

CITY OF NORTHFIELD, MINNESOTA
SANITARY AND STORM SEWER SPECIFICATIONS

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1.00 SCOPE OF WORK

1.01 GENERAL

It is the intent of these specifications to provide the requirements for sanitary and storm sewer construction in the City of Northfield, Minnesota.

1.02 WORK INCLUDED

The Contractor shall, unless specified otherwise, furnish all materials, equipment, tools and labor necessary to do the work required under the contract and unload, haul and distribute all pipe, castings, fittings, manholes and accessories. The Contractor shall also remove any street surfacing as required; excavate the trenches and pits to the required dimensions; construct and maintain all bridges for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; provide barricades, guards and warning lights; lay and test the pipe, castings, fittings, manholes and accessories, backfill and consolidate the trenches and pits; maintain the street or other surface over the trench until surface restoration; restore the roadway surface unless otherwise stipulated; remove surplus excavated material; and clean the site of the work.

The Contractor shall also furnish all equipment, tools, labor and materials required to re-arrange sewers, conduits, ducts, pipes or other structures encountered in the installation of the work. All the above work to completely construct the sewer facilities shall be done in strict accordance with the project's contract documents to which these Specifications are a part thereof.

1.03 LOCATION OF THE WORK

The location of this work is as shown on the plans.

1.04 COORDINATION OF WORK

The Contractor shall be responsible for the satisfactory coordination of the construction of the sewer facilities with other construction and activities in the area affected. Delays in work resulting from lack of such harmony shall not in any way be a cause for extra compensation by any of the parties.

1.05 REFERENCE REQUIREMENTS

A part of the contract documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship. Reference made to Mn/DOT Specifications shall mean the most current edition of the Standard Specifications for Construction of the Minnesota Department of Transportation and all subsequent revisions. Reference made to CEAM Specifications shall mean the most current edition of the City Engineer's Association of Minnesota specifications.

1.07 SUBSURFACE DRAINS

Mn/DOT Specification No. 2502 shall apply to the subsurface drains, except as modified herein.

2.00 MATERIALS

2.01 GENERAL

The materials used in this work shall be all new, and conform to the requirements for class, kind, size, and material as specified below. The Contractor shall submit in writing a list of materials showing the manufacturer and designation of all materials. This list must be approved by the Engineer. Any material not listed below must have written approval by the City Engineer before it is incorporated into the work.

2.02 REINFORCED CONCRETE PIPE (RCP)

Reinforced concrete pipe and fittings including bends, tee sections and specials shall conform to the requirements of the Standard Specification for Reinforced Concrete Sewer Pipe, ASTM Designation C76 Wall B with circular reinforcing for the class of pipe specified. Pipe required for piling shall be reinforced concrete pipe furnished in (8) foot lengths and shall be of special design in accordance with Section 10, ASTM Designation C76, latest revision. Concrete pipe to be jacked shall be Class V or greater.

Concrete pipe bends called for on the plans shall be 7 1/2° pipe bends with a 4'-0" center line laying length and a 30.5' radius of curve, and with wall thicknesses and steel reinforcing in accordance with ASTM Specifications C76. The bends shall be of the same pipe class as the pipe on either side of the bend. Joints shall be tongue and groove with rubber gaskets meeting the requirements of ASTM C443.

2.03 DUCTILE IRON PIPE (DIP)

Ductile iron pipe shall be designed for a minimum working pressure of 150 pounds per square inch and shall conform to the applicable dimensions, weights and tolerances of Federal Specification WW-P-421b for cast iron pipe. Ductile iron shall be Grade 60-42-10 with 40/90 metal strength and shall be tested in accordance with ASTM Specifications A339-55. All pipe shall be cement lined inside and tar coated outside, meeting the requirements of AWWA C151-76. The class of ductile iron pipe shall be as specified by the Engineer.

2.04 SOLID WALL POLYVINYL CHLORIDE (PVC) PIPE

1. 4" THROUGH 6" Diameters: Smooth-walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM D-3034 for the Standard Dimension Ratio (SDR) of 26, unless otherwise specified on the plans.

2. 8" through 15" Diameters: Smooth-walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM D-3034 for the Standard Dimension Ratio (SDR) of 35, for depths of less than 18 feet, unless otherwise specified on the plans. The SDR for depths exceeding 18 feet shall be 26, unless otherwise specified on the plans.

3. Over 15" Diameters: Smooth-walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM F679 with a minimum wall thickness for a minimum pipe stiffness of 46.

4. WYES: All wyes shall be heavy wall and shall conform with the requirements of ASTM D-3034 for the Standard Dimension Ratio (SDR) of 26, unless otherwise specified on the plans.

5. The connection shall be push-up with elastomeric gasket joints, which are bonded to the inner walls of the gasket recess of the bell socket.
6. The pipe grade used shall be resistant to aggressive soil and corrosive substances in accordance with the requirements of ASTM D-543.

2.05 HIGH DENSITY POLYETHEYLENE (HDPE)

Corrugated polyethylene pipe and fittings shall be manufactured from high-density polyethylene (HDPE) virgin compounds. Clean reworked HDPE materials from the manufacturer's own production may be used by the manufacturer of HDPE pipe, provided that the pipe and fittings produced meet all requirements of these special provisions and in AASHTO M294 and Design Section 18 of the AASHTO Standard Specifications for Highway Bridges. The polyethylene compounds shall conform to the requirements of ASTM D 3350 Cell Class 335420C.

HDPE shall be used only with site specific bedding requirements and written permission from the Engineer.

2.06 SUBSURFACE DRAIN PIPE / CONDUITS

- 4" Perforated Dual Wall HDPE Pipe (no sock)
- 2" HDPE SDR 13.5 smooth/smooth for conduits

2.07 STEEL CASING PIPE FOR JACKING-BORING

Steel casing pipe for jacking-boring shall conform to ASTM Designation A252, Grade 2 or ASTM Designation A139, Grade B. The casing pipe shall have minimum thickness as follows:

<u>Nominal Casing Size</u>	<u>Outside Diameter (inches)</u>	<u>Minimum Shell Thickness (inches)</u>
12	12-3/4	0.250
14	14	0.282
16	16	0.282
18	18	0.312
20	20	0.343
22	22	0.375
24	24	0.403
26	26	0.438
28	28	0.469
30	30	0.469
32	32	0.500
34	34	0.532
36	36	0.532
38	39	0.563
40	40	0.563
42	42	0.563

2.08 JOINTING MATERIAL

The jointing material for each type of pipe specified here before shall be as follows:

A. Reinforced Concrete Pipe

Reinforced concrete pipe joints shall be Type R-4 meeting the requirements of ASTM C443.

