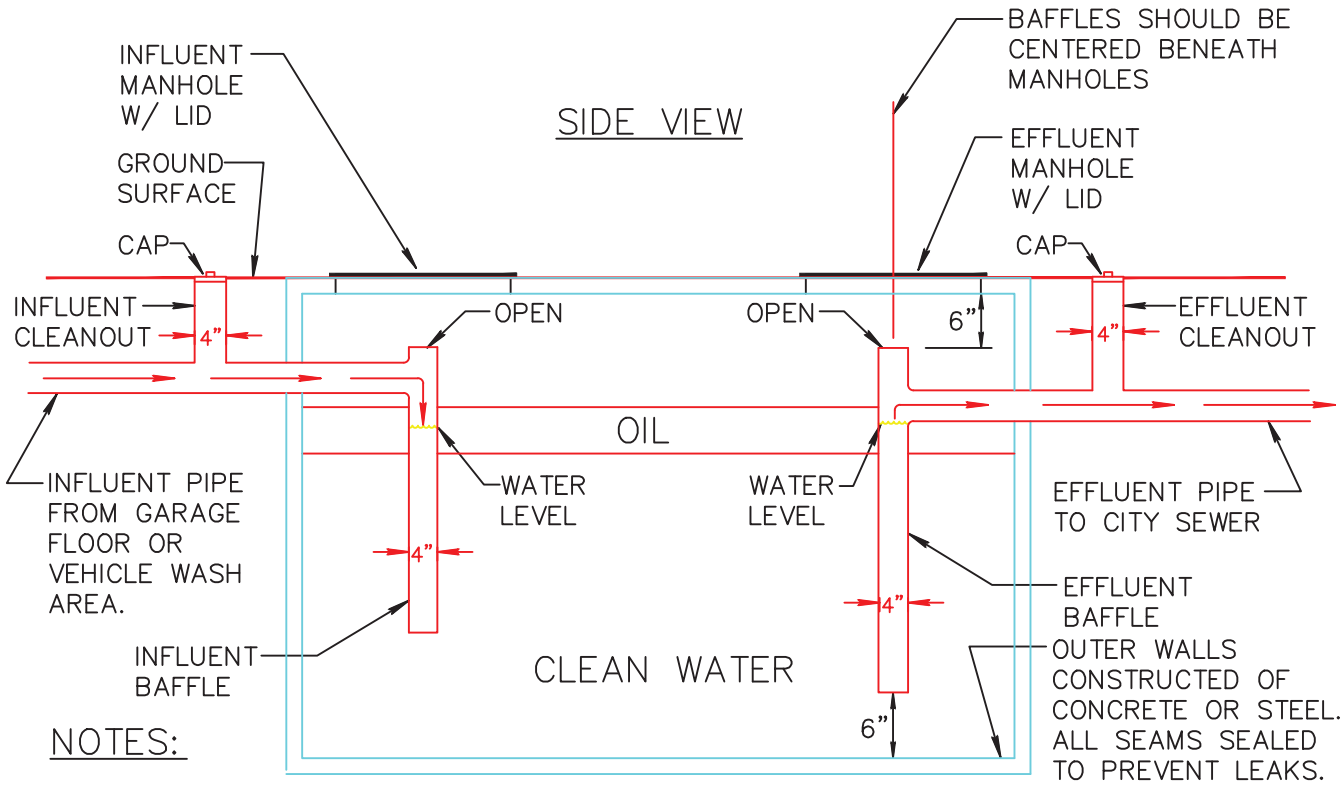


NOTES:

1. NO DOMESTIC EFFLUENT SHALL BE ALLOWED TO DISCHARGE THROUGH THE

SAND INTERCEPTOR

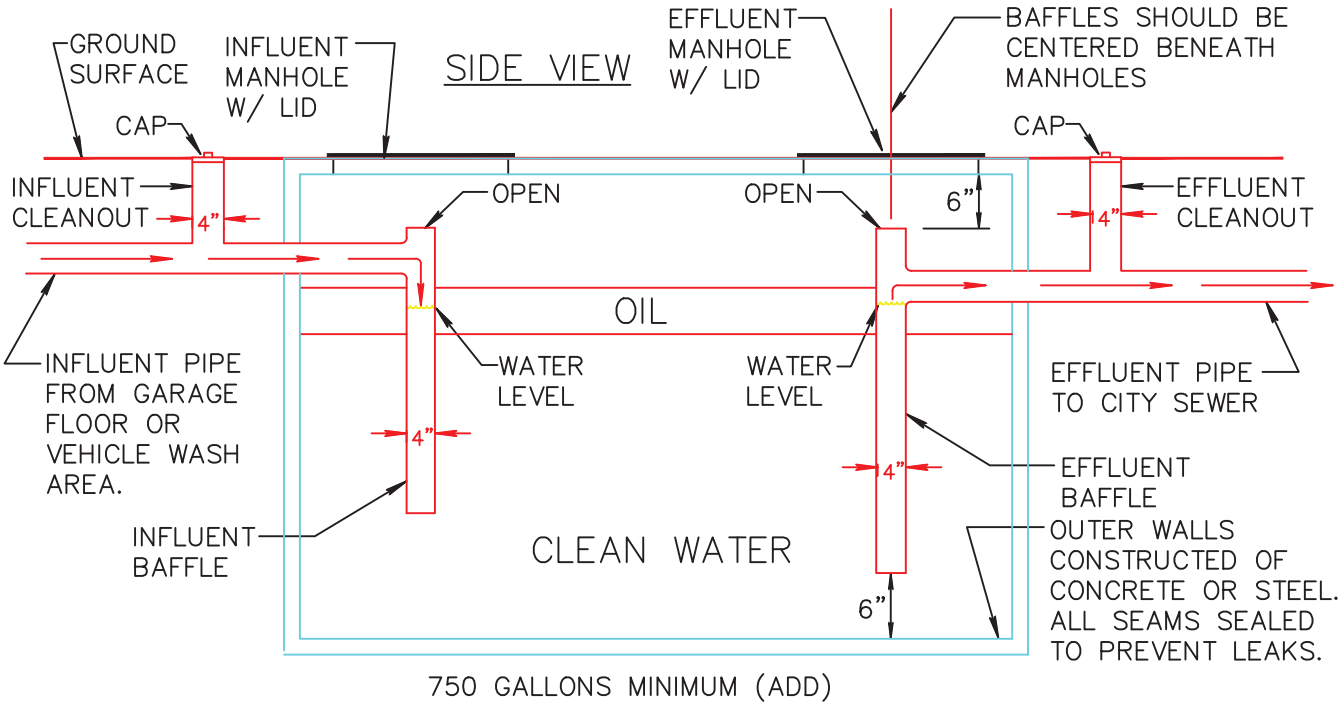
NOT TO SCALE



- ALL NEW BUSINESSES OR INDUSTRIES THAT USE PETROLEUM BASE PRODUCTS IN THEIR DAY TO DAY ACTIVITIES WILL BE REQUIRED TO INSTALL AN OIL/WATER SEPARATOR IF THEY CHOOSE TO OPERATE WITH OPEN FLOOR DRAINS.
- NO DOMESTIC EFFLUENT SHALL BE ALLOWED TO DISCHARGE THROUGH THE OIL/WATER SEPARATOR AS STATED IN THE STANDARD PLUMBING CODE OF THE SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI), CHAPTER 8, SECTION 801.3 "TYPES OF WASTE".
- OIL/WATER SEPARATOR MODELS AND WATER RECYCLE UNITS MANUFACTURED BY COMPANIES SUCH AS ZURN, SMITH, LANDA INC. OR RGF ENVIROMENTAL SYSTEMS INC. AND OTHERS CAN BE SUBSTITUTED FOR THE ABOVE DESIGN WITH HUD APPROVAL.
- ALL SIDES OF IN-GROUND OIL/WATER SEPARATOR UNITS (EXCEPT ACCESS DOORS AND MANHOLES) ARE REQUIRED TO BE CONSTRUCTED OF 1/8" INCH (OR GREATER) STEEL OR 4" REINFORCED CONCRETE (OR GREATER).
- IF INSTALLED, ACCESS DOOR TO IN-GROUND OIL/WATER SEPARATOR UNITS SHALL BE CONSTRUCTED OF ALUMINUM WITH H-20 LOADING CAPACITY PER SPECIFICATIONS BY U.S. FOUNDRY, CORP. OR EQUIVALENT.
- OIL INTERCEPTORS SHALL BE PUMPED OUT COMPLETELY AT A MINIMUM OF ONCE EVERY NINETY (90) DAYS, OR MORE FREQUENTLY AS NEEDED TO PREVENT CARRY OVER OF OIL OIL INTO COLLECTION SYSTEM.

SIZING GUIDELINES OIL/WATER INTERCEPTOR

NOT TO SCALE



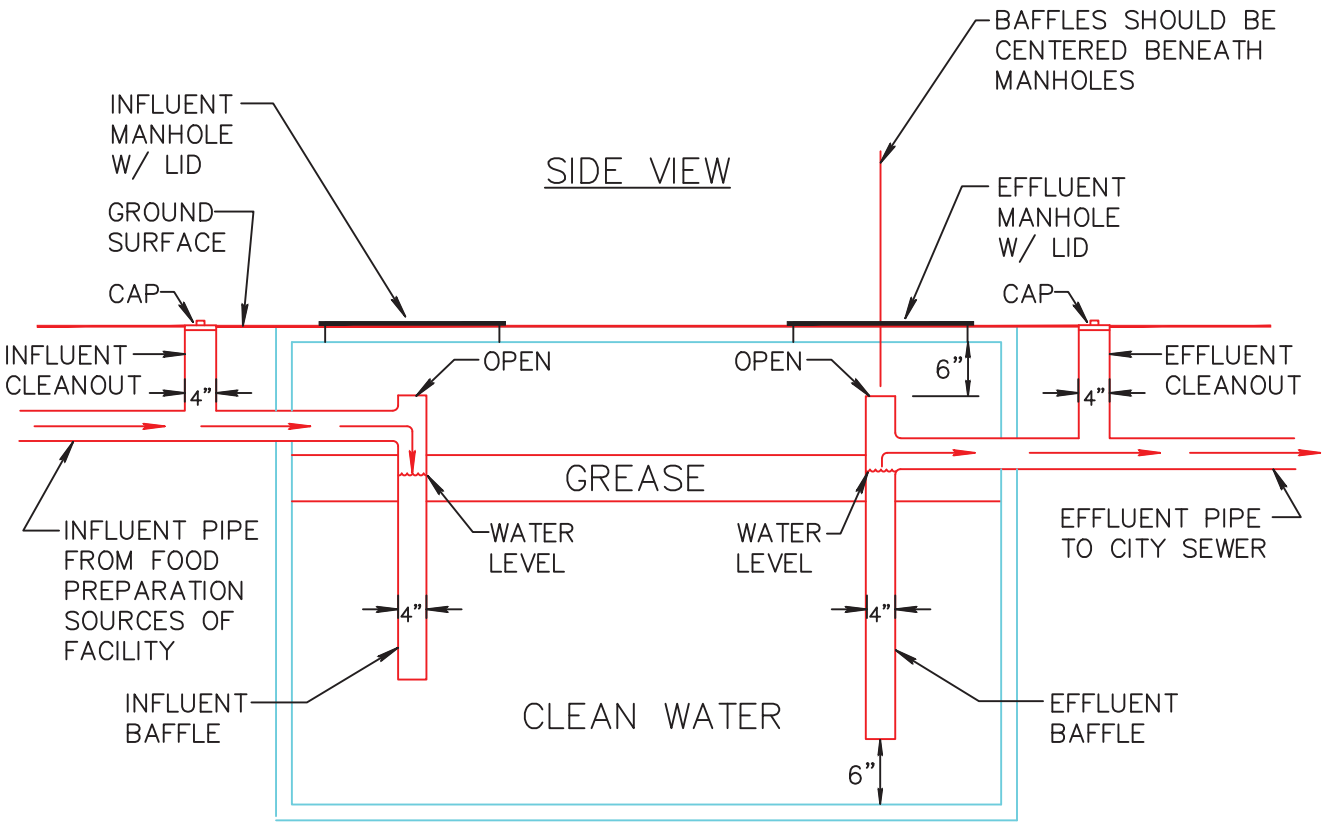
750 GALLONS MINIMUM (ADD)

NOTES:

- ALL NEW BUSINESSES OR INDUSTRIES THAT WASH CARS WILL BE REQUIRED TO INSTALL AN OIL/WATER SEPARATOR.
- IF YOU CHOOSE TO WASH CARS OUTSIDE, THE WASH PAD WILL HAVE TO BE SHELTERED SO RAIN WATER WILL NOT BE DISCHARGED TO SANITARY SEWER SYSTEM.
- TO PREVENT WASH WATER FROM RUNNING OUTSIDE OF WASH AREA, A SPEED BUMP WILL NEED TO BE INSTALLED ALONG THE ENTRANCE TO THE BAYS OF YOUR BUSINESS AND/OR ALONG THE OUTSIDE EDGES OF THE WASH PAD.
- ALL NEW BUSINESSES OR INDUSTRIES THAT USE PETROLEUM BASE PRODUCTS IN THEIR DAY TO DAY ACTIVITIES WILL BE REQUIRED TO INSTALL AN OIL/WATER SEPARATOR IF THEY CHOOSE TO OPERATE WITH OPEN FLOOR DRAINS.
- NO DOMESTIC EFFLUENT SHALL BE ALLOWED TO DISCHARGE THROUGH THE OIL/WATER SEPARATOR AS STATED IN THE STANDARD PLUMBING CODE OF THE SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI), CHAPTER 8, SECTION 801.3 "TYPES OF WASTE".
- OIL/WATER SEPARATOR MODELS AND WATER RECYCLE UNITS MANUFACTURED BY COMPANIES SUCH AS ZURN, SMITH, LANDA INC. OR RGF ENVIROMENTAL SYSTEMS INC. AND OTHERS CAN BE SUBSTITUTED FOR THE ABOVE DESIGN WITH HUD PERSONNEL APPROVAL.
- ALL SIDES OF IN-GROUND OIL/WATER SEPARATOR UNITS (EXCEPT ACCESS DOORS AND MANHOLES) ARE REQUIRED TO BE CONSTRUCTED OF 1/8" INCH (OR GREATER) STEEL OR 4" (OR GREATER) REINFORCED CONCRETE, OR FIBERGLASS.
- IF INSTALLED, ACCESS DOOR TO IN-GROUND OIL/WATER SEPARATOR UNITS SHALL BE CONSTRUCTED OF ALUMINUM WITH H-20 LOADING CAPACITY PER SPECIFICATIONS BY U.S. FOUNDRY, CORP. OR EQUIVALENT.

OIL/ WATER INTERCEPTOR FOR CAR WASH

NOT TO SCALE



NOTES:

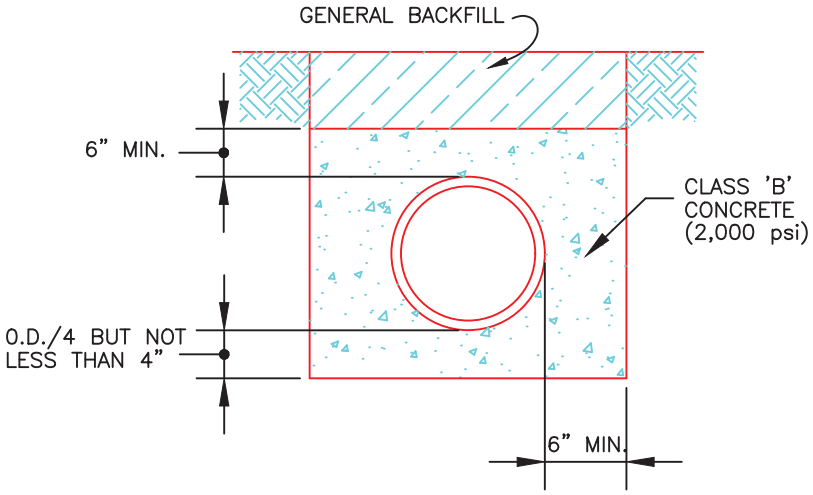
1. NO DOMESTIC EFFLUENT SHALL BE ALLOWED TO DISCHARGE THROUGH THE OIL/GREASE SEPARATOR AS STATED IN THE STANDARD PLUMBING CODE OF THE SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI), CHAPTER 8, SECTION 801.3 "TYPES OF WASTE".

2. ALL SIDES OF IN-GROUND OIL/GREASE SEPARATOR UNITS (EXCEPT ACCESS DOORS AND MANHOLES) ARE REQUIRED TO BE CONSTRUCTED OF 1/8" INCH (OR GREATER) STEEL OR 4" REINFORCED CONCRETE (OR GREATER).

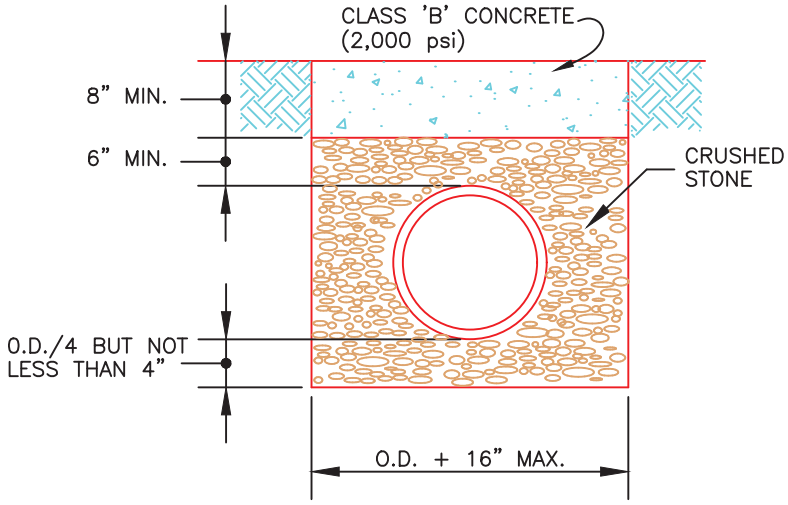
3. GREASE INTERCEPTORS SHALL BE PUMPED OUT COMPLETELY AT A MINIMUM FREQUENCY ONCE EVERY NINETY 90 (DAYS), OR MORE FREQUENCY AS NEEDED TO PREVENT CARRY OVER OF GREASE INTO COLLECTION SYSTEM.