B. Ductile Iron Pipe

Ductile iron pipe shall be push-on type which comply with A.W.W.A. Specifications C-111 latest version. If used as a pressure line, an electrical contact must be provided through every joint.

C. Polyvinyl Chloride Pipe

Polyvinyl chloride pipe joints shall be rubber gasketed push-on type joints conforming to ASTM D-1784. Joints supplied by the pipe manufacturer shall be installed according to their instructions.

2.09 MANHOLES AND CATCHBASINS

Manholes and catchbasins shall be constructed using precast sections conforming to ASTM Specifications C-478 and have a minimum inside diameter of 48" or as specified in the contract documents. Manhole section joints shall be Type R-4 Rubber Gaskets. No speed crete will be allowed for manhole sealing.

Sanitary sewer manholes shall be supplied with pre-formed inverts and flexible sleeve connections for all laterals. All inverts shall have 0.10 foot of fall across the manhole unless otherwise stated in the plans and specifications. The flexible connection shall be an Interpace Boot as manufactured by Elk River Concrete, or Kore-N-Seal Boot as manufactured by Hanson Concrete or equal. The flexible connection is shown on the attached standard plate. Joints shall be waterproofed on the exterior of the manhole with a mastic material approved by the Engineer.

Where shown on the Detail Plates or Drawings, manholes may be built using blocks laid up on full mortar beds and vertical joints shall be completely filled with mortar. The base of the unit shall be shaped to form a smooth transition section from inlet to outlet either formed directly in the concrete or built up of brickwork and mortar or by running a half section of pipe through the manhole.

2.10 MANHOLE AND CATCHBASIN - FRAMES AND COVERS

Cast iron for both manholes and catchbasin frames and covers shall be of the best grade of cast iron, free from all injurious defects and flaws, and shall conform to the following Specifications: Federal AA-1-652 ASTM A48-56, A.A.S.H.O. M105-49 and ASA 6.25101948.

The standard manhole casting shall be Neenah Foundry No. R1642-B, or equal, as shown on the Standard Plate and shall have two concealed pick holes. The minimum allowable weight shall be 360 pounds.

Lettering on the manhole castings shall be as shown on the Standard Plate.

Storm sewer inlet castings shall be as specified on the plans and shown on the Standard Plate.

All castings shall conform to the requirements and dimensions shown on the drawings. All covers must fit closely in the rings in any and all positions and, when placed in the rings, must fit the ring solidly in all positions so that there will be no rocking from pressure on any point of the cover.

2.11 MANHOLE STEPS

Manhole steps shall be in accordance with the Standard Plate for Manhole Steps and shall be spaced 16" on centers, on the downstream face of the manhole, unless specified otherwise. All Sanitary Manholes shall have all steps turned 1/8th of a turn clockwise from the downstream invert.

Vinyl or rubber coated cast iron manhole steps shall be manufactured from hi-test metal having a minimum tensile strength 35,000 pounds per square inch. All manhole steps shall be Neenah Foundry Step No. R-1981J, Badger F-15 or equal.

2.12 MORTAR

Mortar shall consist of a mixture of one part Portland Hydraulic Cement and two parts of clean washed sand by volume. The quantity of Mortar in the mixture shall be sufficient to produce a stiff workable mortar, but in no case shall exceed five and one-half (5 1/2) gallons of water per sack of cement.

Sand shall conform to ASTM C-144.

Portland Cement shall conform to ASTM C-150.

2.13 PRE-CAST SEGMENTAL BLOCK

Eight inch precast segmental radial block may be used for the lower portion of manhole over large diameter pipe and for shallow manholes and catch basins. Concrete used in the manufacture of these blocks shall conform to the requirements of A.S.T.M. "Specifications for Concrete and Masonry Units for Construction of Catch Basins and Manholes", Serial Designation C-139.

The exterior of all block manholes shall be plastered with one-half inch of mortar.

2.14 CONCRETE

Concrete to be used shall be composed of a mixture of fine and coarse aggregate and a Portland Hydraulic Cement conforming to the ASTM Specification Designation C-150, Type 1, with the proper water-cement ratio to obtain a concrete testing not less than 3,000 pounds per square inch in 28 days. The fine aggregate for concrete shall be composed of a clean washed sand of hard, sharp, durable particles. Coarse aggregate for concrete shall be composed of a gravel uniformly graded 3/4 inch maximum size to #4 sieve. Coarse aggregate shall be composed of hard durable particles free of shale, chert, flat or elongated pieces. Mixing water shall be suitable for drinking purposes, containing no acids, alkalies, oils or other deleterious materials. Concrete shall be

mixed in a mechanically operated mixer so controlled that the drum shall operate a minute and one-half after all materials including water are in the drum.

2.15 STEEL REINFORCING BARS

Steel reinforcing bars shall be deformed steel bars with approved casting for concrete reinforcement in conformance with ASTM Designation A-305 and ASTM Designation A-15 Intermediate Grade Billet Steel.

2.16 SOIL MATERIALS

A. Normal "Fill Material"

Is defined under the Sewer Specification 13.05.

B. Granular Selected Material

Mn/DOT Specification 3149 aggregate shall be used for granular selected material as shown and specified under the pipe bedding classification or an equivalent natural granular soil.

C. Fine Granular Fill Material

This material shall consist of sound durable particles without cohesion of clean sand and/or well rounded gravel. The largest size of gravel which may be used shall be dependent upon the size of the pipe used. A maximum of 3/8 inch gravel may be used when the pipe diameter exceeds 24 inches.

D. Class 4 and Class 5 Sand and Gravel

Class 4 and Class 5 sand and gravel shall be in conformance with Mn/DOT Specification 3138.

E. Crushed Rock

The material shall consist of durable crushed quarry rock of which 100% passes a 2" sieve and of which 95% is retained on a #4 sieve size. It shall not contain soil overburden, sod, roots, plants, and other organic matter, or any other materials considered objectionable by the Engineer.

F. Pit Run Gravel

The material shall consist of sound, durable particles of gravel and sand with which may be included limited amounts of fine soil particles as binding material, and of which 100% passes a 2" sieve and of which 90% is retained on the #200 sieve size. It shall not contain sod, roots, plants, and other organic matter, or any other objectionable materials.

G. Rock Stabilization

Rock stabilization shall consist of 3/4 inch minus rock installed in the trench bottom at the direction of the Engineer.

H. Course Filter Aggregate

Coarse filter aggregate material, to be used as granular foundation per CEAM Spec. 2621.2F or to be used beneath sanitary sewer and storm sewer structures or to be used as the gravel pit material below hydrants, shall be per Mn/DOT Spec. 3149.2H as determined by the Engineer. Course filter aggregate material shall also be used for surfacing due to wet conditions or other such uses. The use of course filter aggregate will be considered incidental to the utility being installed.