OIL/GREASE INTERCEPTOR

NOT TO SCALE



CONCRETE ENCASEMENT

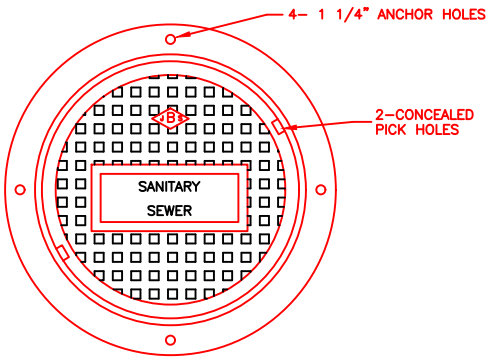


CONCRETE CAP

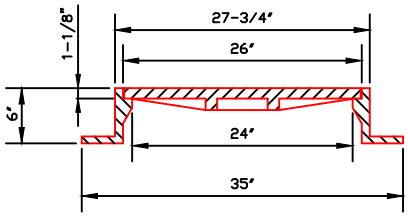
NOTE: TO BE USED WHERE NOTE ON DRAWINGS REQUIRES PIPE TO BE ENCASED OR CAPPED WITH CONCRETE OR WHERE THE OWNER OR HIS AUTHORIZED REPRESENTATIVE DIRECTS CONCRETE TO BE POURED.

CONCRETE CAP AND ENCASEMENT DETAILS

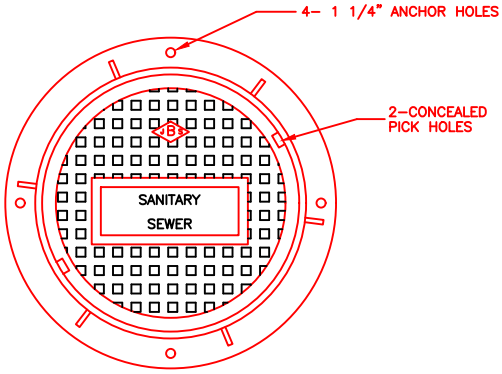
NOT TO SCALE



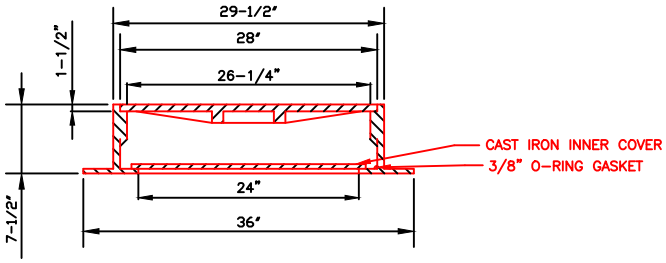
JOHN BOUCHARD & SONS CO.
NO. 1155 OR APPROVED EQUAL



STANDARD TRAFFIC TYPE



JOHN BOUCHARD & SONS CO.
NO. 1155 BOLT DOWN WATER
TIGHT OR APPROVED EQUAL



STANDARD WATERTIGHT MANHOLE FRAME AND COVER

HENDERSONVILLE UTILITY DISTRICT	STANDARD DETAIL	S–21

DIVISION 2

STANDARD SPECIFICATIONS FOR PRESSURE WASTEWATER COLLECTION SYSTEMS, COLLECTOR MAIN, SERVICE CONNECTIONS, AND GRINDER PUMP INSTALLATIONS

PRESSURE WASTEWATER COLLECTION SYSTEMS
COLLECTOR MAINS AND SERVICE CONNECTIONS

SECTION 1 – GENERAL

These specifications are supplemental to the Standard Sewer System Specifications which preceded this section. Therefore, provisions contained in General Information, Materials, and Construction Methods of the preceding sections also apply to the Pressure Wastewater Collection Systems Specifications.

SECTION 2 - MATERIALS

2.01 GENERAL - All material to be incorporated in the project shall be first quality, new, and undamaged material conforming to all applicable portions of these specifications.

2.02 PIPELINE DETECTION TAPE - Detectable pipeline location tape shall be plastic composition film containing one layer of metalized foil laminated between two layers of inert plastic film specifically formulated for prolonged use underground. Tape shall be a minimum of 5.5 mils thickness and continuously printed in permanent ink to indicate caution for a buried sewer line below.

Tape shall be a minimum of 3-inches in width with a minimum tensile strength of 5,000 psi. Tape shall be Terra-Tape as manufactured by Reef Industries, Inc. or approved equal.

The detectable tape and 14-guage insulated copper tracer wire shall be buried in the utility line trench directly above the installation to be identified. The tracer wire shall be placed directly on top of the pressure sewer and the marking tape shall be placed 15-inches from finish grade of the trench. The tape shall be placed in the trench with the printed side up and be essentially parallel to the finished surface. The Contractor will take necessary precautions to ensure that the tape and tracer wire are not pulled, distorted, or otherwise misplaced in completing the trench backfill. Tape and wire shall be placed in all trenches.

2.03 LOW-PRESSURE SEWER PIPELINE - Pipe material for this project shall be as described below. Material and size shall be as shown on the Drawings or as directed by the Engineer. For pressure sewers 4-inch and larger, pipe shall be AWWA C900 DR18 (see Division 2 for specification requirements) or as directed by owner

A. PVC (Polyvinyl Chloride) Plastic Pipe (1-1/2-inch to 4-inch) - PVC pipe 1-1/2-inch to 4-inch shall be pressure rated, gasket joint pipe manufactured in accordance with ASTM D-2241, latest revision for water service, pressure Class 200, SDR 21, unless noted otherwise on the drawings or as directed by the Engineer.

(1) Material - The pipe shall be manufactured of clean virgin Type 1 Grade 1 (PVC 1120) resin compound with cell classification 12454-B and shall conform to ASTM D-1784, latest revision for PVC compounds.

(2) Testing - Testing and inspection shall be accomplished at the factory in accordance with ASTM D-2241, latest revision. Tests are to include:

Sustained Pressure Test: 420 psi for 1,000 hours in accordance with ASTM D-1598.

Quick Burst Test: 600 psi for 60 to 70 seconds in accordance with ASTM D-1599, latest revision.

Flattening Test: In accordance with ASTM D-2241, latest revision.

Extrusion Quality: In accordance with ASTM D-2152 latest revision, using acetone immersion.

Dimensions: Wall thickness and outside dimensions shall met applicable portions of ASTM D-2122, latest revision.

Tests shall be run on the maximum number of specimens called for under ASTM D-2241, latest revision for all pipe manufactured in each size and strength classification. If any specimen fails to meet any above-stated test requirement all pipe of that size and type between successful tests shall be excluded from use on this project.

The manufacturer shall provide the Sewer Department with three (3) certified copies of statements verifying that all required tests have been performed on the pipe provided for this project and that the pipe provided passed all tests. Such statements shall be submitted to the Sewer Department for review before any pipe is shipped to the job site.

(3) Joint Design - Pipe joints shall be slip-joint gasket design conforming to ASTM D-3139. Gaskets shall conform to ASTM F-477. Gaskets and lubricants shall be compatible with the pipe material and the intended service and shall be furnished by the pipe manufacturer.

Unless approved otherwise by the Sewer Department each gasket shall be factory installed in the bell end of the pipe and locked in place. The joint design shall be approved by the Sewer Department before the Contractor will be permitted to install any pipe on this project.

(4) Manufacturing Standard - The manufacturer's equipment and quality control facilities must be adequate to ensure that all pipe produced is uniform and meets the requirements of the specifications. All pipe for this project shall be manufactured in the USA by the same manufacturer unless specifically approved otherwise by the Engineer.

Pipe used on this project shall have been approved by the NSF and the manufacturer shall provide certification to that effect.

(5) Laying Lengths - The pipe may be furnished in the manufacturer's standard laying lengths from 18 feet to 40 feet.

(6) Shipment and Storage - Shipment packets shall be constructed to protect the pipe usually with supports not more than 5 feet from the pipe ends and such that unsupported lengths do not exceed 15 feet. While in storage and shipment pipe shall be protected from excessive heat or cold and shielded from direct sunlight.

(7) Marking - Each length of pipe is to be permanently marked with: manufacturer's name, nominal size, Class pressure rating or SDR number, material designation, ASTM D-2241, and NSF approval

B. PVC (Polyvinyl Chloride) Plastic Pipe (less than 1-1/2-inch diameter) - PVC pipe less than 1-1/2-inch diameter shall meet all the requirements of Part A above except as specifically stated below. Pipe shall be PVC pressure pipe, Schedule

80, manufactured in accordance with ASTM D-1895 and D-1894. Joints shall be solvent weld.

(1) Material - See above

(2) Testing - See above.

(3) Joint Design - Joints shall be solvent weld type. Primer and cement shall be compatible with the pipe material and the intended use. Joints shall be supplied by the pipe manufacturer and shall conform to ASTM D-2564.

The joint design shall be approved by the Sewer Department before the Contractor will be permitted to install any pipe on this project.

(4) Manufacturing Standard - See above

(5) Laying Lengths - See above

(6) Shipment and Storage - See above

(7) Marking - See above

2.04 FITTINGS

Fittings shall be PVC, solvent weld for 1-1/4-inch through 2-inch PVC. Fitting shall be designed and fabricated to the same pressure rating as the pipeline in which the fitting will be installed.

Fittings shall be fabricated by the same manufacturer as the pipe used on this project unless approved otherwise by the Engineer.

Fittings shall meet the requirements of Section 2.03 with regard to material, testing, joint design, manufacturing standard, storage, and marking

2.05 VALVES

A. Gate Valves - For the purpose of controlling flow either on or off or, in some cases, to regulate the rate of flow. Gate valves shall be installed at locations shown on the construction documents or designated by the Engineer.

Gate valves may be used on lines 2-inches in diameter and larger.

Gate valves shall be resilient seat type meeting all the requirements of AWWA C-509, latest revision. Bonnet bolts, studs, and nuts shall be stainless steel. Valve gates shall be cast iron with resilient seat. Stem seals shall be O-ring. Valves shall be furnished with mechanical joint ends in accordance with USA Standard A21.11, unless otherwise shown or directed. Valves shall be suitable for installation in approximately vertical position in buried pipe lines. All valves shall be open to the left (counterclockwise) and shall be provided with a handwheel for operation.

Valves shall be for working pressures up to 200 psi and shall be equal to latest specifications of ASSA C-509, latest revision in all respects.

Valve boxes for gate valves shall be as described below under heading “Valve Boxes.”

B. Ball Valves - On lines less than 2-inches in diameter ball valves are to be used (and may be used on lines up to 4-inches in diameter) for controlling flow either on or off or to regulate the rate of flow. Ball valves shall be installed at locations shown on the drawings or designated by the Engineer.

Ball valves shall be true union type with PVC body, high impact ABS operating handle, teflon seat rings, and elastomer O-ring seals. Valves are to open and close with one-quarter turn. Pressure rating at 30 F to 120 F shall be no less than 150 psi.

Ball valves shall be as manufactured by Asahi/America, Hayward, or approved equal.

Valve boxes for ball valves shall be as described below under heading "Valve Boxes."

C. Check Valves - A check valve shall be located on each service line in the customer service box to protect against backflow from the collection system to the customer's premises in the event the customer's service line breaks.

Valve shall be 1-1/4-inch PVC with an internal flapper designed to swing clear of the flow path during forward flow and to seat tightly against backflow. Valve shall be full-flow design, angle seat, weighted flapper to seat against low pressures while holding up to 50 psi under some operating conditions (test pressures may be higher--see line testing specification). Seal shall be Buna-N or as approved by Engineer.

Valve shall be supplied with compression type ends to serve as union connections. Body shall be PVC compatible with intended application (1-1/4-inch Schedule 40 PVC service piping). Valve shall be as manufactured by Flo Control, Inc. or approved equal.

D. Air Releases Valves - At the locations shown on the drawings or where directed by the Sewer Department air release valves (ARV) shall be installed to vent accumulations of air or other gases while the system lines remain under pressure. Valve size shall be as shown on the drawings and suitable for system operating pressures of 0 to 50 psi (test pressures will be higher-see specification requirements for line testing, this project). Valve shall be suitable for use in sewage (septic tank effluent). Installation will be in accordance with the detail drawings.

Valve shall be APCO No. 200A or approved equal.

E. Air and Vacuum Valves - At the locations shown on the drawings or where directed by the Sewer Department air and vacuum valves (A/VV) shall be installed to vent large quantities of air or relieve vacuum conditions. Valve size shall be as shown on the drawings and suitable for system operating pressures of 0 to 50 psi (test pressures will be higher--see specification requirements for line testing, this project). Valve shall be suitable for use in sewage (septic tank effluent). Installation will be in accordance with the detail drawings.

Valve shall be ARI D-025 series or approved equal.

2.06 VALVE BOXES

Valve boxes for this project are designated on the drawings as one of the following types:

A. Type "A" Valve Box - For all valve boxes clean-out assemblies, ball valves and other lever or hand wheel operated valves, air release valves, and air and vacuum valves, the valve box shall be constructed of precast concrete with a cast iron frame and cover in accordance with project detail drawings.

Frame and cover shall be heavy cast iron construction (traffic type) providing an opening of approximately 12-inches by 20-inches. Frame and cover shall be equal to John Bouchard Company No. 8110 with word "SEWER" cast in the cover.

B. Type "B" Valve Box - At locations where more room is required than is available in a Type "A" valve box a Type "B" valve box shall be used. The box shall be constructed of precast concrete with a cast iron frame and cover in accordance with project detail drawings.

Frame and cover shall be heavy cast iron construction (traffic type) providing an opening approximately 12-inches by 30-inches. Frame and cover shall be John Bouchard Company No. 8122, or approved equal, with word "SEWER" cast in the cover.

Upon completion of the pressure sewer system all pressure sewer valve boxes in public rights-of-way or dedicated easements shall be painted with orange paint. The Developer shall submit paint for approval.

C. Type "C" Valve Box - At the customer service connection housing a clean-out connection, cut-off (ball) valve and check valve, a Type "C" valve box shall be installed in accordance with project detail drawings.

Valve box shall be a standard plastic meter box with a nominal size of 15-inches by 21-inches (bottom dimensions) by 12-inch height with (normally) one 6-inch extension piece for an overall (normal) height of 18-inches. Box shall be injection molded meeting the requirements of ASTM D-2853, latest revision. Material shall be polyolefin with inorganic component reinforcing (or as otherwise approved by Sewer Department) with UV stabilizer additive to provide resistance to material degradation from exposure to sunlight.

The cover shall be cast iron. The cover shall contain a corrosion-resistant steel plate affixed to the underside to enable a buried cover to be found with electronic detection equipment. The cover shall be imprinted with the word "SEWER."

2.07 PREFABRICATED GRINDER SEWAGE PUMP STATIONS

2.07.1 General

The Contractor shall furnish and install a factory-built simplex or duplex grinder pump station consisting of either locations shown on the drawings or as directed by the Engineer or Sewer Department.

The Contractor shall be responsible for all material furnished by him and shall replace, at his own expense, all such material found defective in manufacture or damaged on delivery. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective.

The Contractor shall be responsible for the safe storage of material furnished by him until it has been incorporated in the completed project. All motors and electrical and mechanical components shall be stored in a dry environment. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign material at all times.

The Contractor shall provide a 1-inch water service with meter to all proposed wastewater pump stations 80 GPM or larger or as directed by the Sewer Department. All water services shall be equipped with a reduced pressure backflow preventer and 120 V ground fault circuit interrupter.

2.07.2 Products

Grinder Pump:

The manufacturer shall furnish a factory-built simples or duplex grinder pump station consisting of either one or two grinder pump units as applicable with mercury switch level controls, discharge piping, pump-mounting plates with bottom rail supports, upper rail supports or guide rails, a quick disconnect coupling, lifting chain, reinforced fiberglass pump cover plate, and all necessary parts and equipment installed in a fiberglass reinforced polyester tank as described in the following specifications. The discharge piping and/or check valves shall be so designed as to prevent siphoning of wastewater from the pump basin when conditions of negative pressure exist at the point of connection to the pressure system piping network. The grinder pump station shall be as manufactured by Barnes or approved equal.

Operating Conditions:

The pumps shall be of centrifugal type. The pumps provided shall be capable of delivering a minimum of 16 GPM against a normal rated total dynamic head of 85 feet or actual conditions, whichever is greater, with a maximum shut-off head of 110 feet. Pump motor shall be a minimum of 2 hp, single phase, 230-volt, 3,450 rpm, 60 cycle. The pumps shall not overload at any point on the performance curve and shall be free from harmful effects of cavitations at either high or low head.

Tank:

The tank shall be a minimum of 24-inches in diameter for simplex systems and a minimum of 48-inches in diameter for duplex systems of depth as shown on the attached drawings.

The tank shall be molded of fiberglass reinforced polyester resin of the lay-up and spray technique to assure that the interior surface is smooth and resin rich.

The tank shall have a minimum wall thickness of 1/4-inch. A heavy rib or flange shall extend around the basin for strength and shall have holes through the rib for anchoring in concrete to prevent flotation.

A flexible coupling bedded in gravel with stainless steel bands shall be placed on the outside of the tank for the discharge line and embedded in gravel. Flexible coupling shall be E-One or approved equal.