1. Aggregate Bedding

The aggregate bedding material to be used for granular bedding and granular encasement purposes as defined by CEAM Spec. 2621.2F, shall be per Mn/DOT Spec. 3149.2G.

2.17 TREATED TIMBER PILING

All treated timber piling shall conform to Mn/DOT Specification 3471.

2.18 TRACER WIRE

All trace wire and trace wire products shall be domestically manufactured in the U.S.A. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.

Directional Drilling/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

Trace wire – Pipe Bursting/Slip Lining - Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.

A. CONNECTORS

All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.

Direct bury wire connectors – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.

Non locking friction fit, twist on or taped connectors are prohibited.

B. TERMINATION/ACCESS

All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

All grade level/in-ground access boxes shall be appropriately identified with “sewer” or “water” cast into the cap and be color coded.

A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.

All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.

Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

Service Laterals on public property - Trace wire must terminate at an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.

Service Laterals on private property - Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.

Hydrants – Trace wire must terminate at an approved above-ground trace wire access box, properly affixed to the hydrant grade flange. (affixing with tape or plastic ties shall not be acceptable)

Long-runs, in excess of 500 linear feet without service laterals or hydrants - Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48” polyethylene marker post, color coded per APWA standard for the specific utility being marked.

C. GROUNDING

Trace wire must be properly grounded at all dead ends/stubs

Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.

When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.

When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In

this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.

Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

D. TRACER WIRE INSTALLATION

Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5' intervals.

Trace wire must be properly grounded as specified.

Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway.

At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire.

Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead- end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.

All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.

In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

E. SANITARY SEWER SYSTEM

1. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.

2. Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.
3. Trace wire on all sanitary service laterals must terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right of way.
4. If the storm sewer system includes service laterals for connection of private drains and tile lines, it shall be specified the same as a sanitary sewer application.

F. PROHIBITED PRODUCTS AND METHODS

1. Uninsulated trace wire
2. Trace wire insulations other than HDPE
3. Trace wires not domestically manufactured
4. Non locking, friction fit, twist on or taped connectors
5. Brass or copper ground rods
6. Wire connections utilizing taping or spray-on waterproofing
7. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
8. Trace wire wrapped around the corresponding utility
9. Brass fittings with trace wire connection lugs
10. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
11. Connecting trace wire to existing conductive utilities

G. TESTING

All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

Continuity testing in lieu of actual line tracing shall not be accepted.

H. PRODUCTS

1. Tracer Wire
 - a. Open Trench – Copperhead #12 High Strength part #1230*EHS or approved equal.
 - b. Directional Drilling/Boring - Copperhead #12 High Strength part #1230*EHS or approved equal.
 - c. Pipe Bursting/Slip Lining – Copperhead SoloShot Extreme Strength 7 x 7 Stranded part # PBX-50

I. CONNECTORS

- a. Copperhead 3-way locking connector part # LCS1230* or approved equal.
- b. DryConn 3-way Direct Bury Lug: Copperhead Part #3WB-01

J. TERMINATION/ACCESS

- a. Non-Roadway access boxes applications: Trace wire access boxes Grade level Copperhead adjustable lite duty Part # LD14*TP or approved equal.
- b. Concrete / Driveway access box applications: Trace wire access boxes Grade level Copperhead Part # CD14*TP 14” or approved equal.
- c. Fire hydrant trace wire access box applications: Above ground two terminal with 1” conduit. Copperhead part # T3-75-F (Cobra T3 Test Station, denoting “F” includes mounting flange) or approved equal.

K. GROUNDING

- a. Drive in Magnesium Anode: Copperhead Part # ANO-1005 (1.5 lb) or approved equal.

3.00 INSPECTION AND TESTING OF MATERIALS

3.01 SHOP INSPECTIONS AND TESTING

All materials furnished by the Contractor are subject, at the discretion of the Engineer, to inspection and/or testing by accepted methods at the plant of the manufacturer. This inspection and/or testing is to be made at the cost of the City. The material supplier shall provide the City with copies of test results on materials that are furnished to the Contractor.

3.02 FIELD INSPECTION AND TESTING

All materials furnished by or for the Contractor for incorporation into the work under contract shall, at the discretion of the Engineer, be subject to inspection and/or testing by methods acceptable to the Engineer and at the expense of the City.

3.03 DISPOSITION OF DEFECTIVE MATERIAL

All material found during the process of inspecting and testing to be defective, or defective material encountered at any time during the progress of the work, will be rejected by the Engineer and the Contractor shall promptly remove from the site all such material.

3.04 CONCRETE TEST CYLINDERS

On all type of concrete construction, up to 4 test cylinders may be taken from each section of the structure cast in one operation. The City shall, within seven (7) days of their origin, deliver all cylinders to an approved testing laboratory. The cost of testing shall be paid by the City.

4.00 CONTRACTOR’S RESPONSIBILITY FOR MATERIALS

4.01 MATERIAL FURNISHED BY CONTRACTOR

The Contractor shall be responsible for all material furnished by the Contractor, and the Contractor shall replace at the Contractor's own expense all such material that is found to be defective in manufacture or that has become damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work or during the warranty period.

4.02 MATERIAL FURNISHED BY THE OWNER

The Contractor's responsibility for material furnished by the Owner shall begin at the point of delivery by the manufacturer, or Owner, and upon acceptance of the material by the Contractor. The Contractor shall examine all material furnished by the Owner at the time and place of delivery and shall reject all defective material. The point of delivery shall be stated in the "Special Provisions".

4.03 REPLACEMENT OF DAMAGED MATERIAL

Any material furnished by the Owner that becomes damaged after acceptance by the Contractor shall be replaced by the Contractor at the Contractor's own expense.

4.04 RESPONSIBILITY FOR SAFE STORAGE

The Contractor shall be responsible for the safe storage of material furnished by or to the Contractor, and accepted by the Contractor, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times.

5.00 MATERIAL HANDLING, ALIGNMENT AND GRADE

5.01 MATERIAL HANDLING

Pipe and other accessories shall, unless otherwise directed in the Special Provisions, be unloaded at the point of delivery, hauled to and distributed at the site of project by the Contractor. They shall at all times be handled with care to avoid damage. In distributing the material at the site, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the lining or coating is damaged, the repair shall be made by the Contractor at the Contractor's expense in a manner satisfactory to the Engineer.

5.02 PIPE ALIGNMENT AND GRADE

All pipe shall be laid and maintained to the required lines and grades, with manholes, catchbasins and fittings at the required locations. The owner will furnish one set of line and grade stakes necessary for the work. It shall be the Contractor's responsibility to preserve these stakes from loss or displacement. The Engineer may order the replacement of any stakes deemed necessary for the proper installation of the work. Any replacements shall be at the Contractor's expense. All pipes shall be laid to the grade shown on the contract drawings.