Tank Cover:

Cover shall be 7/15-inch thick fiberglass with reinforcing ribs with high-temperature bake epoxy paint. Cover shall be bolted to basin with cap screws. Nuts for screws shall be completely embedded in the fiberglass to prevent turning and for corrosion resistance. Cover to be sealed with caulking compound or a gasket fastened to covers.

A basin inlet flange with O-ring for 4-inch Schedule 40 plastic pipe shall be included but not mounted on the basin. Flange to be mounted in the field at inlet height required by the installation. Conduit fittings shall be furnished for sealing cords from control box into conduit entering basin. This is to prevent sewer gases from carrying to control box.

Check Valve:

A heavy all-rubber flapper type check valve or ball check valve shall be an integral part of the lift out discharge seal assembly and shall lift out with the pump assembly.

Shut-Off Valve:

A 2-inch PVC ball with extension handle to top of basin shall be installed in the discharge line for closing when pump assembly is removed. Discharge from station shall be through side of basin and shall consist of 2-inch NPT flexible coupling

Pump and Motor:

The grinder pump and motor are to be especially designed and manufactured so that they can operate completely submerged in the liquid being pumped. Electrical power cord shall be laid in conduit and shall be sealed by use of a cord grip with individual conductors additionally sealed into the cord-cap assembly with epoxy sealing compound, thus eliminating water getting into the motor by following individual conductors inside the insulation unless the pump has a waterproof underground cable. The cord grip shall have a male taper pipe thread which is threaded into a female taper pipe thread in a cord cap. The cord cap shall be sealed into the motor housing with a Buna-N O-ring, providing an

electrical connection which is completely watertight, yet may be easily removed for service.

The combination centrifugal pump impeller and grinder unit shall be attached to a common motor and pump shaft made of stainless steel. The grinder unit shall be on the suction side of the pump impeller and discharging directly into the impeller inlet leaving no exposed shaft to permit packing of ground solids. The grinder shall have two stages or have grinding impeller and shredding ring. Both stationary and rotating cutters shall be made of hardened and ground stainless steel. Pump and motor housings are to be high-quality grey iron castings. Impeller shall be bronze. All fasteners shall be of a high-grade stainless steel.

The pump motor shaft shall be sealed by two mechanical carbon and ceramic faced seals within an oil-filled chamber to provide clean, constant lubrication. The shaft shall be supported by a ball radial and thrust bearing and a lower bronze radial sleeve bearing, between bearing, between the shaft seals to minimize overhang, both running in oil.

The motor winding and rotor are to be mounted in a sealed, submersible type housing which is filled with clean, high dielectric oil for bearing lubrication and to transmit heat from motor winding to outer housing. Motor winding shall be securely held in the housing with machine screws or it shall be pressed into the housing.

Controls for Simplex Station:

Sealed float type mercury switches shall be supplied to control sump level and alarm signal. 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 and a weight shall be attached to cord above the float to prevent sharp bends in the cord when the float operates under water. The float switches shall hang in the sump supported only by the cord that is held to the NEMA 4 fiberglass junction box. Two float switches shall be used to control level: one for pump turn-on, one for pump turn-off, and a third switch shall be provided for alarm control.

A red alarm light is to be supplied for mounting on the control box.

The light shall consist of a 40-watt high-intensity bulb and a red polycarbonate lens with a neoprene gasket. The alarm light will flash to indicate a high water condition and go out when the water level drops.

Operation of Simplex System: On sump level rise, the lower mercury switch shall first be energized, then upper level switch shall next energize and start pump. With pump operating sump level shall lower to low switch turn-off setting and pump shall stop. If level continues to rise when pump is operating the alarm switch shall energize. All level switches shall be adjustable for level settings from the surface.

Electrical Control Panel for Simplex Station:

Control panel shall have a NEMA 4X weatherproof enclosure. A lock hasp shall be provided on door. A circuit breaker shall be provided for the pump and a magnetic starter with one leg overload protection for single phase operation shall be supplied. H-O-A switches and run lights shall be supplied for the pump.

Terminal strip shall be provided for connecting pump and control valves. Additional terminals shall be provided to connect alarm. Control circuit shall be 115V or a transformer shall be supplied to give 24V control circuit. The control panels shall be provided with a disconnect switch that will permit the servicing of the various electrical components without such components being subject electrical power. **All electrical connections shall be to the bottom of the electrical disconnect and control panels. Duct seal is to be used in all conduits.**

Note: Control panel must be UL listed.

Controls for Duplex Station:

Sealed float type mercury switches shall be supplied to control sump level and alarm signal. 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. A weight shall be attached to cord above the float to hold switch in place in sump. Weight shall be above the float to effectively prevent sharp bends in the cord when the float operates. The float switches shall hang in the sump supported only by the cord that is held to the NEMA 4X cast iron or cast aluminum junction box. Three float switches shall be used to control level: one for pump turn-on, one for pump turn-off, and a one for both pumps turn-on. A fourth switch shall be provided for alarm control.

A red alarm light is to be supplied for mounting on the control box.

The light shall consist of a 40-watt high-intensity bulb and a red polycarbonate lens with a neoprene gasket. The alarm light will flash to indicate a high water condition and go out when the water level drops.

Operation of Duplex System:

On sump level rise the lower mercury switch shall first be energized, then upper level switch shall next energize and start lead pump. With lead pump operating sump level shall lower to low switch turn-off setting and pump shall stop. Alternating relay shall index on stopping of pump so that lag pump will start on the next operation. If sump level continues to rise when lead pump is operating override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low-level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm switch shall energize and signal the alarm. If one pump should fail for any reason the second pump shall operate on the override control and if level continues to rise the alarm switch shall energize and signal the alarm. All level switches shall be adjustable for level setting from the surface.

Electrical Control Panel for Duplex Station:

Control panel shall have a NEMA 3 R/12 weatherproof enclosure. A lock hasp shall be provided on door. A circuit breaker shall be provided for each pump and a magnetic starter with a leg overload protection shall be supplied. An alternating relay or solid state alternator shall be provided to alternate pumps on each successive cycle of operation. Starters shall have auxiliary contact to operate both pumps on override condition. An interlock relay shall be provided to automatically reconnect the control circuit in case of circuit breaker trip on one pump. H-O-A switches and run lights shall be supplied for each pump. Terminal

strip shall be provided for connecting pump and control wires. Additional terminals shall be provided to connect alarm. Control circuit shall be 115V or a transformer shall be supplied to give 24V control circuit. The control panels shall be provided with a disconnect switch that will permit the servicing of the various electrical components without such components being subject electrical power.

Note: Control panel must be UL listed.

Wiring:

It shall be the responsibility of the electrical contractor to furnish and install, according to the drawings and in compliance with appropriate national and local codes, the branch circuit protection and all wiring to the pump leads and to the high alarm indicator lamp.

Corrosion Protection:

All materials exposed to wastewater shall have inherent corrosion protection: i.e., cast iron, fiberglass, stainless steel, PVC. Any exterior steel surfaces are to be suitably protected against corrosion.

Serviceability:

The grinder pump unit shall have provisions for lifting to facilitate easy removal of the unit from the tank if necessary.

Manufacturer:

The equipment specified shall be the product of a company experienced in the design and manufacture of grinder pumps for specific use in low-pressure sewage systems. The company shall submit detailed installation and user instructions for its product; submit evidence of an established service support program including complete parts and service manuals; and be responsible for maintaining a continuing inventory of grinder pump replacement parts.

Warranty:

The manufacturer shall warrant its product to be free from defects in material and factory workmanship for a period of one year from date of acceptance. Repair or parts replacement required as a result of such defects will be made free of charge during this period.

The manufacturer will provide the General Contractor specific instructions on the assembly and installation of the pump stations and related equipment.

The manufacturer will furnish, at his own expense, the services of a factory-trained serviceman to instruct the Owner's personnel in the operation and maintenance of the pumps and related equipment. The individual performing the instruction to the Owner is to be trained and/or certified by the manufacturer as its authorized operation, maintenance, and service specialist.

Execution

Install grinder sewage pump station as shown on the drawings and in accordance with the manufacturer’s recommendations.

Obtain the services of the manufacturer's service engineer to check the installation of each grinder sewage pump station and make any field adjustments necessary to ensure proper operation.

For typical grinder pump installations see Standard Drawings attached hereto.

2.08 SUBMERSIBLE WASTEWATER PUMP STATIONS

2.08.1 General

For wastewater pump stations to operate over 180 gpm, the contractor shall furnish two (2) heavy-duty submersible explosion-proof sewage pumps capable of handling raw unscreened sewage with motors, controls, and all other equipment specified herein. Pump and motors shall be Gorman Rupp or approved equal by the Owner.

The Contractor shall coordinate inspection and tests with the pump station manufacturer. Manufacturer is to inspect the installation and operation of the equipment and provide to the Sewer Department a written certification that the facilities are properly installed and operating in accordance with the requirements of the manufacturer.

After installation representatives of the manufacturer shall conduct field tests to demonstrate that capacities and operating characteristics specified are developed. In addition the manufacturer shall furnish a certificate stating the pumps and equipment were installed in accordance with the manufacturer's recommendation.

The Contractors attention is directed to the fact that stand-by power is required for all wet well mounted pump stations. Type of stand-by power is to be determined on a case by case basis and as required by the Sewer Department.

The Contractor shall provide a 1-inch water service with meter to all proposed wastewater pump stations.

For some wastewater pump stations odor control facilities may be required. These type facilities will be directed by the Sewer Department prior to approval for construction.

2.08.2 Products

Solids Handling Capability

The pump and integrated, close-coupled motor shall be a water tight, fully submersible unit, capable of handling raw unscreened sewage, storm water, and other similar solids-laden fluids without clogging. The pump with its appurtenances and cable shall be capable of continuous submergence in the pumped liquid to a depth of 65 feet. When used in dry pit applications, the optional integrated motor cooling system shall allow the motor to run at full load continuously without the need for supplemental external cooling.

Pump and Motor

Major pump components shall be of gray iron, ASTM A-48, Class 40, or ductile iron, Class 65-45-12, with a 125# Flange. Casing shall be easily removable from the motor for full inspection of impeller. All exposed nuts and bolts shall be AISI type 316 stainless steel construction. All external surfaces coming into contact with pumped media shall be protected by water-based epoxy primer and a waterborne enamel top coat with a minimum 8 mil thickness. All exposed fasteners and lock washers shall be of 300 series stainless steel.

Sealing design for the pump/motor assembly shall incorporate metal to metal contact between machined surfaces. Critical mating surfaces where a watertight seal is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without requiring a specific torque limit. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate or equal. Secondary sealing compounds shall neither be required nor used.

All pump openings and passages shall be of adequate size to pass 3.5" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system.

The rotating assembly (impeller, shaft and rotor) shall be dynamically balanced such that undue vibration or other unsatisfactory characteristics will not result when the pump is in operation.

The pump shaft and motor shaft shall be an integral unit. Each shaft shall be a one-piece design manufactured from 416 stainless steel material, and adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system. Maximum deflection shall not exceed .002” at the primary shaft seal. The shaft shall have a polished finish and have accurately machined shoulders to accommodate bearings, seals, and impeller. Shafts of multiple piece design such as friction welded shafts, those requiring shaft sleeves, or shafts made from carbon steel or chrome plated steel shall not be allowed.

Two separate mechanical seals shall be provided, arranged in tandem. The upper seal shall have a carbon rotating face and ni-resist stationary face. The lower seal shall incorporate silicon carbide on both the rotating and stationary faces. Cage and springs shall be of stainless steel and elastomers of Viton or Buna-N. The rotating seal faces shall be lubricated from an oil filled reservoir between pump and motor; the oil serving as both lubricating and a cooling media. The reservoir shall have two oil fill and drain plugs to insure accuracy when measuring lubricant level and for ease of maintenance. Seal shall require no special maintenance or routine adjustment; however, shall be easily inspected or replaced. No seal damage shall result from operating the pump for short periods of time without liquid. A seal failure electric probe sensor shall be installed in the seal chamber. The sensor shall be capable of sensing leakage into the seal chamber and the sensitivity level shall be set in the control panel.

The impeller shall be enclosed non-clog channel design, incorporating multiple vanes with wide flow channels. It shall be ductile iron, Class 65-45-12, with designed counter weight mass for dynamic balancing to eliminate vibration. Balancing shall not deform or weaken the impeller. The impeller shall be driven by means of a key slotted into the shaft. Impeller fasteners shall be non-corroding. The axial suction clearance between the impeller and pump casing shall be fully adjustable to maintain peak operating efficiency of the pump. The adjustment shall be easily accomplished using four external adjusting screws.

The pump volute shall be single piece gray cast iron, ASTM A48, Class 40, non-concentric design with centerline discharge. Passages shall be smooth, and large enough to pass ant solids that may exit the impeller. The discharge flange design shall permit attachment to either standard ANSI or standard DIN flanges/appurtenances. The motor shall be attached to the volute by stainless steel bolts. The motor unit, with impeller attached, shall be removable from the volute without requiring removal of the impeller, and without disturbing the watertight integrity of the motor unit.

Each phase of the motor shall contain a bi-metallic temperature monitor in the upper portion of the stator windings. These thermal switches shall be connected in series and set to open at 140˚C ± 5˚C. They shall be connected to the control panel, and used in conjunction with, and supplemental to, external motor overload protection. AS an option, RTD type temperature measuring devices shall be available for the motor winding.

Each pump shaft shall rotate on permanently lubricated, greased bearings. The upper bearing shall be a deep groove ball bearing. The lower bearings shall be a heavy-duty double row angular contact ball bearing. Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. L-10 bearing life shall be a minimum of 50,000 hours at flows ranging from ½ of BEP flow to 1½ times BEP flow (BEP is best efficiency point).

Each pump shall be factory tested by manufacturer for capacity, power requirement and efficiency at specified minimum operating head, rated head, shut-off head and at as many other points as necessary to provide certified pump performance curves. At least four (4) copies of such certified performance curves shall be furnished to Engineer for approval prior to shipment of the equipment.

Pump Station Components

Power Cables:

The power cables shall be sized and selected according to applicable NEC, CSA, and FM standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be an oil resistant and UV stable material, and shall be capable of continuous submergence in water to a depth of 65 feet.

Cable Entry / Junction Chamber:

The cable entry design shall not require a specific torque to insure a watertight seal. The cable entry shall consist of a cylindrical elastomer grommet, flanked by stainless steel washers. A cable cap incorporating a strain relief shall mount to the cable entry boss compressing the grommet ID to the cable while the grommet OD seals against the bore of the cable entry. The junction chamber is to be isolated and sealed from the motor chamber by means of sealing glands. Electrical connections between the power cables and motor leads shall be made via a post type terminal board, and ring terminals, allowing easy disconnection and maintenance.

Lifting Bale:

The pump shall be fitted with a rigid stainless steel lifting bale of suitable strength to lift up to four times the weight of the pump. The lifting bale shall provide a large open loop so that the bale can be hooked from the surface, precluding the need for personnel to enter the wet well. The bale shall be designed so that standard, commercially available shackles and fittings can be used to attach lifting chains. A hoisting bail shall provide for proper balance of pump while it is being lifted

Lift Out Rail System:

Each lift out rail system shall consist of: a ductile iron discharge base, cast iron pump attaching and sealing plate, stainless steel pump guide plate, and cast iron elbow. All

exposed nuts, bolts, and fasteners shall be of 300 series stainless steel. No fabricated steel parts shall be used.

Quick Connect Guide Rail System:

The discharge base elbow shall be permanently installed in the wet well and connected to the discharge piping. In order to prevent binding or separation of the pump from the guide rail system, the pumps shall connect to the guide rail base automatically and firmly, guided by two guide bars extending from the top of the station to the discharge base elbow. Systems using guide cable in lieu of rigid guide bars or pipes shall not be considered acceptable. The sliding guide bracket shall be a separate part of the pumping unit, capable of being attached to either standard ANSI or standard DIN pump flanges, so that the bracket is interchangeable with other pumps, and not limited to a specific pump. Non standard flange dimensions or proprietary flange designs shall no be considered acceptable. There shall be no need for personnel to enter the wet well to remove or reinstall the pumps. A field replaceable Nitrile rubber profile gasket or o-ring shall accomplish positive sealing of the pump flange / guide rail bracket to the discharge elbow. Metal to metal contact between the pump and discharge base elbow as a means of sealing shall not be considered acceptable. No portion of the pump shall bear directly on the floor of the sump.

Guide Rail:

Two rail pipes shall be used to guide the pump from the surface to the discharge base connection. The guide rails shall be 2-inch schedule 40 stainless steel pipe. The weight of the pump shall bear solely on the discharge base and not the guide rails. Rail systems which require the pump to be supported by legs which could interfere with the flow of solids into the pump suction shall not be allowed. The guide rails shall be firmly attached to the access hatch frame. Systems deeper than 21 feet shall use an intermediate guide for each 21 feet of wet well depth. All guide rails shall be type 304, schedule 40 stainless steel.

Lifting Chain:

An adequate length of ¼-inch stainless steel lifting chain shall be supplied for removing the pump. The chain shall be of sufficient length and shall include an adequate number of lifting rings for easy removal. Length shall be 5’ greater than the overall wet well depth. A stainless steel fabricated hook shall be provided for each chain. These hooks shall be secured to the hatch frame with stainless steel bolts and nuts before the hatch is cast into concrete.

Top Rail Support Plates:

One (1) each stainless steel top rail support plate shall be provided for each installed pump. This plate shall be fabricated of stainless steel plate and shall contain expandable rubber bushings to accept the 2” stainless steel guide rails. These rubber bushings when completely tightened shall provide for a tight, vibration free guide rail installation. Notched openings in the rail support plates shall provide for horizontal adjustment. All fasteners shall be stainless steel. Steel or galvanized top plates shall not be allowed.

Pump Motors

The motor and pump must be connected to form an integral unit. Motor shall be a squirrel-cage, induction type in an air-filled water tight enclosure, oil-filled motors shall not be acceptable. The motor shall conform to NEMA design standards, and incorporate Class H insulation materials to withstand a continuous operating temperature of 180^0C (356^0F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40^0C (104^0F).

Motor shall be capable of sustaining a minimum of 15 starts per hour and shall be inverter duty rated in accordance with NEMA MG1. The motor shall not require a cooling jacket or any other means of auxiliary cooling during normal continuous operation.

Motor housing shall be of cast iron. The stator shall consist of copper windings with copper connectors applied to high grade electrical steel laminations. The stator shall be held securely in place by a heat-shrink fit into the motor housing. Any other means of securing the stator which would require penetration of the motor housing shall not be considered acceptable.

Combined rotor and shaft assembly shall be dynamically balanced for vibration-free operation. Rotor end bars and short circuit rings shall be of aluminum. The pump shaft shall be of 17-4 PH series stainless steel. The shaft shall be machined with shoulders or snap ring grooves for positive placement of bearings.

The upper and lower bearing shall be of heavy-duty design, capable of supporting the shaft and rotor while under maximum radial and thrust loads. The bearings shall be permanently grease lubricated and sealed at the time of installation. The minimum B-10 bearing life shall be 50,000 hours over the normal operating range of the curve.

Note: The pump and motor assembly shall be explosion proof and UL listed.

All static seals at watertight mating surfaces shall be of Buna-N or Viton rubber O-ring type. Use of auxiliary sealing compounds shall not be required.

The power and control cables shall enter the motor through a terminal housing. The entrance shall be sealed with a rubber grommet and clamp set which when compressed longitudinally causes a radial watertight seal. The individual leads of the power and control cables shall be separated by a compressible grommet, which shall provide protection from wicking through the cable. Any other cable entrance design requiring use of epoxies, silicones, or similar caulking materials shall be considered unacceptable.

The motor and sensor leads shall be mated to the cable leads through a group of quick-connect, color-coded cable connectors.

The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity to a depth of 65 feet.

The watertight integrity of the motor housing and shaft seal shall be tested during manufacture by vacuum testing the completed pump assembly.

Motor Protection

The motor shall be protected from thermal damage by a group of three separate thermostatic switches embedded into the stator windings, one per stator phase. Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature set point of 160^{O}C (320^{O}F) and shall automatically reset upon cooling of the winding. The thermal sensing device shall be connected to the pump control panel by the contractor. The pump shall utilize a single probe to monitor both the motor and seal chambers for moisture intrusion. The detection of moisture in either chamber shall send a signal to the control panel which shall be used to notify the user of the need for an inspection.

Automatic Discharge Connection

Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design must insure an automatic and firm connection of the pump to the discharge piping when lowered into place.

A gray iron or fabricated steel base plate with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base plate shall be designed with an integral 90^{0} elbow, or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base plate shall be coated with an epoxy coating for corrosion resistance. The manufacturer shall provide all necessary drawings to insure proper installation and alignment of baseplate within the sump.

Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.

The contractor shall provide two lengths of 2", schedule 40 stainless steel guide rail pipe for each pump.

Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.

The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.

Lifting cable shall consist of a 316 stainless steel braided wire cable attached to the pump lifting bail. A crimped ball end shall be provided at the upper end of this cable for attaching to the wet well access frame.

All bolts, machine screws, nuts, washers, and lock washers for complete assembly of access cover, guide rails, and discharge elbow shall be stainless steel.

2.08.3 Valves and Piping

Check Valve

Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable. Valves shall be APCO, Kennedy or approved equal.

Plug Valve

Each discharge line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the common discharge header. The plug valve shall be non-lubricated type. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall have ports designed to pass 3" spherical solids.

Piping

Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

Bolt holes shall be in angular alignment within $1/2^0$ between flanges. Flanges shall be faced and a gasket finish applied.

All pipes connected to the pump station shall be installed plum and without strains or binds and be properly supported according to good commercial practice. Fabricated pipe supports shall be stainless steel or aluminum

2.08.4 Pump Operations and Control

Panel Enclosure

The pump control panel shall be a NEMA 4X full dead front stainless steel panel. Panel shall be appropriate for 3/60/480 volt electrical service. Present sizing on all components shall be based on minimum 35 horsepower motor. Panel shall be furnished by the pump

supplier and mounted at location as shown on the plans. All electrical switches, lamps, relays, breakers and starters shall be as manufactured by Square D or approved equal. All control work shall conform to the National Electrical Code and only U.L. listed devices shall be used.

The panel shall be supported by an aluminum control panel mounting system. This mounting pedestal shall be a minimum of 6x6x24 and fabricated of aluminum or stainless steel. All pump and control cables shall pass through this pedestal and enter the control enclosure through the bottom. Sealing of the cable entries shall be accomplished by Nylon cable grips for a gas tight seal.

A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

Other Control Components

The pump control panel shall be equipped to terminate pump operation due to high motor winding temperature or moisture in the motor housing or seal cavity, utilizing contacts in the pump motor housing and seal cavity. If a moisture or thermal event should occur, the motor starter will drop out and a visible indicator on the door shall indicate the pump motor has been shut down. If shutdown is due to high motor temperature, motor power will automatically be restored when the temperature returns to normal range. If the shutdown occurs due to moisture, a manual reset will be required before motor power is restored. Dry contacts, wired to terminal blocks, shall be furnished for each pump for thermal/moisture shutdown.

The control circuit shall be protected by a normal duty thermal- magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.

Pump mode selector switches shall be connected to permit manual start and manual stop for each pump individually, and to select automatic operation of each pump under control of the liquid level control system. Manual operation shall override the liquid level control system. Selector switches shall be heavy duty, oil-tight design, with contacts rated NEMA A300 minimum.

Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.

Control panel shall be equipped with one oil-tight pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running.

Six digit elapsed time meter shall be shall be displayed on the Integrinex™ Standard operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.

A switch shall be provided to permit the station operator to select automatic alternation of the pumps, to select pump number one to be the lead pump for each pumping cycle or to select pump number two to be the lead pump for each pumping cycle. Selector switch shall be oil-tight design, with contacts rated NEMA A300 minimum.

A duplex ground fault indicating utility receptacle providing 115 VAC, 60 Hertz, single phase current, shall be mounted on the door panel of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

The lift station shall be equipped with a 3 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.

A properly sized heavy duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating at 480 volts. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

An open frame, across-the-line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. Coils shall be epoxy molded for protection from moisture and corrosive atmospheres. The starter assembly shall be equipped with a metal mounting plate for durability. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts and coils shall be easily replaceable without removing the motor starter from its mounted position.

Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

Control Logic

The control logic shall be the standard lead/lag pump operation with selector switches as described below. Various devices and functions to be included in the control panel shall be as follows:

a. Branch circuit breaker – each pump (Square D type QOU)
b. Magnetic starter with thermal overload protection – each pump (Sq D IEC rated)
c. 115 volt circuit breakers as required including one 20 amp breaker supplying a weatherproof duplex receptacle mounted below the panel.
d. Two pump alternator (Diversified type ARA)
e. Pump run time meter – each pump
f. H-O-A selector switch for each pump
g. With above switches in “Auto” position the pumps shall operate through a third 3 Pump #2 or alternate. This switch can be mounted on the alternator.
h. Motor over temperature shutdown
i. Strip heater with thermostat on separate circuit.
j. Power monitor/phase failure relay
k. Lightning arrestor with surge capacitor
l. Wiring from dry contracts on starters or control relays to a terminal strip to activate future telemetering equipment for the following: pump 1 run, pump 2 run, pump 1 fail, pump 2 fail, low level alarm, high lelev alarm, seal leak alarm, power failure

Wiring

The control panel, as furnished by the manufacturer, shall be completely wired. The contractor shall field connect the power feeder lines to the main terminal block, final connections to the remote alarm devices, and the connections between the pump and the pump motor control. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).

All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:

a. Line and load circuits, AC or DC power.....Black
b. AC control circuit less than line voltage.....Red
c. DC control circuit.....Blue
d. Interlock control circuit, from external source..Yellow
e. Equipment grounding conductor.....Green
f. Current carrying ground.....White
g. Hot with circuit breaker open.....Orange

Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be of 16 gauge minimum, type MTW or THW, 600 volts. Power wiring shall be 14 gauge minimum.

Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in accordance with the electrical diagrams. All wires on the sub-plate shall be bundled and tied.

Wires connected to components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position without undue stress or abrasion on the wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.

Conduit requirements are as follows:

All conduit and fittings shall be UL listed.

Liquid tight flexible metal conduit shall be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.

Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.

Conduit shall be sized according to the National Electric Code.

Grounding:

The pump control manufacturer shall provide a common ground bar mounted on the enclosure back plate. The mounting surface of the ground bar shall have any paint removed before making final connections.

The contractor shall make the field connections to the main ground lug and each pump motor in accordance with the National Electric Code.

Identification:

A permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:

a. Equipment serial number
b. Control panel short circuit rating
c. Supply voltage, phase and frequency
d. Current rating of the minimum main conductor
e. Electrical wiring diagram number
f. Motor horsepower and full load current
g. Motor overload heater element
h. Motor circuit breaker trip current rating
i. Name and location of equipment manufacturer

Control components shall be permanently marked using the same identification shown on the electrical diagram. Identification label shall be mounted adjacent to the device.

Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Marking shall be mounted adjacent to and above the device.

2.08.5 Liquid Level Control

The level control system shall start and stop pump motors in response to changes in wet well level. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system.

The level control system shall start and stop the pumps in accordance to the wet well level. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the "lead pump start level". When the water is lowered to the "pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the water continue to rise, an additional float switch will start the second pump after reaching the "lag pump start level" so that both pumps operate together. Both pumps shall stop at the same "all pumps off level". Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

The level control system shall work in conjunction with an alternator relay to select first one pump, then the second pump, to run as "Lead" pump. Alternation will occur at the end of each pumping cycle.

Three float switches shall be supplied for installation by the contractor. Each float shall contain a mercury switch sealed in a polypropylene housing, with 30 feet of power cord, and polypropylene mounting hardware. The floats shall be secured to a weight and chain in the wet well.

High Water and Low Water Alarm with Alarm Silence

A separate float switch and relay shall be used to alert maintenance personnel to a high water level in the wet well. Should the water level rise to the "high water alarm" level, the float switch and relay shall energize a 115-volt AC circuit for an external alarm device. An electrical or mechanical indicator, visible from front of control panel, shall indicate high level condition exists. The alarm signal shall be maintained until wet well level is lowered and alarm circuit has been manually reset.

A separate float switch shall be used to alert maintenance personnel to a low liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause of the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable both pump motors. When the wet well rises above the low level point, both pump motors shall be automatically enabled. The low water alarm shall be furnished with SPDT dry contacts.

An alarm silence switch and relay shall provide maintenance personnel a means to de-energize the external alarm device while corrective actions are under way. After silencing the alarm, manual reset of the magnetic switch shall provide automatic reset of the alarm silence relay.

2.08.6 Pump Station Accessories

Discharge Gauge Kit

The pump station shall be equipped with a glycerin-filled pressure gauge to monitor discharge pressures. Gauge shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Pressure gauge shall be graduated 0 to 140 feet water column minimum. Gauge kit shall be mounted and complete with all hoses and fittings and shall include a shutoff valve installed in each connection to discharge piping and a three way valve to monitor either pump.

The pressure gauge shall be protected by a diaphragm seal. The seal assembly shall be 316 SST constructed and be equal to Ashcroft Model 200

Portable Hoist and Socket

The pump station shall be provided with a portable hoist with winch assembly. Hoist shall be designed to lift pumps weighing up to 650 pounds. Portable hoist shall not weigh more than 75 pounds. Hoist socket shall be permanently installed on station slab.

Hoist Socket

The pump station shall be provided with a hoist socket permanently installed on station slab for use with portable hoist.

UL Label Requirements:

Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

Transient Voltage Surge Suppressor:

The control panel shall be equipped with a modular surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected by heavy duty zinc-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a short circuit current rating of 200,000 Amps and a Maximum Discharge current rating of 40,000 Amperes. Nominal discharge current is 20,000 Amperes. Surge arrester according to UL 1449 3rd Edition, Type 2 component assembly.

Alarm Light:

Station manufacturer will supply one 115 volt AC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light shall be mounted on the station enclosure.

Drain Kit:

Pumps to be supplied with a drain kit for ease of maintenance. The kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and

factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

Spare Parts Kit:

The following minimum spare parts shall be furnished with the pump station:

a) One spare pump mechanical seal (complete with shaft sleeve).
b) One cover plate O-Ring.
c) One rotating assembly O-Ring.
d) One set of rotating assembly spacers.

Gauge Kit

A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.

Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

Secondary Lightning Arrestor and Pump Start Delay:

The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

Three Phase Voltage Monitor:

The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

Low Water Alarm

The electronic pressure switch shall be equipped with an additional electronic comparator and solid state output relay to alert maintenance personnel to a low liquid level in the wet well. In the event that the wet well liquid reaches a preset low water alarm level the alarm output relay shall energize a signal relay. The signal relay shall complete a 12 volt DC circuit for an external alarm device. An indicator, visible on the front of the control panel, shall indicate that a low wet well level exists. The signal relay shall maintain the alarm signal until the wet well level has risen and the circuit has been manually reset.

Spare 120 Volt Circuits

The pump station control panel shall be provided with four (4) spare 20 amp circuit breakers to provide 120/1/60 power to various ancillary devices.

Muffin Monster (Grinder):

For stations with a design of 300 gallons per minute or more, a Muffin Monster or approved equal type grinder shall be required. The grinder shall be mounted to the wall of the wet well on the influent line to the wastewater pump station.

2.08.7 Telemetry Communication

All pumping duplex or larger type pumping stations with a capacity of 40 gpm or greater, or as directed by the Hendersonville Utility District, shall be required to have the Advantis® Pump Scout remote monitor satellite system. The system shall provide alarms and alerts for at a minimum high/low water alarm, pump run hours, breaker trip, motor starter or pump failure, and power loss. The system shall also provide a daily report of all activity at the remote location including acknowledgements for the person that responded. The equipment shall consist of Nema 4X enclosure, battery backup, power supply and antenna. Remote monitor communication equipment to be obtained from Advantis, LLC of Marshall, Texas, 903-472-5663 or as directed by HUD personnel. Developer or installing contractor shall be required to pay for start-up and first six months of monitoring in addition to installation and equipment cost.

* * *

SECTION 3 - CONSTRUCTION

(Low Pressure Sewage Collection System)

3.01 PRELIMINARY WORK

3.01.1 Location of Lines - The streets, roads and easements in which lines shall be placed shall be shown on the drawings. Any change from locations shall be approved by the Sewer Department before construction

3.01.2 Location and Protection of Underground Utilities - Prior to trenching the Contractor shall determine, insofar as possible, the actual location of all underground utilities in the vicinity of these operations and shall clearly mark their locations so they may be avoided by equipment operators. Utility lines or services that appear to lie in the path of construction shall be uncovered in advance to determine the exact location and depth and to avoid damage due to trenching operations. Existing facilities shall be protected during construction or removed and replaced in equal condition as necessary.

Should any existing utility line or service be damaged during, or as a result of, the Contractor's operations the Contractor shall take such emergency measures as may be necessary to minimize damage and shall immediately notify the utility involved. The Contractor shall then repair the damage to the satisfaction of the utility or shall pay the utility for making the repairs. In all cases the restoration and/or repair shall be such that the damaged structure will be in as good or better condition as before the damage occurred.

3.01.3 Removal of Obstructions - The Contractor shall be responsible for the removal, safeguarding and replacement of fences, walls, structures, culverts, street signs, billboards, shrubs, mailboxes, or other obstructions which must be moved to facilitate construction. Such obstructions must be restored to at least their original condition.

3.01.4 Clearing and Grubbing - The Contractor shall be responsible for cutting, removing and disposing of all trees, brush, stumps, roots and weeds within the construction area. Disposal shall be by means of chippers, landfills, or other approved method and not in conflict with State or local ordinances.

Care shall be taken to avoid unnecessary cutting or damage to trees not in the construction area. The Contractor will be responsible for loss or damage to trees as well as other damages outside the permanent easement or rights-of-way resulting from the Contractor's activities.

3.02. EXCAVATION

3.02.1 General - The Contractor shall perform all required excavation and backfilling incidental to the installation of the sewers, manholes, force mains, and other appurtenances. Excavation shall be carried to the depths indicated on the Drawings or as necessary to permit the installation of pipe, bedding, structures, or appurtenances. Care shall be taken to provide a firm, undisturbed, uniform surface in the bottoms of trenches and excavations for structures. Where the excavation exceeds the required depth the Contractor shall bring the excavation to proper grade through the use of an approved incompressible backfill material (generally crushed stone or fill concrete, depending upon the nature of the facility to be placed thereon). In the event unstable soil conditions are encountered at

the bottom of the excavation the Engineer may direct the Contractor to continue the excavation to firm soil or to provide pilings or other suitable special foundations.

The Contractor shall take such precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities or structures through cave-ins, slides, settlement or other soil disturbance resulting from his operations. The Contractor shall be responsible for storage of excavated material, disposal of surplus excavated material, trench dewatering and other operations incidental to excavation and backfilling operations.

The Contractor shall be responsible for storage of excavated material, disposal of surplus excavated material, trench dewatering and other operations incidental to excavation and backfill operations.

3.02.2 Pavement Removal - Where existing paved streets, roads, parking lots, drives or sidewalks must be disturbed during construction of the project the Contractor shall take the necessary steps to minimize damage. Permanent type pavement shall be cut or sawed in a straight line before removal and care shall be taken during excavation to avoid damage to adjacent pavement. Where trucks or other heavy equipment must cross curbs or sidewalks such areas shall be suitably protected. A Street Cut Permit shall be obtained from the City of Hendersonville Public Works Department prior to commencement of any work within the right-of-way.