5.03 DEVIATION WITH ENGINEER'S CONSENT

No deviation shall be made from the required line or grade except with the written consent of the Engineer.

6.00 UNDERGROUND, SURFACE AND OVERHEAD UTILITIES

6.01 EXISTING UTILITIES

Existing water and sewer mains, and other underground utilities, are shown on the plans only by general location. The Owner does not guarantee the locations as shown on the plans, and the Contractor shall be solely responsible for verifying the exact location of each of these utilities, without additional compensation. Prior to the start of any construction, the Contractor shall notify all utility companies having utilities in the project area.

The Contractor shall have sole responsibility for providing temporary support and for protecting and maintaining all existing utilities in the project area during the entire period of construction, including but not limited to the period of excavation, backfill and compaction. In carrying out this responsibility, the Contractor shall exercise particular care, whenever gas mains or other utility lines are crossed, to provide compacted backfill or other stable support for such lines to prevent any detrimental displacement, rupture or other failure.

6.02 SUBSURFACE EXPLORATION

It shall be the Contractor's responsibility to determine and verify the location of existing pipes, valves or other underground structures as necessary to progress with the work with no additional compensation allowed. The Engineer shall make all known records available. All known utilities are designated on the plans in a general way only as stated above.

6.03 OVERHEAD UTILITIES AND OBSTRUCTIONS

Overhead utilities, poles, etc., shall be protected against damages by the Contractor and if damaged by the Contractor, shall be replaced by the Contractor. Should it become necessary during the progress of the work to remove or relocate existing poles, overhead utilities and obstructions, the Contractor shall cause the same to be done at no expense to the Owner unless otherwise provided for in the "Special Provisions". This requirement is not intended to allow utility companies to charge for expenses incurred for work performed where their utilities lie within the street right-of-way or dedicated easements.

It will be the duty of the Contractor to visit the site and make exact determination of the existence of any such facilities prior to the submission of the Contractor's bid.

7.00 EXCAVATION AND TRENCH PREPARATION

7.01 GENERAL

The trench shall be so dug that the pipe can be laid to the alignment and depth required and shall be excavated only so far in advance of pipe laying as the Engineer shall specify. The trench shall be so braced and drained that the workers may work therein safely and efficiently. All trenches shall be sheeted and braced as per Chapter sixty-six: Trench bracing of the Minnesota Regulations Relating to Industrial Safety to a safe angle of repose. Such angle of repose shall be no less than that repose required by the Accident Prevention Division of the Minnesota State Industrial Commission or the requirements of the Occupational Safety and Health Act (OSHA) whichever is more restrictive.

It is essential that the discharge of any required trench dewatering pumps be conducted to natural public drainage channels, drains or storm sewers. Only clean groundwater can be discharged into waters of the State.

All trench bedding material shall be incidental unless otherwise indicated in the plans and specifications or if so directed by the Engineer. If bedding material is to be paid for on a weight basis, weight slips shall be delivered to the Engineer daily.

7.02 CLASS OF BEDDING

Class B (first class bedding) or Class C (ordinary bedding) as shown in the Standard Plates, shall be used as directed on the plans or specified in the Special Provisions. PVC pipe shall be bedded in accordance with the specifications described below. Any special bedding shall be in accordance with the Special Provisions.

A. Polyvinyl Chloride Pipe (PVC)

All PVC pipe shall be installed and bedded in accordance with ASTM Specification D-2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." Embedment materials shall be Class I or Class II. These materials shall all pass a 1 3/4 inch sieve and not more than 10% shall pass a #200 sieve. Embedment materials shall be compacted in six inch (6") lifts to a point twelve inches (12") above the pipe and to a density of at least ninety-five percent (95%) of Standard Proctor density as described by ASTM Methods D698. All embedment materials shall be tested for compliance with the above specification and test results shall be supplied to the Engineer.

The Owner reserves the right to check for excess deflection in any portion of the PVC sanitary sewer line after placement of the backfill material in the trench. The deflection will be checked by means of a mandrel device prior to final acceptance of the sanitary sewer line or within thirty (30) days of its installation. Deflections greater than 5% of the inside diameter of the pipe shall be considered failure of the bedding procedure.

B. Class B or first class bedding shall be achieved with compacted backfill in the "pipe zone". The pipe shall be bedded in compacted granular selected material placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth the outside pipe diameter. The side fills plus a minimum depth of twelve inches (12") over the top of the pipe shall be filled with carefully compacted granular selected material.

C. Class C or ordinary bedding shall be achieved by bedding the pipe with ordinary care in an earth foundation formed in the trench bottom by a shaped excavation which will fit the pipe barrel with reasonable closeness for a width of at least 50% of the outside pipe diameter. The side fills and area over the pipe to a minimum depth of six inches (6") above the top of the pipe shall be filled with compacted normal fill material.

7.03 TRENCH WIDTH AND DESCRIPTION

The trench width at the top of the excavation may vary depending upon the depth of the trench and the nature of material encountered. However, the maximum allowable width of trench shall be in strict accordance with Man/DOT Specification 2503.3B. The width of the trench shall also be kept at a minimum to prevent excess destruction of the existing street or highway pavement.

For trench width at the top of pipe greater than specified in the paragraph above, the Contractor may propose alternate strength of pipe to depth of cover relationships other than those listed on the Form of Proposal, or shown on the plans. Such proposals must be submitted to the Engineer for approval in writing and with pertinent pipe strength and soil weight data at least fourteen (14) days prior to the desired construction date. No extra compensation shall be allowed for any increase in material or construction costs created by alternate plans.

7.04 CORRECTING FAULTY GRADE

Any part of the trench excavated below grade shall be corrected with approved material and thoroughly compacted without additional compensation to the Contractor.

7.05 PIPE FOUNDATION IN POOR SOIL

When the bottom of subgrade is soft and in the opinion of the Engineer cannot adequately support the pipe, a further depth and/or width shall be excavated and refilled to pipe foundation grade with approved material and thoroughly compacted; or other approved means such as piling, shall be adopted to assure a firm foundation for the pipe with extra compensation allowed the Contractor as provided elsewhere in these specifications. This does not apply to soil which is unsuitable due to high water level. If this is the case, the Contractor shall dewater the area to provide adequate laying conditions.

The Contractor shall furnish, drive, and place piling if ordered by the Engineer. Piles shall be driven in exact position at locations determined by the Engineer. The Contractor, at the Contractor's own expense, must replace piles not correctly positioned at the completion of driving.

7.06 PIPE FOUNDATION IN ROCK

The space between the bottom of the trench and the bottom of the pipe shall be backfilled with granular base material thoroughly tamped and compacted, a minimum of 12 inches. Generally speaking the material from the trench excavation, other than rocks or boulders shall be considered as suitable material. No additional compensation for placing or tamping this material shall be allowed.