3.02.3 Trench Excavation - Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material, and appurtenances.

Trenching for installation of low-pressure sewage collection piping shall be such that the pipe will have a minimum cover of thirty (30) inches. The bottom of trenches must be shaped by hand and bell holes must be dug so that full length of pipe is resting on trench bottom. Blocking shall not be used.

Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions but, in general, shall not include more than 300 feet of continuous open trench at any time. The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill and clean-up and in the event of failure to do so may be prohibited from opening additional trenches until such work is completed.

The Contractor shall plan his operations so as to cause a minimum of inconvenience to property owners and to traffic. No road, street or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

1. Permit is secured from appropriate State, County or Municipal authorities having jurisdiction.

2. Fire and Police Departments are notified before road is closed.

3. Suitable detours are provided and are clearly marked.

No driveways shall be cut or blocked without first notifying the occupants of the property. Every effort shall be made to schedule the blocking of drives to suit the occupants' convenience and, except in case of emergency, drives shall not be blocked for a period of more than 8 hours.

The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for the protection of public safety. Flagman shall be provided as required on heavily traveled streets to avoid traffic jams or accidents.

Trench width shall be held to a minimum consistent with proper working space for the assembly of pipe. Maximum trench width up to a point one foot above top of pipe shall be limited to the outside pipe diameter plus 16-inches. Boulders, large stone, shale, and rock shall be removed to provide clearance of 6-inches below and on each side of the pipe.

Trench walls shall be kept as nearly vertical as possible with due consideration to soil conditions encountered and when necessary sheeting or bracing shall be provided to protect life and property.

Where unstable soil conditions are encountered at the trench bottom the Contractor shall remove such additional material as may be directed by the Engineer and replace the excavated material with approved backfill.

The Contractor shall excavate by hand wherever necessary to protect existing structures or utilities from damage or to prevent over-depth excavation in the trench subgrade.

Excavated material shall be stored safely away from the edge of trench and in such a way as to avoid encroachment on private property.

3.02.4 Excavation for Structures - Excavation for manholes, junction boxes, piers, or other structure shall be only as large as may be required for the structure and for working room around the structure. Earth excavation shall generally extend to the outer limits of the structure at the bottom and shall slope outward at such angle as may be required for stability of excavated face. Rock excavation shall be carried to a point 6-inches outside the structure so that no rock is left within 6-inches of the finished structure.

Care shall be taken as the excavation approaches the desired grade to avoid over-depth excavation and provide a firm and undisturbed soil surface on which footings, slabs, or foundations are to be placed. Should the Contractor excavate below the desired grade level excavation shall be brought to grade by the use of Class B concrete at the expense of the Contractor. The use of tamped earth backfill under foundations, footings, or slabs will not be acceptable.

Where structures rest partially upon rock the rock shall be excavated to a point 6-inches below bottom of structure and compacted crushed stone shall be used to bring the excavation back to grade. Where the structure will rest completely on sound solid rock the rock shall be excavated to a point 4-inches below bottom of structure and compacted crushed stone shall be used to bring the excavation back to grade. The Contractor is cautioned to use care in leveling prior to the setting of precast manholes of junction boxes.

Should the material found at the desired subgrade appear to be unstable or otherwise unsuitable for support of the structure such condition shall be immediately called to the attention of the Engineer. The Engineer may direct that such unsuitable material be removed and replaced with concrete, may modify the foundation design to suit the condition, or may determine the bearing capacity of the material for the load to be supported; but, in any case, Engineer shall provide written instructions to the Contractor as to the procedure to be followed.

3.02.5 Rock Excavation - Where rock excavation is encountered in trenches the excavation shall be carried to a depth of 6-inches below the bottom of the pipe. The rock shall also be removed to a width of at least 6-inches beyond the outside of the pipe on each side so that no rock is left within 6-inches of the outside wall of the pipe. The trench shall be brought back to grade by the use of crushed stone which shall be compacted to form a stable base for the pipe laying operation where rock is excavated in the bottom of the trench. If track drills are used for drilling rock, water must be provided and used with the drilling operation to control dust.

The Contractor shall exercise all necessary precautions in blasting operations. Suitable blasting mats shall be provided and utilized as required. Blasting shall be done only by experienced men. Careless shooting, resulting in the ejection of stones or other debris during blasting, shall be corrected immediately by the Contractor's representative.

No blasting shall be conducted unless the Contractor shall have taken out the necessary insurance to fully protect the Owner from all possible damages resulting from the blasting operations. The blasting shall be done in accordance with all recognized safety precautions and in accordance with regulations of authorities having jurisdiction. In addition the Contractor shall exercise the necessary care to safeguard the storing of blasting materials on the property.

Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas, Contractor shall remove the rock in a manner that will ensure protection of these structures. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting. In general blasting shall not be done within 25 feet of the completed pipeline or any existing structure.

3.02.6 Sheeting and Shoring - The Contractor shall provide such bracing, sheeting, or shoring as may be necessary for the protection of life and property. Sheeting will be required where necessary to restrict the trench width to acceptable limits above the top of pipe.

Sheeting, shoring, or bracing shall conform to applicable safety codes and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above top of pipe. The bracing or sheeting may then be removed in an approved manner unless the Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place, either at the direction of the Engineer or option of the Contractor, the sheeting shall be cut off at least 18-inches below the finished ground level.

Care shall be taken in removing sheeting to avoid weakening the trench, increasing the backfill load, or endangering adjacent property. Voids left by the removal of sheeting shall be filled in and compacted with suitable material using tamps intended for this purpose.

3.02.7 Storage of Excavated Material - Excavated material shall be deposited in such a manner as to avoid danger to workmen, sewer, or traffic and to cause minimum inconvenience through blocking of drives, sidewalks, natural drains, etc. Where indicated on the Drawings or necessitated by prevailing conditions the Contractor shall haul away and stockpile excavated material.

3.02.8 Disposal of Surplus Excavated Material - Excavated material that is unsuitable or unnecessary for backfilling shall be hauled to sites as directed by the Engineer for use as fill on the project. No surplus excavated material may be disposed of except as provided herein unless specifically authorized by the Engineer. Any material which is not suitable or not required for the fill on the project shall be disposed of by the Contractor.

3.02.9 Subsurface Obstructions - In excavating, backfilling, and laying pipe, care must be taken not to remove, disturb, or injure other pipes, conduits, or structures without the approval of the utility. If necessary the Contractor, at his own expense, shall sling, shore up, and maintain such structures in operation and, within a reasonable time, shall repair any damage done thereto. Repairs to these facilities shall be made to the satisfaction of the Sewer Department.

The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any other pipe, conduit, etc. and shall abide by their regulations governing such work. In the event subsurface structures are broken or damaged in the prosecution of the work the Contractor shall immediately notify the proper authorities and shall be responsible for any damage to persons or property caused by such breaks.

When pipes or conduits providing service to adjoining buildings are broken during the progress of the work the Contractor shall have them repaired at once. Delays such as would result in buildings being without service overnight or for needlessly long periods during the day will not be tolerated and the District reserves the right to make repairs at the Contractor's expense without prior notification. The Contractor shall not deviate from the planned position of any pipe, conduit, or structure except in strict accordance with instructions given by the Engineer or utility involved.

3.03 INSTALLATION OF PIPELINES AND APPURTENANCES

3.03.1 General - The Contractor shall use only experienced men in the final assembly of pipe in the trench and all pipe shall be laid in accordance with these Specifications and the recommended practice of the pipe manufacturer. Trench bottoms shall be carefully prepared; shall be free of water; and specified bedding shall be in place.

Care shall be exercised to ensure that pipe of the proper strength or classification, meeting the Specifications in every respect, is provided at the site of pipe laying operations. Recommended tools, equipment, lubricant, and other accessories needed for proper assembly or installation of the pipes shall be provided at the site of the work. Any damaged or defective pipe discovered

during the pipe laying operations shall be discarded and removed from the site of the pipe laying operations.

Alignment and grade shall be carefully maintained during the laying operations. The method used for maintaining grade and alignment must be acceptable to the Engineer and must produce the desired results. The top of the bedding material must be brought to the exact grade and must be shaped so as to provide effective support for the bottom quadrant of the pipe except at the bells.

The Contractor shall exercise care in the storage and handling of pipe both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be carefully lowered into the trench piece by piece. Pipe and fittings shall be carefully inspected for defects and for dirt or other foreign material immediately before placing them in the trench. Suitable swabs shall be available at the site of laying operations and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench.

Bell holes for bell and spigot and mechanical joint pipe shall be dug in trench to allow entire length of pipe barrel to be bedded and to allow proper jointing of pipe.

Cutting of pipe shall be done in a neat, workmanlike manner without damage to pipe, coatings and linings and so that a smooth end remains at right angles to axis of pipe.

3.03.2 Pipe Bedding and Envelope - Trench width from a point 1 foot above the top of the pipe (top of "pipe zone") down to bottom of trench shall be held to a minimum, consistent with the provision of necessary space for proper assembly of the pipe. In general, the trench width shall not exceed the outside pipe diameter plus 16-inches.

A minimum of 12-inches of crushed stone bedding shall be placed in the bottom of the trench to provide continuous support of the bottom quadrant of the pipe; minimum of 12-inches of crushed stone or select excavated material bedding in rock. The Contractor shall bring the crushed stone bedding up to the level required to provide support of the bottom quadrant and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe.

After the bedding has been shaped and the pipe has been installed the pipe shall be carefully backfilled with crushed stone bedding 12-inches above the top of the pipe.

The pipe bedding and envelope shall consist of clean, crushed stone, free from debris and other objectionable materials, placed in even layers simultaneously on each side of the pipe, and shall be thoroughly consolidated to completely fill the haunches of the pipe. Consolidation by jetting will not be allowed.

3.03.3 Pipe Laying - After the pipe has been cleaned and inspected for defects and lowered into the trench the mating surfaces of the compression joint shall be wiped clean and coated with lubricant of a type supplied by the pipe manufacturer. The pipe shall then be assembled with due care being taken to

insure that the spigot end of the pipe is shoved home and that the pipe is left in proper grade and alignment.

Whenever pipe laying operations are to be discontinued for a period of time exceeding two (2) hours the end of the pipe shall be carefully secured to avoid displacement or misalignment and a tight fitting plug or stopper shall be placed in the line. Upon resumption of laying operations the plug or stopper shall not be removed from the line until any water, mud or other debris has been removed to avoid entry into the completed section of the sewer.

Installation of sewer pipe including force mains shall conform to provisions of these Specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The proper gaskets and lubricants shall be furnished by the pipe manufacturer and lubricants shall be delivered to the job site in properly labeled unopened containers.

Cradle, encasement, or cap concrete shall be provided in locations as shown on the Drawings or where the nature of the work requires such protection. In the event the cradle, encasement, or cap concrete is required but is not shown on the Drawings, the Contractor shall obtain written authorization from the Engineer for the installation of such protection. Cradle, encasement, and cap concrete will be measured in cubic yards, based on the linear feet of cradle, encasement, or cap concrete furnished and placed on each pipe size, multiplied by the cubic yards per linear foot for each pipe size indicated in the cradle tabulation or shown on the encasement cross-sections included in the Contract Drawings.

Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave smooth end at right angles to the axis of the bore and the end shall be beveled or finished as required to make the joint without risk or damage to the gasket.

3.03.4 Installation of Pressure Sewer - Lay the pressure sewer to and keep it at the lines and grades required by the Drawings. All fittings shall be at the required locations and spigots well centered in the bells.

Unless otherwise indicated by the drawings all pressure sewers shall have at least 30-inches of cover. No departure from this policy shall be made except at the order of the Sewer Department.

Provide and use tools and facilities that are satisfactory to the Sewer Department and that will allow the work to be done in a safe and convenient manner. Use a derrick, ropes, or other suitable equipment to lower all pipe fittings into the trench one piece at a time. Carefully lower each piece so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances shall Contractor drop or dump pressure sewer materials into the trench.

No pipes or fittings shall be lowered into the trench until they have been swabbed to remove any mud, debris, etc. that may have accumulated within them. After the pipe has been lowered remove all unnecessary materials from it.

Before any pipe is laid brush and wipe clean the outside of its spigot end and the inside of its bell and ensure that the pipe is dry and oil-free.

Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside it then place a heavy, tightly woven canvas bag of suitable size over each end of the pipe and leave it there until it is time to connect that pipe to the one adjacent to it.

Place no debris, tools, clothing, or other materials in the pipe during laying operations.

After a length of pipe has been placed in the trench center the spigot end in the bell of the adjacent pipe and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.

Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

Whenever pipe laying is not in progress close the open ends of pipe in the trench that cannot be completed until a later time with packing in order to make them as watertight as possible. This shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench seal shall remain in place until the trench has been pumped completely dry.

The cutting of pipe so that fittings or closure pieces can be inserted shall be done in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.

Lay pipe with the bell ends facing in the direction of laying unless otherwise directed by the Engineer.

Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions of plumb stems or wherever long radius curves are permitted the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made nor that recommended by the pipe manufacturer and shall be approved by the Engineer.
Lay no pipe in water or when it is the Engineer's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, this shall be considered incidental to the project.

Install thrust blocks wherever the force main changes direction (e.g., at tees and bends), at dead ends, or at any other point where the manufacturer recommends and/or the Engineer indicates that they are to be used.

Make all joints, whether standard mechanical or push-on joints, in conformance with the recommendations of the joint manufacturer as approved by the Engineer or Owner.

The detectable tape and 14-guage insulated copper tracer wire shall be buried in the utility line trench directly above the installation to be identified. The tracer wire shall be placed directly on top of the pressure sewer and the marking tape shall be placed 15-inches from finish grade of the trench. The tape shall be placed in the trench with the printed side up and be essentially parallel to the finished surface. The Contractor will take necessary precautions to ensure that the tape and tracer wire are not pulled, distorted, or otherwise misplaced in completing the trench backfill. Tape and wire shall be placed in all trenches.

3.03.5 Pressure Sewer Service Assemblies

Materials

Ball Valve: The valve on the service line at the connection to the main shall be a PVC ball valve of true union design with permanently lubricated Teflon seats and elastomer "O"-ring seals. The valves are to open and close with a quarter turn.

Working pressure at 70°F shall be 150 pounds per square inch.

Redundant Check Valve (E-1 Glass Line): Each service line shall include a check valve for installation in the discharge line between the grinder pump and the pressure sewer to ensure maximum protection against backflow in the event of sewer service line break.

Installation

The service line shall have a minimum of 24-inches of cover. Sewer Service Clean-outs shall be installed at the property line and right-of-way or easement line.

The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve with the box cover flush with the surface of the finish pavement or centered over the valve and clean-out or approximately 1/2-inch above the ground surface or such other level as may be directed.

3.03.6 Pressure Sewer Valves

Air Release Valves: At the locations shown on the Contract Drawings and in accordance with these Specifications, install an air release valve. The valve shall have a body of cast iron construction, a stainless steel float and a Buna-N seat. The valve shall have a 2-inch inlet.

Fittings: Fittings shall be of the solvent welded type for use in conjunction with valves. Fittings shall be fabricated by the manufacturer of the pipe used.

Valve Boxes Shall be as indicated on the Contract Drawings: Unless otherwise shown valve boxes shall be a standard plastic meter box with a nominal size of 36" x 15" x 18" and a 6" extension. The meter box shall be injection molded meeting ASTM D-2853-70, Class 1212. It shall be a rigid combination of

polyolefin with inorganic component reinforcing and UV stabilizer additive to assure resistance to material degradation for ultraviolet light.

The cover shall be molded of the same material and designed with no molded protrusions for latching. A 2-1/2-inch diameter 16-gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection. The cover shall be green with the words "CONTROL VALVE" imprinted on the top.

3.03.7 Laying Sewage Force Mains - Sewage force mains shall be constructed as shown on the Construction Drawings or as directed by HUD.

Trenches for sewage force mains shall be deep enough to provide no less than 30-inches of cover for installed pipe. The bottom of the trench shall be carefully graded to provide continuous support for the bottom quadrant of the pipe except at bell joints where bell holes shall be dug. In the event rock is encountered in the trench, such rock shall be removed down to an elevation 6-inches below the outside of the pipe and 6-inches beyond the outside diameter of the pipe on the sides. The trench bottom shall be brought back to grade using crushed stone where rock is removed in the bottom of the trench.

The Contractor will be required to exercise care to maintain satisfactory grades and alignments and avoid unnecessary kinks, sags, or high points. Exact grades or centerline elevations are not indicated or required, but grades shall be such as to provide a continuous upward slope to discharge point or other summit point where facilities for release of air shall be provided. In trenching for sewage force mains, the Contractor will be required to excavate far enough ahead of pipe laying to be made. Should the Contractor fail to observe this precaution and encounter an obstruction necessitating adjustment in pipe grade or alignment. Contractor shall remove and replace such joints of pipe already laid as may be necessary in order to accomplish the desired correction without humps or sags.

Changes in grade or alignment may be made by means of deflection in pipe joints provided that the recommended deflection as shown in published tables supplied by the pipe manufacturer are not exceeded and that the work required for the installation of the line does not encroach on adjoining property not within the granted easement. The Contractor shall have on hand at the site of work a table showing the permissible deflections whenever the pipelaying is in progress.

Assembly of the pipe joints shall be in accordance with the manufacturer's instructions using gaskets and lubricants supplied by the pipe manufacturer. Pipe fittings shall be supplied by the pipe manufacturer. Pipe fittings shall be provided as indicated on the Drawings as directed by the Engineer. Fittings shall be suitably braced in accordance with standard details to avoid the pipe from being blown apart due to internal pressure. Bracing shall be sufficient to withstand normal operating pressure plus 50 psi with due allowance for the character of soil against which the braces will be placed.

Detectable pipeline location tape (3-inches wide) shall be plastic composition film containing one layer of metalized foil laminated between two layers of inert plastic film specifically formulated for prolonged use underground. Tape shall be a minimum of 5.5 mils thickness, green in color, and continuously printed in permanent ink to indicate caution for a buried sewer line below.

All pressure sewers and force mains not constructed of ferrous material shall be installed with detectable tape and tracer wire.

Detectable tape shall be 3-inches wide and shall be an inert, bonded layer plastic with a metalized foil core and shall be highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The tape shall be brightly colored (Green) to contrast with soil and shall bear the imprint "CAUTION -- SEWER LINE BURIED BELOW." Tape shall be Terra-Tape as manufactured by Reef Industries, Inc. or approved equal.

Additionally, the Contractor shall provide and install a 14-gauge insulated copper wire on top of the newly installed PVC force main or pressure sewer main.

3.03.8 Connections to Existing System - No pipe shall be connected to the existing sewage system until all new upstream construction has been completed, pipe is free of foreign materials, and obvious defects have been corrected. New lines must remain disconnected from the existing system by actual physical separation by plugs of a type approved by the Engineer or by other means approved by the Engineer.

3.03.9 Automatic Sewage Air Release Valves

The Contractor shall install an automatic combination sewage air/vacuum valve for the sewer force main to allow for unrestricted venting and re-entry of air where shown on the Drawings or where directed by the Engineer.

The combination sewage air valve installation shall be constructed in accordance with the Standard Detail Drawing. The combination valve shall be furnished with flushing accessories and shall have a 2-inch inlet and 2-inch outlet for the combination air and vacuum valve unless otherwise shown on the Drawings.

Automatic air release valves shall be ARI Valves, Model D-025 (w/attachments) SAAR short version or approved equal as per special detail on the Contract Drawings. Air release valve shall be installed in eccentric manhole with required protective coatings in accordance with these specifications and details and as directed by HUD personnel. All air release valves shall be manufactured in stainless steel.

The Contractor is cautioned to allow for an increase of bury on the force main at the location of the combination sewage air/vacuum valve installation to provide for the proper manhole cover at designed finish grade.

3.04 BACKFILL

3.04.1 General - Backfilling above the pipe envelope shall be carried out as expeditiously as possible but shall not be undertaken until the Engineer has been given the opportunity to inspect the work. The Contractor must carry out all backfilling operations with due regard to: the protection of pipes, structures and appurtenances; the use of prescribed backfill materials; and procedures to obtain the desired degree of compaction. No equipment or method may be used which will result in damage to or misalignment of the pipe.

3.04.2 Acceptable Backfill Material - Crushed stone shall be No. 67 size as designated by Tennessee Department of Transportation Standards for crushed stone used in road surfacing when required.

Where crushed stone is not required but the excavated material is unsuitable for use in the backfill the Contractor may use fine, dry selected earth or clay as backfill material. Material containing excessive organic matter (stumps, roots, refuse or foreign matter or hard clay lumps that cannot readily be compacted) will not be acceptable for use as backfill.

In highways, streets, drives, or other paved or traveled areas or within 3 feet of these areas and where called for on the Drawings the Contractor shall backfill entire trench with crushed stone which shall be placed in layers or lifts not exceeding 9-inches in thickness. After placing in layers crushed stone shall be carefully compacted to maximum density or minimum volume. Stone backfill in areas other than as described above, and where directed by the Engineer, shall be designated as crushed stone backfill.

Where the trench is located in open country or on public right-of-way more than 3 feet from the roadway or shoulder the backfill up to a point 12-inches above the top of the pipe shall be placed as specified under “Pipe Bedding and Envelope”. Above this point the backfill may consist of excavated material provided such material is selected to exclude rocks larger than 6-inches in any dimension. No rocks larger than 1-1/2 inches may be used in the top 6-inches in any dimension.

Sufficient care must be exercised to avoid leaving any holes or voids over, around, or under stones, boulders, or other backfill materials which may later be filled by leaching or settlement of surrounding material thereby causing future trench settlement.

The Contractor shall be responsible for and shall protect all sewers, storm sewers, electric, telephone, water or other pipes or conduits against danger or damage while the trenches are being backfilled and from future settlement of the backfill. Contractor shall repair any damage promptly to the Engineer's satisfaction.

The Contractor's attention is called to the fact that he will be held completely responsible for any damage to pavement, sidewalks, curbs, gutters, meter or valve boxes, street inlets, or other structure or appurtenances as a result of the Contractor's operations. It should be specifically noted that the Contractor shall be responsible for damage even though the character or nature of the original pavement or structure was such that it was not capable of carrying the load of the construction equipment regardless of the construction methods used.

3.04.2 Other Backfill - Backfill around manholes located in highways, streets, or other traveled areas shall consist of such material and shall be placed in such manner as described for adjacent trenches under "Backfill" above. Backfill around manholes, piers, or other structures in locations not subject to traffic may consist of excavated material subject to the following restrictions:

1. No rock larger than 6-inches in any dimension shall be placed within 6-inches of the manhole walls or pipes entering or leaving the manhole.

2. No rock larger than 6-inches in any dimension shall be placed in the vertical prism above and extending 9-inches outside of the pipe lines.

3. Crushed stone shall be used under, around, and up to a point 12-inches over the tops of any pipes entering or leaving the manholes. This requirement shall include the inlet pipe for drop manholes.

4. Excavated material used for backfill shall be carefully placed in layers not exceeding 9-inches and compacted in such manner as to fill all voids and prevent excessive settlement.

3.05 COMPLETING INSTALLATION OF LINES, STRUCTURES, ETC.

3.05.1 General - The Contractor shall not, without the permission of the Engineer or Sewer Department, remove from the line any earth excavated which may be suitable for backfilling or surfacing until the excavation has been refilled and surfaced.

As soon as the backfilling of any excavation is completed and when in areas of existing development the Contractor must at once begin the removal of all surplus dirt except that actually necessary to provide for the settlement of the fill.

Contractor shall also remove all the pipe and other material placed or left on the street except material needed for the replacement of paving and the street shall be opened up and made passable for traffic. Following the above work the repairing and complete restoration of the street surfaces, bridges, crossings, and all places affected by the work shall be done as promptly as possible.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable condition. Contractor will be required to re-grass lawns or neutral grounds where trenches are excavated in these locations or where Contractor has damaged lawns or neutral grounds by his operations.

The Sewer Department shall be sole authority in determining time in which rough and final clean-up shall be conducted. Rough clean-up shall consist of removal of large rocks, grading of excess backfill material over pipe line or removal of said material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or roadway, restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same. Rough clean-up shall be prosecuted no later than 1 day after pipe laying and backfilling or no farther behind pipe laying operations than 1,000 feet, whichever time limit is shortest. Final clean-up consisting of pavement replacement, side of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items shall be prosecuted as soon as is practical after pipe has been laid and backfilled and no later than 2 to 3 weeks after completion of backfilling.

3.05.2 Final Grading and Seeding - Final clean-up shall consist of, among other items, placing of topsoil, final grading of disturbed areas and seeding of areas where grass growth was damaged or destroyed by the Contractor's operation. In areas of established lawns no rock shall be left in the top 6-inches of soil and the finished grade shall be that which existed before construction began. In all cases lawn areas shall be left neat and in a condition so that hand mowing is as easy and convenient as before construction began. The lawn areas and other areas disturbed by Contractor's activities shall have ground cover restored at least equal to the condition which existed before construction began. In established lawn areas new grass shall be of the same type as originally present. Grass and other ground cover shall be properly applied, fertilized, strawed, and watered as necessary and required to establish a good stand of grass.

Fertilizer shall be “Vertigreen,” “Vigaro,” or approved equal. It shall contain not less than 5% nitrogen, 10% phosphorus, and 4% potash. If, by test, the area soil requires adjustment of the pH for proper growth of ground cover, ground limestone shall be applied to bring the pH into the proper range.

In existing garden areas disturbed by sewer construction the Contractor shall place topsoil to a finished depth of 24-inches and fine rake the garden area. The topsoil may be obtained by stripping the garden area prior to construction and stockpiling the topsoil or bringing in additional topsoil. Seeding and mulching shall be omitted in garden areas.

3.05.3 Pavement Replacement - Before trenching in paved roadways for street crossings the Contractor shall straight-line cut pavement on each side of trench. This is to be done to minimize damage to existing paving. During construction suitable precautions shall be taken to protect the pavement edges and surfaces and minimize damage.

As soon as the pipe has been installed the trench shall be backfilled as specified and, where directed by the Sewer Department, a temporary pavement patch shall be provided in areas which have permanent paving. “Permanent Paving” shall mean asphaltic concrete (“hot mix”) or Portland cement concrete. Cold mix, surface treatments, and crushed stone are excluded from the “permanent pavement” classification. The temporary pavement patch shall consist of at least 6-inches of compacted stone base brought to within 2-inches of the surface of the existing permanent pavement. A 2-inch layer of cold mix asphaltic concrete shall then be applied to protect the base, prevent “pot holes” or “chuck holes”, and provide a reasonably smooth pavement surface until the permanent patch is made. The temporary pavement patch shall be placed within 48 hours of receipt of written instruction of the Sewer Department.

3.05.4 SLOPE PROTECTION AND EROSION CONTROL - Consists of temporary control measures as shown in the Drawings or directed by the Engineer or as required by the State of Tennessee - Water Pollution Control Division during the life of the Contract to control erosion and water pollution through the use of hay bales and other control devices. All slope protection and erosion control shall be approved by the City of Hendersonville Public Works Department.

The Contractor’s attention is directed to the requirement for executing a Notice of Intent (NOI) for storm water discharges. The Developer will pay required fee and transmit the NOI package to the State for review and approval. This NOI must be approved by the State of Tennessee prior to beginning work.

It shall be the responsibility of the Contractor to fully comply with all requirements and regulations of the NOI, storm water discharge regulations, and all other requirements contained herein.

Note: The Developer/Contractor’s attention is directed to the fact that a permit from the Division of Water Pollution Control might be required for aquatic resource alteration for work in and/or around streams.

3.06 PREFABRICATED GRINDER SEWAGE PUMP STATIONS

The contractor shall refer to material specifications concerning work on this item and Standard Drawings PS-10.

* * *

SECTION 4 - TESTING

4.01 GENERAL

Upon completion of construction the Contractor shall remove all sand, dirt, brick, and other foreign materials from the sewers and shall conduct his own inspection to locate any defects and determine when the sewers are ready for testing and final inspection by the Engineer and the Sewer Department. All apparent defects shall be corrected by the Contractor before testing or final inspection is requested.

No sewer line shall be allowed to discharge into the existing sewage system until said line is free of foreign materials and obvious defects have been corrected. New lines must remain disconnected from the existing system by actual physical separations, by plugs of type approved by the Sewer Department, or by other means approved by the Sewer Department.

Testing of the system before final inspection by the Sewer Department shall consist of visual observation and leakage tests conducted by the Developer and observed by the Sewer Department. The Sewer Department will not conduct a final inspection until receiving written notification from the Developer that the construction is complete in accordance with approved Drawings and Specifications. This notification shall include a report of the results of the visual observation and leakage tests.

4.02 PIPELINE TESTING

Pressure sewers installed as part of this project shall be tested for leakage as described herein. The tests shall be run on the collector mains and all services installed as part of this project. The primary test shall be hydrostatic pressure test which shall, if necessary, be supplemented by a leakage measurement test. The Contractor and/or Developer shall furnish all labor, tools, equipment, and materials for making the test. In the event that the test results are unsatisfactory the Contractor shall correct the defect(s) and repeat the test until satisfactory results are obtained. Test shall be made in the presence of the Sewer Department.

All test equipment shall be in first-class working order for use in any tests. Pressure gauges used for pressure and leakage tests shall be good quality gauges, accurate to within 2-1/2% of full scale, range to 200 psi (300 psi where specified test pressure exceeds 175 psi), 2-inch (minimum) diameter, 5-point graduations. Water meter for leakage tests shall be standard 5/8-inch x 3/4-inch water meter meeting requirements of AWWA C-700, latest revision for cold water meters displacement type.

Pressure gauge and water meter shall be subject to such tests for proof of accuracy as the Sewer Department may require.

4.02.1 Pipeline Pressure Test - Each section of pipeline, including services, shall be subject to a pressure test. The section to be tested shall be valved off after having been filled with clean water and all entrapped air expelled. If valves are not available at high points Contractor shall make necessary taps to allow entrapped air to be expelled. Such taps shall be plugged after testing has been satisfactorily completed.

After the line section has been filled with water and entrapped air expelled, a positive displacement test pump shall be used to pump clean water into the pipeline section and pump up to a test pressure of 50 psi. The test pump shall then be valved off from the system and the pressure shall be observed over a period of at least one hour.

A drop in pressure of 5 psi or more during the one-hour test period shall indicate test failure.

The Contractor shall correct the problem(s) and repeat the test as necessary until the pipeline section passes the pressure test.

Should the Contractor be unable to obtain satisfactory results in the pressure test a leakage test must be satisfactorily performed or the pipeline section shall not be accepted.

4.02.2 Pipeline Leakage Test - A leakage test must be performed on any pipeline section failing the pressure test described above. Such test shall be performed as a supplementary test after the Contractor has utilized all reasonable methods to find and correct the cause of the pressure test failure.

The test shall be performed utilizing a water line tap (corporation stop) or other tap as approved by the Engineer and a standard water meter to measure line leakage. Leakage test shall be run at system operating pressure plus 25 psi for a period of 24 hours maximum, 2 hours minimum, with actual time as designated by Engineer to allow practical observation of leakage.

Leakage during the designated test period shall not exceed that tabulated below. Leakage is defined as the amount of water which must be supplied to the test section to maintain the specified test pressure after the initial filling of the line with water.

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE
(Gallons per 2 hours)

Line Size,	Test Pressure, psi			
Inches	25	50	75	100
1-1/4	0.05	0.07	0.09	0.10
1-1/2	0.06	0.08	0.10	0.12
2	0.08	0.11	0.14	0.16
2-1/2	0.10	0.14	0.17	0.20
3	0.12	0.17	0.21	0.24
4	0.16	0.23	0.28	0.32

The following formula shall be used for computing allowable leakage:

$$Q = \frac{L\ D\ P^{.5}}{133{,}200}$$

Where: Q is allowable leakage, gallons per hour

L is length of pipe tested, feet

D is diameter of pipe tested, inches

P is average pressure during leakage test, pounds test, pounds per square inch gauge.

All visible leaks are to be repaired regardless of the amount of leakage.

4.03 TESTING OF VALVES

Upon completion of the work the Contractor/Developer shall operate all buried valves in the presence of the Engineer/Sewer Department Representative to verify proper operation of each valve.

4.04 TESTING OF GRINDER PUMPS

Upon completion of the work the Contractor/Developer shall operate and test all grinder pumps in the presence of the Engineer/Sewer Department representative to verify proper operation and performance of each pump station. This test shall include operating all valves, measuring amp draw for pumps, and checking all controls.

4.05 TESTING OF SUBMERSIBLE PUMPS

Prior to acceptance by owner an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics. Pump station start-up shall be coordinated with the manufacturer's technical representative and Engineer.

After pump station installation the Contractor along with representatives of the pump manufacturer shall conduct the following tests and the Engineer shall witness these tests:

A. Head Measurements - With the discharge valve shut pump(s) shall be run long enough to obtain an accurate shut-off head reading. **Caution: Do not run at shut-off long enough to cause pump damage; such time to be established by recommendation from pump manufacturer**. The Contractor shall furnish suitable gauges, taps, and etc.

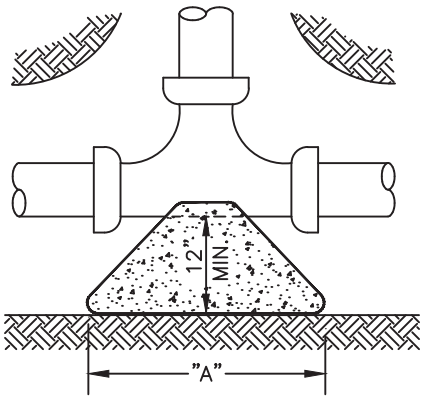
B. Electrical measurements - Contractor shall measure current draw from each pump motor at all stages of operation.

C. Flow tests - Discharge rate(s) shall be established for each pump. This may be accomplished by accurately calibrated flow measurement equipment or calculated rates based on timing wet well drawdown.

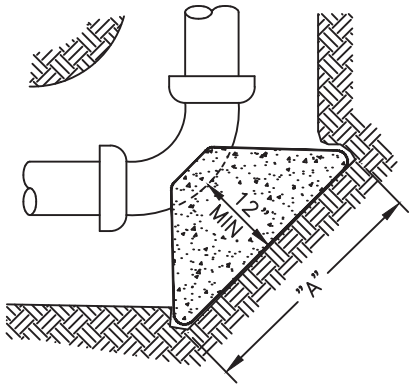
D. Methods and equipment to be used for the above tests to be as approved by Engineer.

A written start-up report shall be furnished to the Engineer including results of the pump tests and a statement from the manufacturer's representative that the equipment has been installed properly and is operating according to specifications. All gauges, taps, etc. needed for start-up shall be furnished by the Contractor / Pump manufacturer.