7.07 SOLID ROCK EXCAVATION DEFINED

Solid rock excavation shall include such rocks as are not decomposed, weathered or shattered and which will require blasting, barring, wedging or use of air tools for removal. Under this classification shall be included the removal of any concrete or masonry structure (except concrete pavement, curb, gutter and sidewalk) exceeding one (1) cubic yard in volume that may be encountered in the work.

7.08 BLASTING PROCEDURE

The hours of blasting will be fixed by the Engineer. The Contractor's methods of procedure relative to blasting shall conform to local and State laws and Municipal Ordinances.

7.09 BRACED AND SHEETED TRENCHES

The Contractor shall adequately brace and sheet excavation wherever necessary to prevent caving or damage to nearby property. The cost of this temporary sheeting and bracing, unless provided for otherwise, shall be considered as part of the excavation costs without additional compensation to the Contractor. Trench sheeting shall remain in place until pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted to a depth of one (1) foot over the top of the pipe. Sheeting, bracing, etc., placed in the "pipe zone" (that part of the trench below a distance of one (1) foot above the top of the pipe) shall not be removed without the written permission or written order of the Engineer; that sheeting thereby left in place shall be paid for at the unit price bid. Sheeting ordered left in place by the Engineer in writing shall be paid for at the unit price bid.

The Contractor may also leave in place, at the Contractor's expense, to be embedded in the backfill of the trench any sheeting or bracing in addition to that ordered left in place by the Engineer for the purpose of preventing injury or damage to persons, corporations, or property, whether public or private, for which the Contractor under the terms of this contract is liable.

7.10 PILING OF EXCAVATED MATERIAL

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Material shall not be placed where runoff or sluffing of piles will encroach onto private property. Silt fence shall be placed in all places where runoff will exit the right-of-way or outside the construction easement.

7.11 BARRICADES, GUARDS AND SAFETY PROVISIONS

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, flashers, and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the roadway. All material piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authorities respecting safety provisions shall be observed. All traffic control shall be in conformance with Appendix B of the Minnesota Manual on Uniform Traffic Control Devices.

7.12 TRAFFIC AND UTILITY CONTROLS

Excavations for pipe laying operations shall be conducted in a manner to cause the least interruptions to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways. The Contractor shall post, where directed by the Engineer, suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Hydrants under pressure, valve pit covers, valve boxes, curb stop

boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.

7.13 PRIVATE PROPERTY PROTECTION

Trees, fences, poles and all other private property shall be protected unless their removal is authorized; and any property damage shall be satisfactorily restored by the Contractor, or adequate compensation therefore shall be the responsibility of the Contractor.

7.14 TUNNELING, JACKING, BORING OR EXCAVATION OTHER THAN OPEN TRENCH

Where pipe cannot be placed by open trench excavation, the method for placing and payment therefore shall be stated in the Special Provisions.

7.15 RAILROAD AND HIGHWAY CROSSINGS

When any railroad is crossed, all precautionary construction measures required by the railroad shall be followed. See Special Provisions or Detail Drawings. The Contractor shall be responsible for the securing of necessary crossing permits.

Before any construction is started, the successful bidder shall meet with the Minnesota Department of Transportation, County Highway Department, Railroad Maintenance Engineer, and the Engineers to determine the construction procedure to be followed, methods of rerouting traffic, placing of barricades, flares, signs, flaggers, etc., and methods of preventing damage to the highway or railroad. If required by the railroad or highway department, the Contractor shall deposit with them a certified check in the amount specified by them to cover the required repair work.

7.16 INCIDENTAL ITEMS

The furnishing and installing of specific items and/or the performance of work under certain circumstances shall not be individually paid. The costs shall be included in the unit price bid for the individual pipeline items associated with the stated specific item or work effort. Such items of work include but are not limited to:

1. Interference with other above and underground structures and utilities.
 - a. The removal and restoration, or protection of existing structures and utilities that are shown on the plans and for which there is no bid item for removing and restoring, or working around the utility.
2. Unless separately itemized in the *Schedule of Unit Prices*, any dewatering necessary for construction.
3. Foundation materials placed in lieu of performing necessary dewatering.
4. Bulkheading of existing pipes to be abandoned in place.
5. Granular foundation, granular bedding and granular encasement materials.
6. Granular foundation materials used in lieu of bedding materials in the specified bedding zone, where specified.
7. Granular foundation materials used in unstable trench conditions.
8. The removal and disposal of native materials that are unsuitable for bedding and/or backfill.

9. Providing and maintaining utility service.
10. The replacement of all material displaced due to shrinkage or loss during the excavation and backfilling operations.
11. The removal of excess materials above the original topography the resulting from the additional volume created from pipe bedding, utility pipe, and/or underground structures.
12. Delays due to other utility conflicts that result during the course of construction.
13. Protecting existing improvements and previously accepted elements of this construction from damage.
14. Protecting the inverts of other utility pipes from the accumulation of debris and soil, the removal of blockages that threaten to damage property, and/or the cleaning of both the newly constructed lines and the existing lines of all debris and soil that accumulated during the construction.
15. If a separate bid item for bypass pumping is NOT included in the *Schedule of Unit Prices*, providing temporary bypass pumping / control of storm water flows around the construction zone, include in the price bid for the associated items being installed.
16. The use of special construction techniques such as trench boxes, sheeting, shoring, etc. , include in the price bid for the associated items being installed.
17. Compaction testing and compaction, if required, include in the price bid for the associated items being installed.

7.17 SPECIFICATION REFERENCES

- A. City of Northfield Standard Contract Document and Technical Specifications February 11, 2008 (inclusive with this specification).
- B. Reference CEAM Specification No. 2600 shall apply to excavating, installing bedding and backfilling all trench excavation construction necessary for the completion of work, except as modified herein.
 1. All references to Mn/DOT specifications shall mean the specific edition, including Supplemental Specifications and Technical Memoranda as identified in Section 01420 of these Specifications.
 2. CEAM Specification 2600.3.A1 Maintenance of Traffic is hereby deleted, See Section 01555 of these Specifications.
 3. CEAM Specification 2600.3.A2 Establishing Line and Grade is modified by Section 01720 of these Specifications.
 4. CEAM Specification 2600.3.A3 Protection of Surface Structures:
 - (a) Street signs shall be considered as items of essential service.
 - (b) The last sentence in the third paragraph is deleted.
 5. CEAM Specification 2600.3.A5 Removal of Surface Improvements - All rubble and debris to be disposed of off-site, shall be disposed of at a location secured by the Contractor and in a manner in compliance with applicable Local, State and Federal regulations.
 6. CEAM Specification 2600.3.B3 Excavation Limits and Requirements - OSHA limitations shall also apply to the top of trench width determination. The seven day written notice is waived if changing soil conditions and OSHA compliance apply.
 7. CEAM 2600.3.C1 Jacking/Boring - The Contractor is responsible for protecting all existing utilities above the elevation of the pipe invert minus 2 times the wall

thickness of the casing pipe being installed. In addition, bentonite materials shall not be permitted to flow back into the excavation during the non-open cut construction.

8. CEAM 2600.3.F1 Turf Restoration is hereby deleted, See Section 02920 of these Specifications.
 9. CEAM 2600.3.F1 Pavement Restoration is hereby deleted, See applicable sections of these Specifications.
 10. CEAM 2600.4 Method of Measurement Paragraphs B and C are hereby deleted. See applicable sections of these Specifications.
- C. Reference Mn/DOT Specification No. 2451 shall apply to granular materials for foundation, bedding and encasement of utility line construction, except as modified herein.
- D. Unless noted otherwise, the provisions in this section are in addition to the referenced specification.

8.00 LAYING OF PIPE

8.01 TRENCH PREPARATION

Prior to the laying of the pipe, the trench shall be excavated and prepared in accordance with the previous specifications and the class of bedding specified.

8.02 TYPE, SIZE AND CLASS OF PIPE

The type, size and class of pipe installed shall be in conformance with that specified.

8.03 CLASS OF BEDDING

The class of bedding shall be in conformance with that specified in the project specification or on the Standard Plates.

8.04 CLEANING PIPE

All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying. The outside of the tongue or spigot end of the pipe shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

8.05 LAYING PIPE

Pipe laying shall proceed upgrade with the tongue or spigot ends pointed in the direction of flow. The laying of pipe shall conform to the class of bedding specified. Pipe shall not be laid in water, or when the trench conditions are unsuitable for such work except by written permission of the Engineer. The excavation of trenches shall be fully completed a sufficient distance in advance of the pipe laying and the exposed ends of all pipe shall be fully protected with a board or approved stopper to prevent earth or other substances from entering the pipe.

The interior of the sewer shall be carefully cleaned from all dirt, cement, or superfluous material of every description as the work progresses. If necessary, pipe shall be thoroughly flushed at the completion of the work at the expense of the Contractor as directed by the Engineer.

If an existing utility is shown on the plans and there is no bid item for removing and restoring, or working around the utility, the Contractor shall be required to remove and restore, or protect the utility.

The inverts of existing sewers (storm & sanitary), culverts, subdrains, etc. shall be protected during construction. The Contractor is responsible to inspect and clean, if necessary, all lines which have become compromised by the construction operations.

The trench for all flexible pipe shall be undercut six-inches below the pipe barrel to permit the installation of granular bedding or foundation material.

The trench for all rigid pipe shall be undercut three-inches below the pipe barrel to permit the installation of granular bedding or foundation material.

The Contractor shall install and operate a dewatering system to maintain all trenches free of water wherever necessary. The Contractor shall make his own subsurface investigations and determine what dewatering methods to utilize to prevent such damage.

The Contractor shall be responsible for any damage to adjacent structures or buildings caused by the dewatering operations.

Use of granular foundation material in lieu of performing dewatering is permitted.

All suitable excess excavated material shall remain the property of the Owner and shall be loaded, hauled, placed and compacted at a site chosen by the Owner within 2 miles of the site. All unsuitable excess excavated material, with the exception of topsoil shall become the property of the Contractor and shall be removed from the site and disposed of at a site secured by the Contractor.

All excess excavated material shall become the property of the Contractor and shall be removed from the site and disposed of at a location secured by the Contractor.

Geo-textile fabric sock shall not be installed.

Inspection tees shall be installed flush with the finished boulevard grade.

Where subdrains are connected to catch basins or manholes, rodent protection shall be installed.

On each side of the road, one conduit shall be of the orange/orange type and one conduit shall be of the orange/blue type.

8.06 TRACER WIRE

Tracer wire shall meet the requirements of one of the following:

1. 1/8" galvanized aircraft wire clear PVC coated to 3/16".
2. 1/8" 304 stainless steel wire clear PVC coated to 3/16".

3. #12AWG solid copper or copper clad steel (CCS) wire with 30mil high density polyethylene (HDPE) insulating jacket.

Connectors shall be “wire nut” or “twist on” type connectors filled with silicone waterproofing sealant suitable for direct bury applications according to UL 486D test standard. Connectors shall be DryConn™ connectors as manufactured by King Innovation or approved equal.

8.07 LINE AND GRADE CONTROL

The Contractor shall maintain the line and grade of the pipe in the trench by means of the grade or batter board method or laser.

9.00 PIPE JOINTING

9.01 GENERAL

Joints for concrete pipe shall be made by wiping the joints clean, applying the manufacturer's recommended lubricant compound over the entire joint surface and then inserting the spigot end into the bell with sufficient force to properly seat the pipes. Joints for polyvinyl chloride pipe shall be made by the use of push-on rubber gaskets. All jointing procedure shall be in accordance with the recommendations of the pipe manufacturer.

9.02 PIPE JOINTS

Pipe joints shall be made using the materials specified under Article 2.06. All sliding surfaces of the joint shall be cleaned and lubricated immediately before the pipe is brought home.

10.00 HOUSE CONNECTIONS, WYES AND TEES

10.01 GENERAL

As indicated on the plans and at such other points as may be deemed necessary, six inch or four inch wyes only, SDR 26, shall be installed for house connections at such intervals as the size of the lots may demand. Where the depth of the trench exceeds twelve feet, the Contractor shall use a riser on which shall be used a tee or tee saddle on the main line and shall be extended to a minimum of nine feet below the surface at a point five feet behind the curb line or five feet on the street side of the street property line (see Standard Plate), or as shown on the plan for the invert of sewer services. The minimum required cover for any service shall be 4 feet. If 4 feet of cover is not attainable, the service shall be insulated as directed by the Engineer. Service connections shall be made at existing wyes where available or by means of a saddle where a wye is not available. No connections shall be made into a manhole without written consent by the City Engineer. The minimum grade for a sanitary service shall be 1%.

The joints and bedding shall be made as previously specified. The tops of all risers and openings to wye and/or tee branches shall be capped by a slip joint plug to prevent any water from entering the service until the connection is placed in service. In areas with non-granular fill, all wyes and 45° bends shall be backfilled with granular fill a minimum of 1' around the connection. Granular fill shall be incidental to the installation.

10.02 PRIVATE SERVICES Sanitary sewer and water services shall be constructed to the right-of-way line at a minimum and to houses as directed by the Engineer. Sewer and water services shall be installed in the same trench to the greatest extent possible. The connection of the new service to the existing service shall be considered incidental and should be figured into the price for the wye or curb stop and box.