* * *



PLAN: TEE

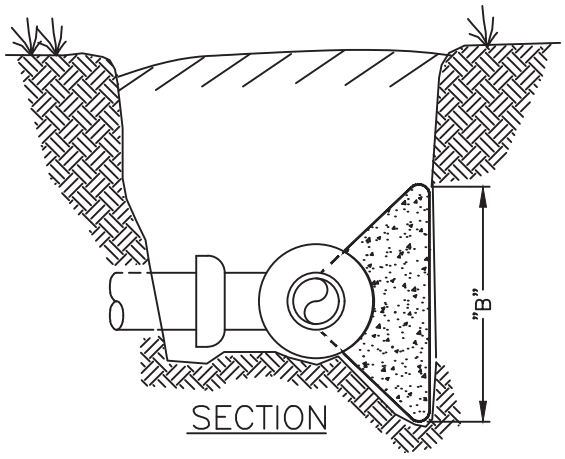


PLAN: 90° BEND

NOTES:

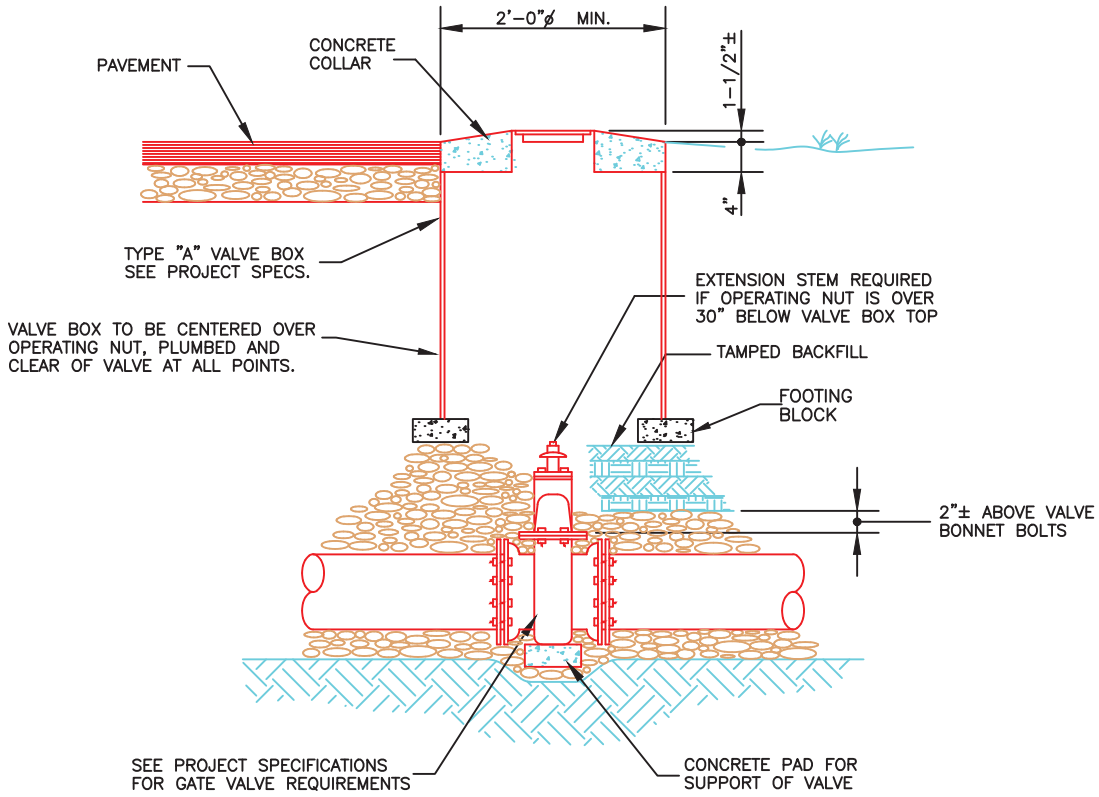
1. CONCRETE TO BE CLASS "B" (2000 P.S.I.) OR STRONGER.
2. DIMENSIONS AS SHOWN ARE APPROXIMATE – SUBJECT TO CHANGE AT DIRECTION OF OR APPROVAL OF ENGINEER.
3. KEEP CONCRETE CLEAR OF ANY PIPE JOINT, ETC.
4. CONCRETE TO BEAR AGAINST UNDISTURBED EARTH WITH BEARING AREA EQUIVALENT TO AT LEAST AxB.

A = NORMAL PIPE SIZE X 2.0
B = NORMAL PIPE SIZE X 2.0



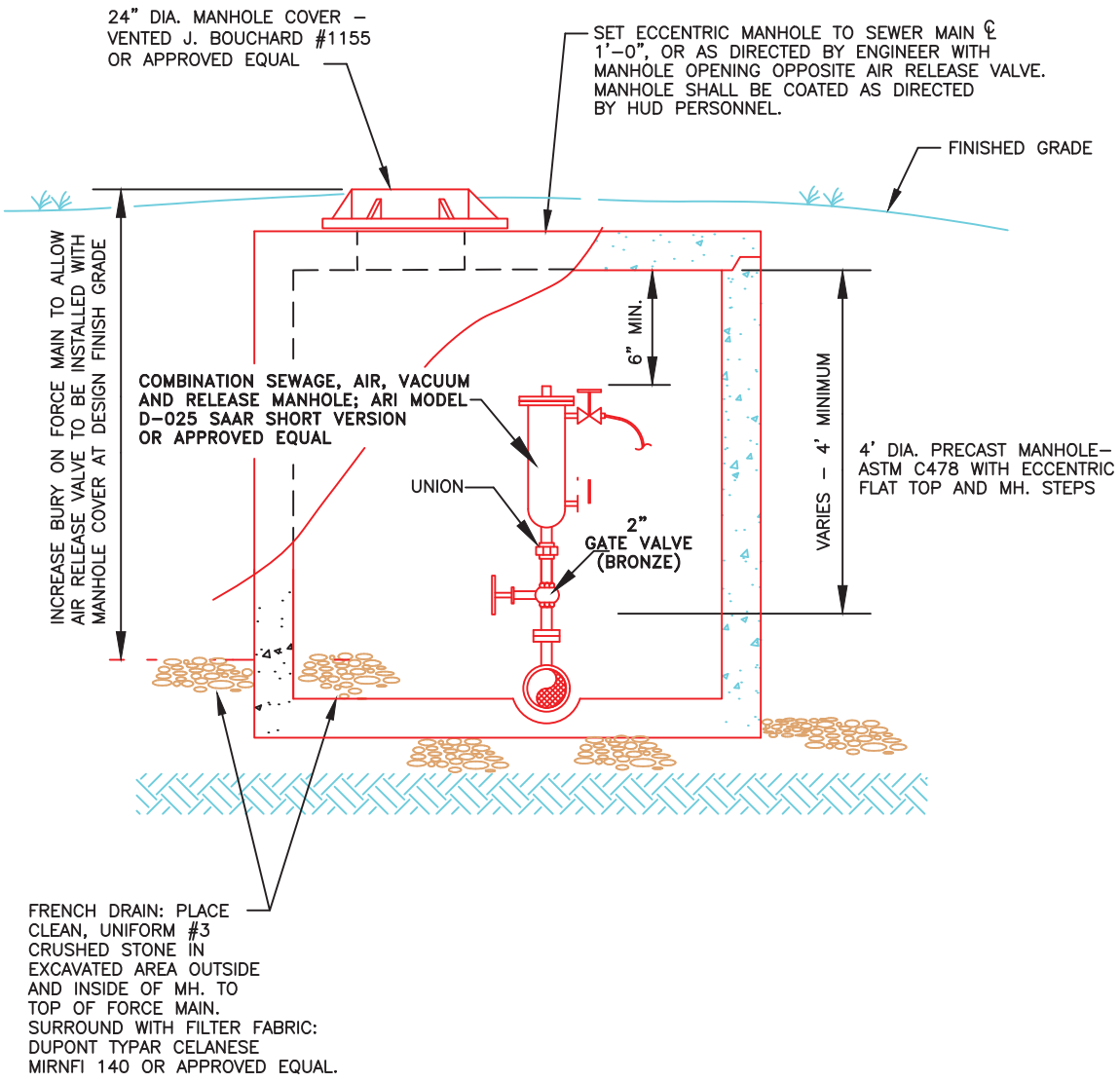
SECTION

CONCRETE THRUST BLOCK



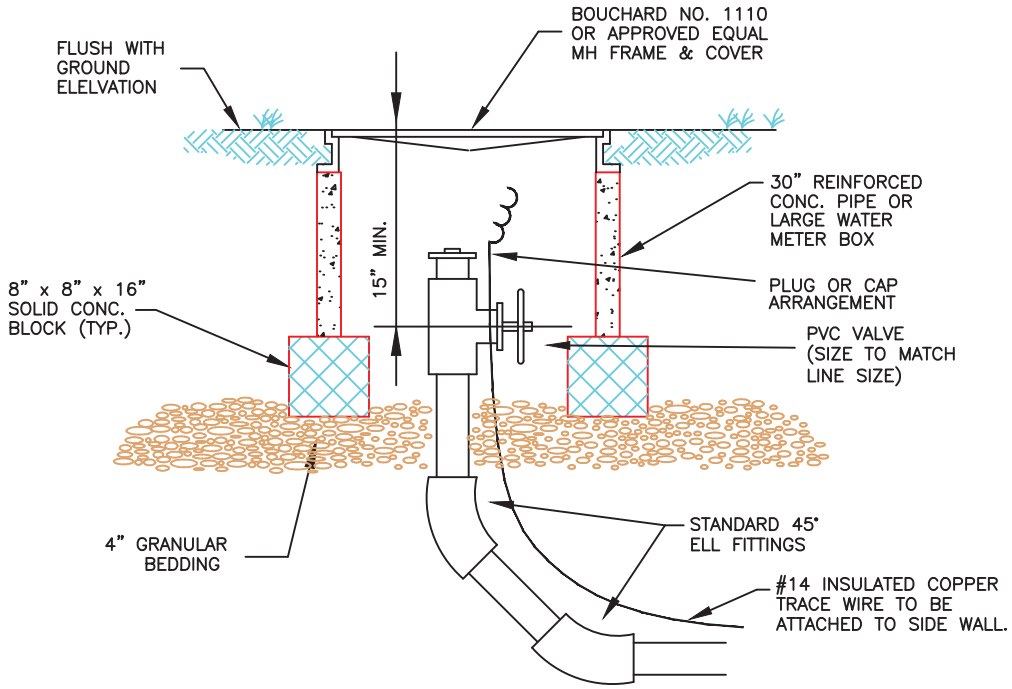
GATE VALVE
WITH TYPE "A" VALVE BOX

NOTE: ALL AIR RELEASE VALVES SHALL BE STAINLESS STELL. FOR COMBINATION AIR AND VACUUM VALVES 4" OR LARGER, THE VALVE SHALL BE ARI MODEL D-020SS OR APPROVED EQUAL'



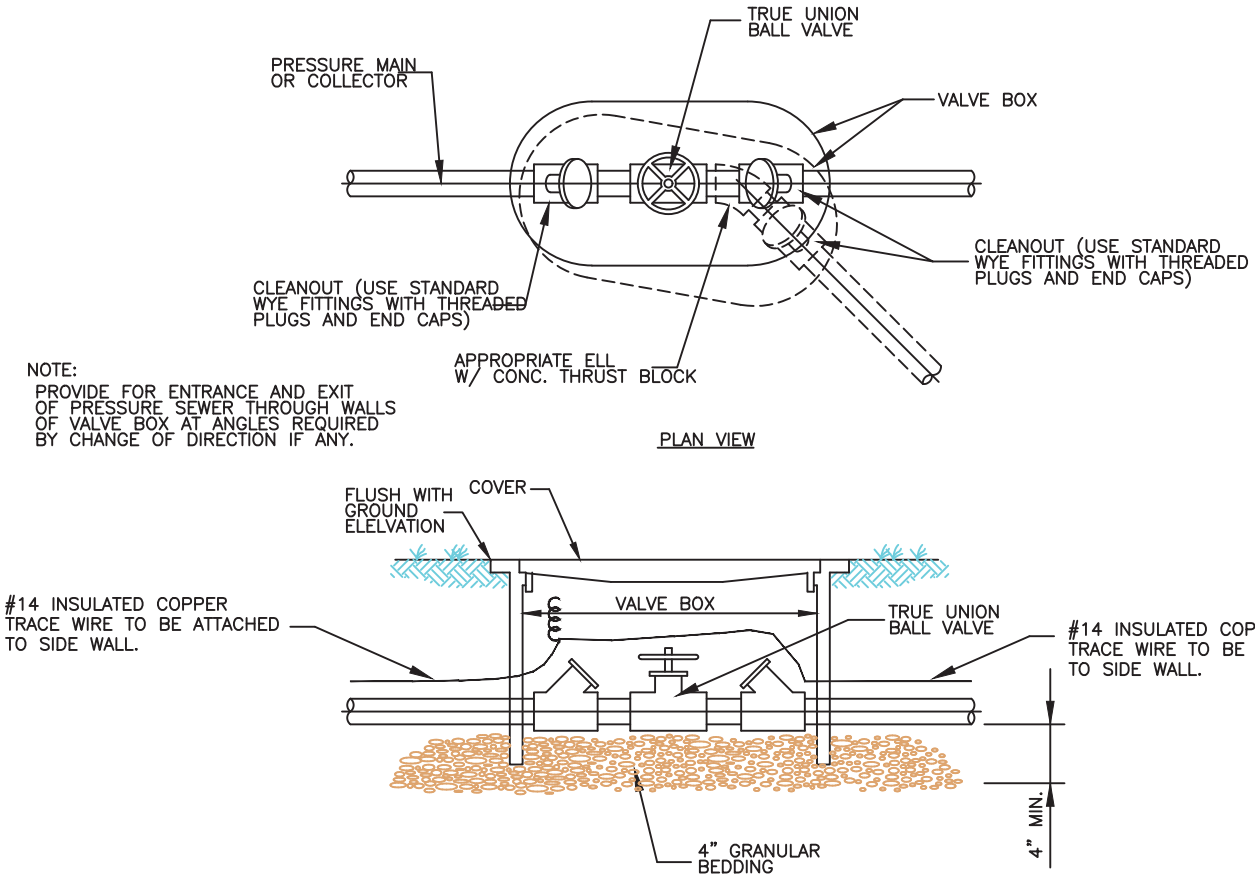
TYPE B – AUTOMATIC
COMBINATION AIR & VACUUM RELEASE MANHOLE

NOT TO SCALE



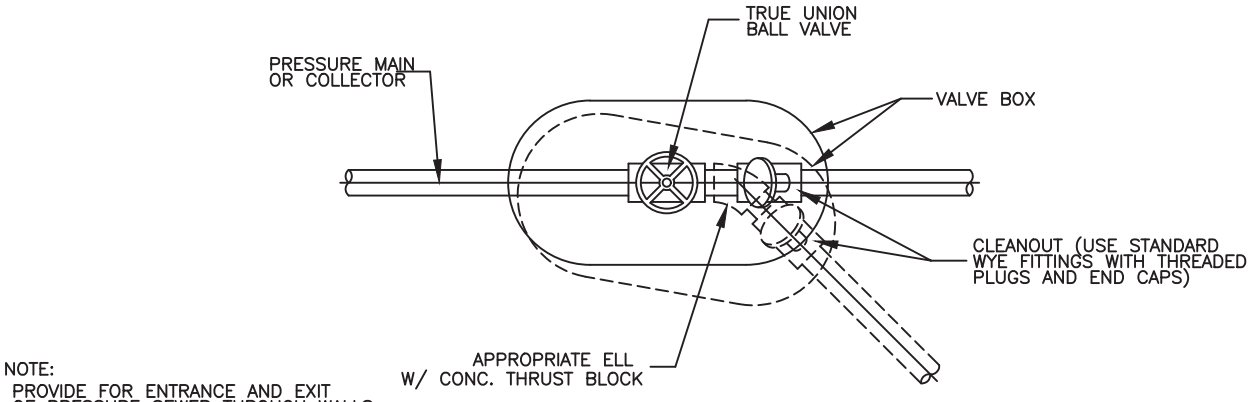
TERMINAL VALVE BOX AND CLEANOUT ASSEMBLY AT END OF PRESSURE SEWER

NOT TO SCALE



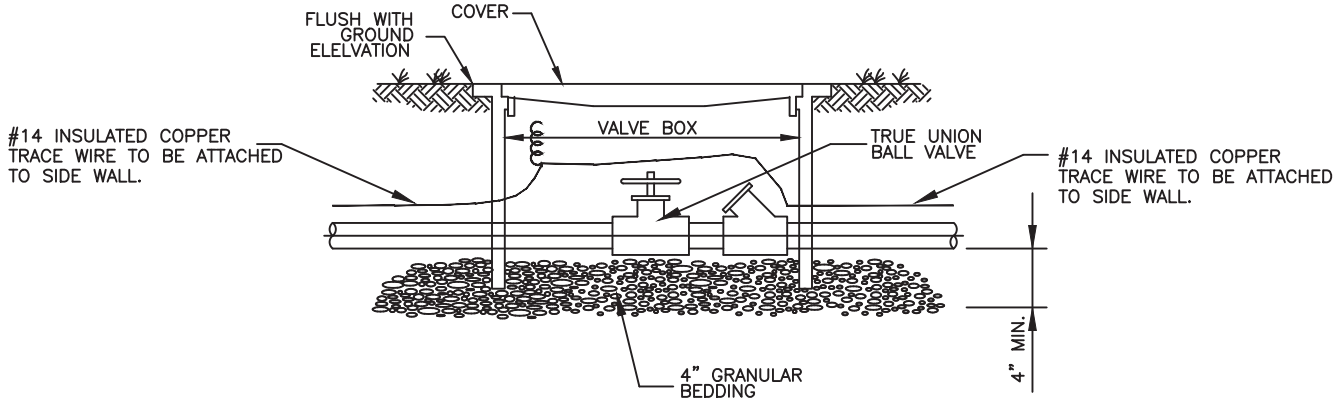
TYPICAL VALVE BOX AND CLEANOUT ARRANGEMENT ALONG STRAIGHT RUNS AND AT CHANGES IN DIRECTION

NOT TO SCALE



NOTE:
PROVIDE FOR ENTRANCE AND EXIT OF PRESSURE SEWER THROUGH WALLS OF VALVE BOX AT ANGLES REQUIRED BY CHANGE OF DIRECTION IF ANY.