A water service will be installed to the right-of-way as a minimum or to the building as directed by the Engineer. Services installed to the building shall be brought beyond the foundation to an opening in the basement floor. A separate sewer service (4") and water service (1") shall be installed from the mainline pipes for each unit of multiple family housing structures such as double bungalows, triplexes, quads, etc. A variance from these requirements is acknowledged only in the event that a revised service layout detail is drawn on the plans and receives written approval by the City Engineer.

Boring, pneuma-gophering, tunneling, insertion inside existing services or other means of service installation will be required in some cases for water and sewer line installations. All surfaces will be restored to their original condition.

Sewer and water service work on the interior of the buildings from the point of floor openings to the water meter, sewer stack, or other required locations shall be performed by a licensed plumber. The Contractor is responsible for the protection of all property not scheduled for replacement in the building. Work shall be performed in conformance to all applicable codes.

The Contractor shall be responsible for coordination with the homeowner for the protection of private property on the exterior and interior of the home, including trees.

Remove Concrete Floor / Concrete Pavement Special

- (a) Where necessary, the Contractor shall remove and replace portions of the existing concrete floor for the purpose of sanitary sewer and water service work in buildings as directed by the Engineer. All edges shall be neatly saw-cut. The concrete removal area shall be as small as possible to complete the work. Replacement of the floor shall be performed by a qualified craftsman and shall meet or exceed the thickness, quality, finish, and appearance of the existing floor, which is typically 4" crushed aggregate base with a minimum Portland cement concrete (PCC). The Contractor shall be responsible for the removal of rubble, excess dirt, protection of existing property from dust accumulation or other damage and cleanup for a complete patch, satisfactory to the Engineer and homeowner.

The Contractor shall be responsible for coordinating the schedule and other items relevant to this work with the homeowner such that adequate notice is available to allow removal of carpet, furniture, etc. by the homeowner. Payment shall be at the contract unit price per square foot measured in place upon completion. All materials, labor, rubble and excavated material disposal, cleanup, or other required items are incidental. Any hours spent by the plumber on removing or replacing concrete floor will not be included in the common laborers pay item.

Common Laborers Hours (Connect Services in Building)

- (b) Payment for sanitary sewer and/or water service work from the location of the pipe in the floor opening to the meter, sewer stack, or other required location on the inside of the building shall be on a time and material basis. No hours shall be charged for preparation work such as remove and replace concrete floor, excavation, excavation, removal, etc. Materials shall be paid at the invoice cost plus 15% markup. A currently licensed plumber shall perform the work. Hours shall be based on one licensed plumber. Payment shall be at the contract unit price per man-hour.

Coordination, testing, flushing, property protection or other items required to satisfactorily complete the work outside the building are incidental to bid items for that work. Actual hours worked in the building will be counted and rounded to the nearest ¼ hour. The Contractor shall give the Engineer sufficient notice prior to any work such that inspection can be provided. The Contractor shall provide itemized receipts for each service indicating property address, crew, dates, times work performed, materials used and total hours.

10.03 RECORD AND LOCATION OF SERVICE CONNECTIONS

It shall be the duty of the Contractor to keep an accurate record of service connections as to location, depth to top of riser, type of connection provided, etc. Location shall be made in respect to the nearest manhole center downgrade from the service. This record shall be turned over to the Engineer for the Engineer's records at time intervals specified by the Engineer.

At the end of all house connections, the Contractor shall furnish and set a 2" x 2" wooden marker stake set vertically to two feet above the ground surface. In areas of newly platted land where the houses have yet been built on the lots served, the Contractor shall furnish and set steel fence posts securely wired to the 2" x 2" and allowed to extend 2' to 3' above the ground surface. The 2" x 2" wooden marker stake shall extend from the invert of the service stub to two feet above the ground surface. A tracer wire shall be installed as detailed within the City's Standard Details.

10.04 SERVICE ABANDONMENT

Any Sanitary Service that is abandon shall be removed completely and or sandfilled to the main or riser. Abandonment procedure shall be approved by the Engineer.

11.00 TESTING PROCEDURES

11.01 GENERAL

The Contractor shall furnish the weirs and other material and labor for placing the weirs in the sewers and shall assist the Engineer in making leakage tests and corrective work. The cost to the Contractor for the Contractor's labor and material to assist the testing and the Contractor's labor and material necessary to reduce leakage to allowable values shall be considered as incidental to the project without extra compensation to the Contractor.

If measurements indicate a leakage greater than the maximum allowable leakage, additional measurements shall be taken and continued until all leaks are located and the necessary repairs and permanent corrective work necessary to reduce leakage below the maximum allowed by these specifications are completed. Each section of the project of a maximum length of 400 feet or the distance between two (2) manholes shall be required to comply with the below allowable rates of exfiltration. The quantity of pipe used in these calculations is to include mains and street laterals only and is not to include house service laterals.

A low pressure air test will be required on all sanitary sewer construction. Other tests shall be as specified in the Special Provisions. The cost of testing shall be considered incidental to the contract project.

11.02 EXFILTRATION TEST

Upon completion of the sewer and before any house services are connected, exfiltration tests may be made to determine the amount of exfiltration from the sewer line. The section of the sewer to be tested shall be sealed, and the manholes and pipe line to be tested shall be filled with water to a level or elevation specified by the Engineer. Measurements of the drop in water level shall be taken and recorded and the rate of leakage shall be thereby calculated. The maximum allowable rate of leakage shall be two hundred (200) gallons per inch of diameter of pipe per mile for twenty-four (24) hours where the maximum hydrostatic head at the centerline of the pipe does not exceed twenty (20) feet.

11.03 LOW PRESSURE AIR TESTING

Upon completion of the sewer and before any house services are connected to the pipe line, after the line has been backfilled and cleaned, the Contractor shall furnish all equipment and personnel necessary to conduct a "pipe line acceptability test" using low pressure air. This test shall be performed at a maximum distance of 400 feet between two manholes.

The pipe line shall be sealed with a plug whose sealing length is greater than the diameter of the pipe and constructed in such a nature that they will not require external blocking or bracing and maintain a seal against the line's test pressure. All wyes, tees, outlet or ends of lateral services shall be suitably capped and braced to withstand the internal pressures. Such caps or plugs shall be easily removable.