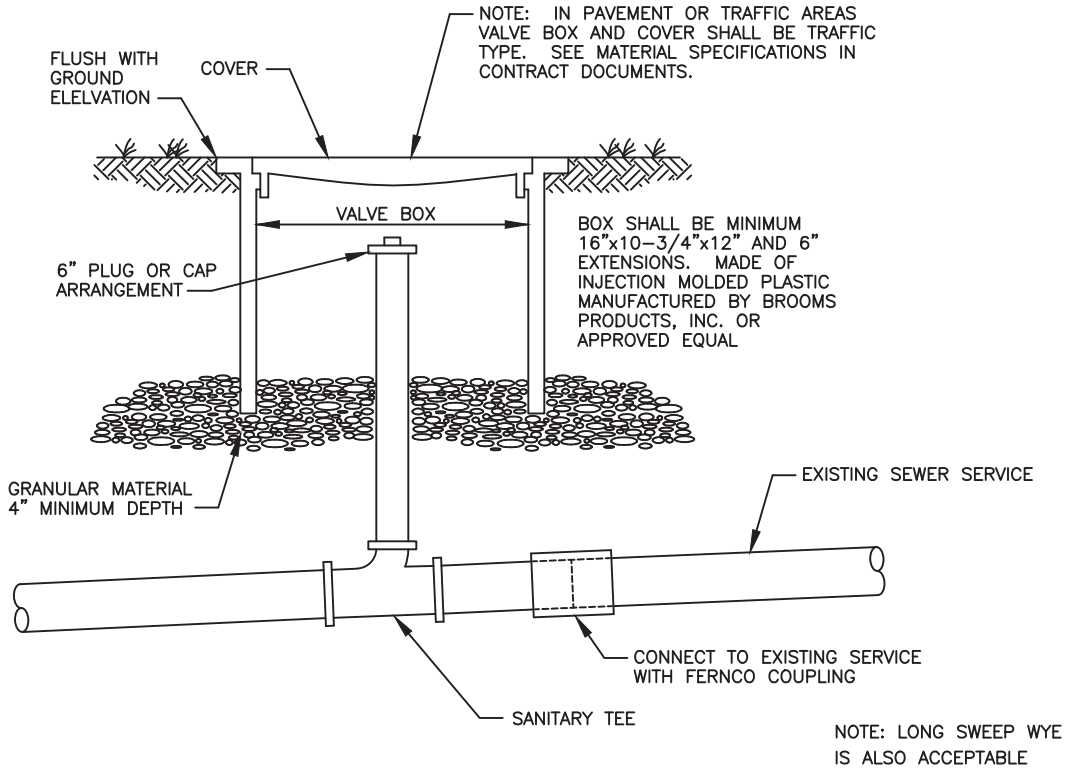
PLAN VIEW



ELEVATION

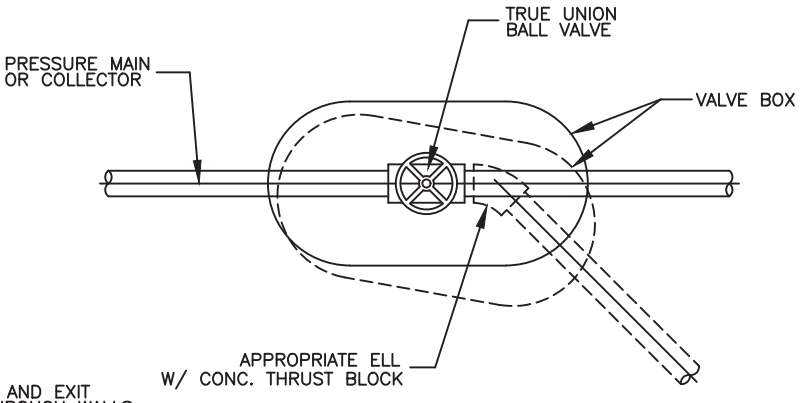
IN-LINE SINGLE CLEANOUT ASSEMBLY

NOT TO SCALE



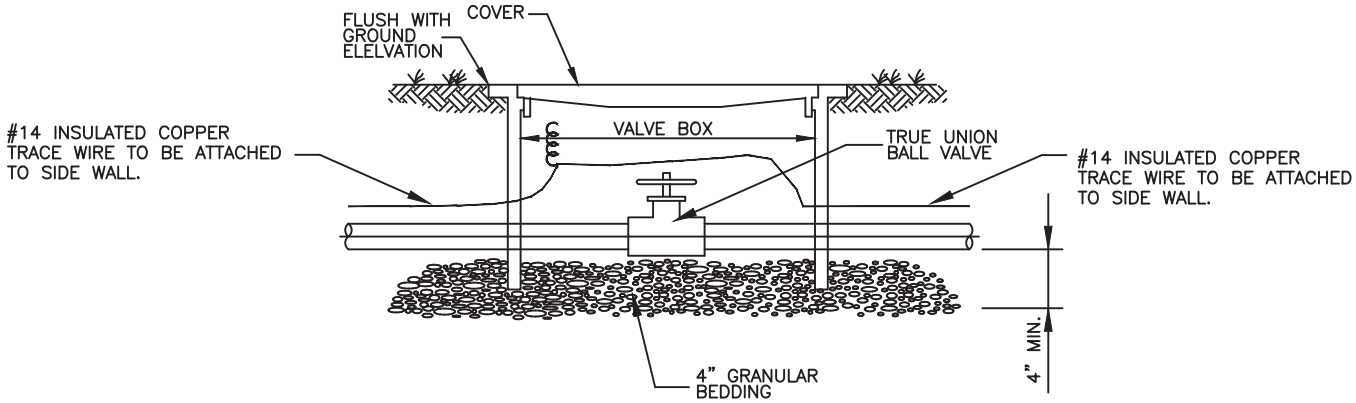
TYPICAL CLEANOUT ASSEMBLY

NOT TO SCALE



NOTE:
PROVIDE FOR ENTRANCE AND EXIT OF PRESSURE SEWER THROUGH WALLS OF VALVE BOX AT ANGLES REQUIRED BY CHANGE OF DIRECTION IF ANY.

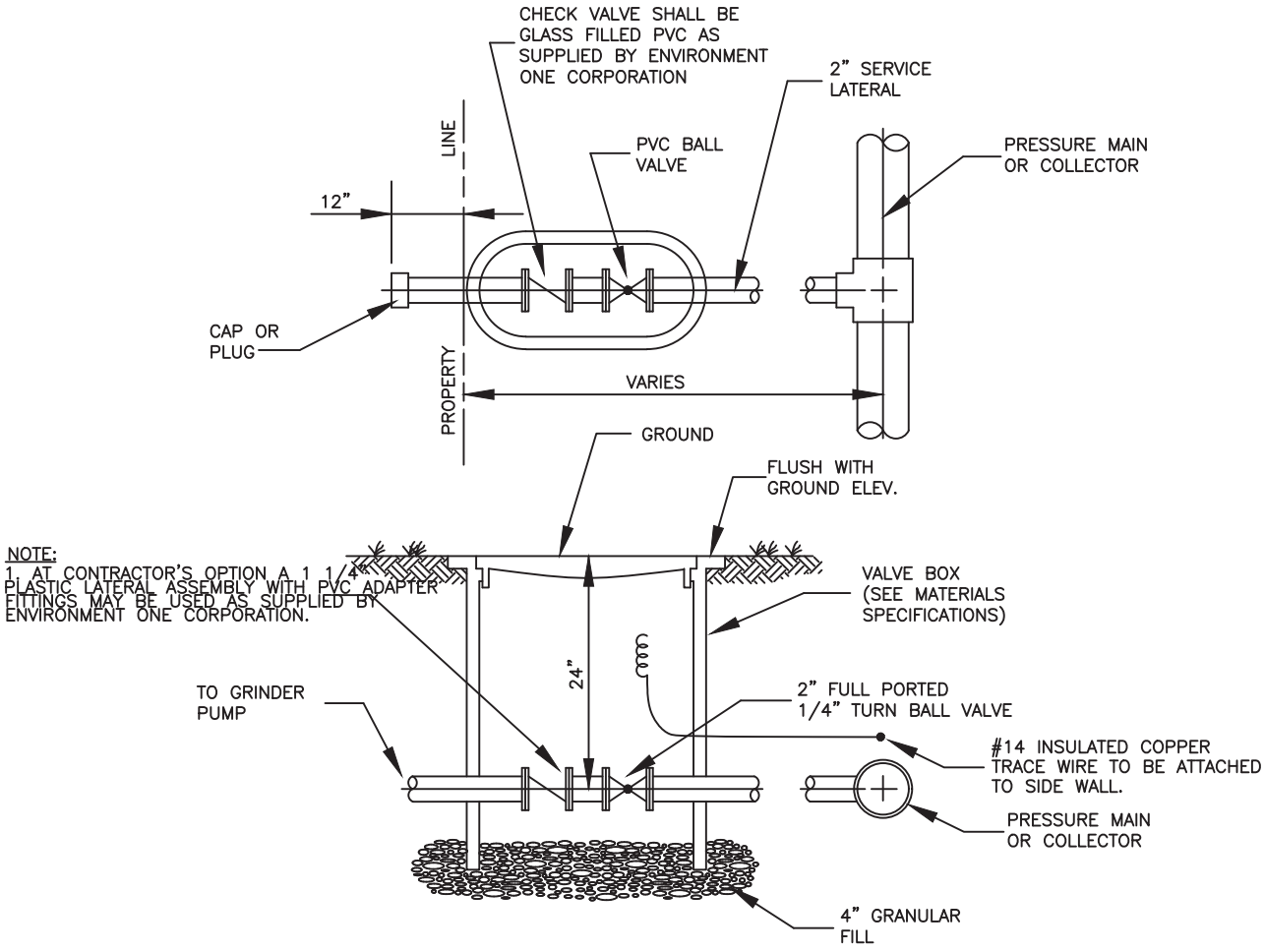
PLAN VIEW



ELEVATION

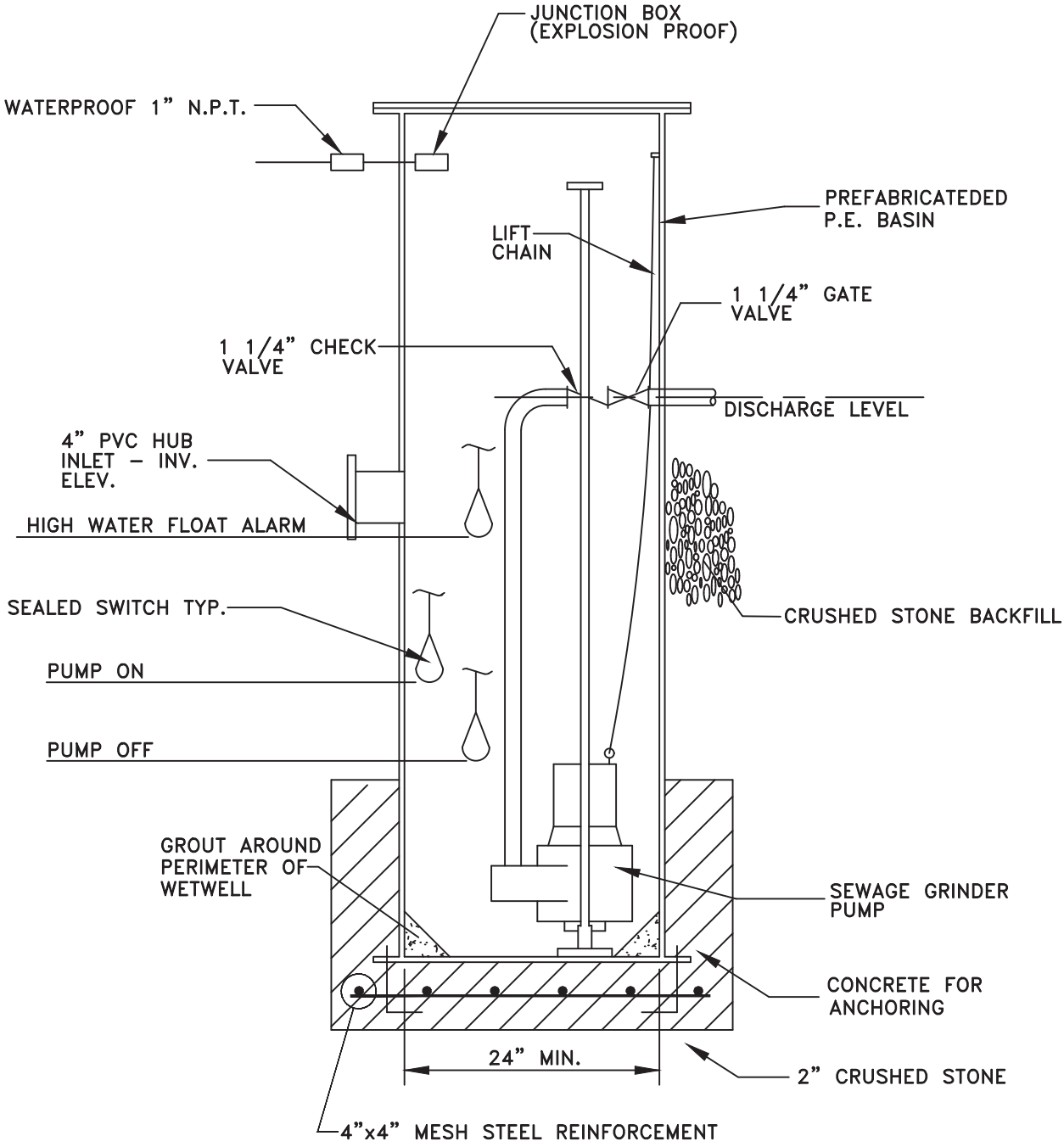
BALL VALVE

NOT TO SCALE



TYPICAL SERVICE ASSEMBLY CONNECTION

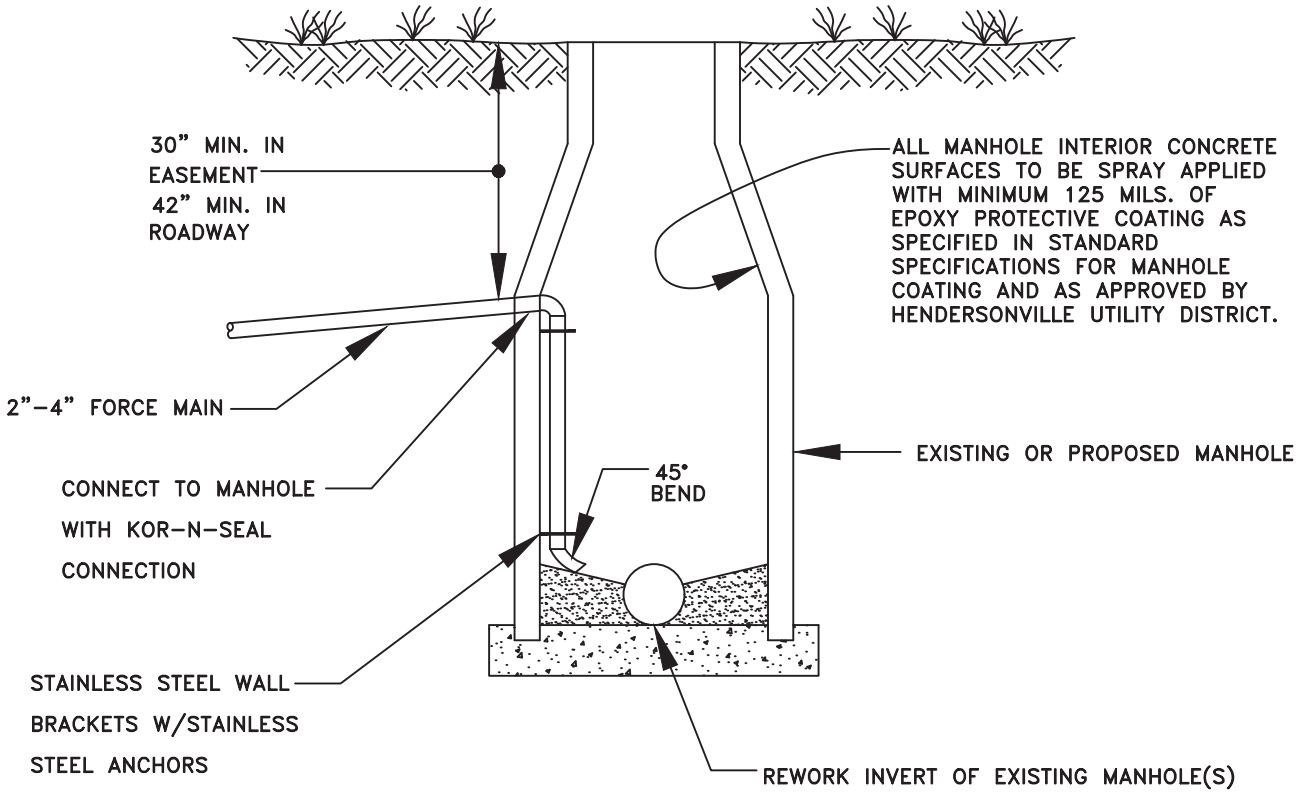
NOT TO SCALE



TYPICAL SIMPLEX GRINDER PUMP STATION

NOT TO SCALE

HENDERSONVILLE UTILITY DISTRICT	STANDARD DETAIL	PS-10



FORCE MAIN TIE-IN AT MANHOLE (TYP.)

NOT TO SCALE