One (1) plug shall be tapped for the air supply hose and the return air pressure hose. The air supply hose, connected from the compressor to the plug, shall have a throttling valve, bleeding valve and shut off valve for control. The air pressure tap shall have a sensitive pressure gauge, 0 to 10 psi range, protected by a gauge cock and a pressure relief valve set at 10 psi. In performing the test, air is added slowly to the pipe line until pressure inside the pipe line reaches 4.0 psig. If air is added too rapidly, the test accuracy will decrease because a change in temperature also has an effect on the change in pressure. When the air pressure inside the pipe line reaches 4.0 psig above the external hydrostatic pressure the supply air is stopped. A time interval is allowed for the temperature difference to stabilize before the actual test is performed. If the air pressure drops below 3.5 psig during this time interval, more air will be supplied to the pipe line and throttled to

maintain a pressure between 3.5 psig and 4.0 psig for a minimum of two (2) minutes after which time the supply air will be shut off.

The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.003 cfm per square foot of interval pipe at an average pressure of 3.0 psig greater than any back pressure exerted by ground water that may be over the pipe at the time of test.

The test shall be accomplished by determining the time in minutes for the pressure to decrease from 3.5 psig to 2.5 psig greater than the average ground water that may be over the pipe. That time shall not be less than the time shown for the given diameter in the following table.

<u>Pipe Diameter in Inches</u>	<u>Minutes</u>
4	1.9
6	2.8
8	3.8
10	4.7
12	5.7
15	7.1
15	8.5
21	9.9

If the pipe line installation fails to meet the requirements of the test, the Contractor shall, at the Contractor's expense, determine the source of leakage, then repair or replace all defective material and/or workmanship.

In determining the pressure greater than the average ground water, the ground water height in feet above the pipe line must be measured. When the water elevation has been established, the height in feet above the pipe line shall be divided by 2.31 and that pressure added to gauge pressure of test.

A table for converting water height to gauge pressure is as follows:

<u>Ground Water Level Over Top of Pipe Line</u>	<u>Added Pressure to be Applied to Gauge Pressure Readings</u>
1 foot	0.43 psig
2 feet	0.86 psig
3 feet	1.29 psig
4 feet	1.72 psig
5 feet	2.16 psig
6 feet	2.59 psig
7 feet	3.01 psig
8 feet	3.44 psig
9 feet	3.87 psig
10 feet	4.30 psig

11.04 MANDREL TEST

The owner reserves the right to check for excess deflection in any portion of the PVC sanitary sewer line after placement of the backfill material in the trench. The deflection will be checked by means of a mandrel device prior to final acceptance of the sanitary sewer line or within thirty (30) days of its installation. Deflections greater than 5% of the inside diameter of the pipe shall be considered failure of the bedding procedure.

11.05 TELEVISIONING

The City of Northfield shall televise, at the Contractor's cost, the sanitary sewer constructed in the project after completion of all the underground utility construction. The televising will be completed by City of Northfield crews and shall be done after the Class 5 material has been placed and before the first lift of base course bituminous asphalt. This information shall be considered part of the final inspection of the project.

Any line that has debris in the pipe shall be cleaned and retelevised, at the Contractor's expense, prior to placement of the first lift of base course bituminous asphalt. All dirt and debris shall be prevented from entering the existing sewer system by means of watertight plugs or other suitable methods. The Contractor must have written approval from the Engineer for the method they select to clean the line. The line will be retelevised at the time of final acceptance at the expense of the City of Northfield.

The television camera shall be mounted on a skid so that it is centered in the pipe. The camera shall have a cross-hair to maintain a constant reference on the image. The camera shall be equipped with sufficient lights to completely illuminate the interior of the pipe within the range of the camera.

A CD shall be made on the entire footage of pipe televised and delivered to the Owner. An alternative, upon written consent of the Engineer, to the CD is a video tape of the footage. The linear footage of pipe televised shall be integrated into the CD or video tape for ease of identification of pipe being viewed.

12.00 SETTING MANHOLES, CATCHBASINS AND CLEAN-OUTS

12.01 GENERAL

Manholes and catchbasins shall be set and jointed to the line in the manner specified for laying and jointing pipe.

12.02 LOCATION

Manholes, catchbasins and clean-outs shall be located as shown on the plan or as directed by the Engineer and all changes in direction, changes in pipe size, dead ends, or every 400 feet.

12.03 TYPE OF CONSTRUCTION

Wherever possible, and unless otherwise specified, the manholes and catchbasins shall be constructed of precast sections. Where standard sections cannot be used, sections may be constructed of block concrete. Unless otherwise specified, the manholes and catchbasins if

necessary shall be constructed with steps in accordance with the Standard Plate of this Specification.

12.04 CONSTRUCTION DETAILS

The details of construction of each individual structure shall conform to the drawings and specifications as designated. Frames and covers shall be set to the designated elevation in a full mortar bed. The bottom of all manholes shall be constructed of half section of equivalent size pipe shaped to conform to the inlet and outlet pipe so as to allow a free, uninterrupted flow. All inverts shall have a 0.10 foot drop across the manhole unless otherwise stated in the plans and specifications. Any manhole invert not within 0.04 feet of the specified 0.10 foot drop shall be rejected.

12.05 ADJUSTING RINGS AND BLOCKS

A minimum of two (2) and a maximum of four (4) adjusting rings shall be provided between the cast iron frame and the top concrete manhole section. The rings shall provide between 4" and 12" of adjustment. Adjusting rings shall be 2", 4", or 6" and be implemented so the fewest number of rings are used.

12.06 WATERPROOFING AND PRECAST SECTION JOINT CONSTRUCTION

Manholes and catchbasins shall be constructed in such a manner that they are waterproof. Joints between manhole sections shall be made using confined O-ring rubber gaskets as specified previously.

12.07 LIFTING HOLES

Not more than two (2) lifting holes will be allowed in any precast manhole section. All lifting holes shall be plugged with non-shrinking grout to ensure a waterproof installation.

12.08 MANHOLE AND CATCHBASIN BASES

The concrete base shall be of size and depth as shown on the drawings. Concrete used shall have a 28-day compressive strength of at least 3,000 pounds per square inch.

Precast concrete bases shall be used unless prior written approval by the Engineer allows poured bases. Precast bases must be placed on a minimum of six inches of granular material which has been thoroughly compacted and leveled off across the entire width of the base.

Where the foundation is unstable, the Engineer may order the Contractor to install manholes on piling. Manhole base reinforcement and timber piles shall be as shown on the drawings.

12.09 MANHOLE CASTINGS

Manhole castings for sanitary sewer manholes shall have temporary structure covers as specified in Article 13.07 of this Specification. The temporary structure covers shall remain covered until just prior to the placement of the final wearing course of bituminous asphalt.

12.10 MANHOLE DROP SECTIONS

Manhole drop sections shall be constructed where shown on the plans according to the Detail Drawings. Pipes shall be installed to match flow lines unless an outside drop is constructed. Inside drops shall only be allowed with written approval from the Engineer. Inside drops shall be manufactured by Reliner/Duran Inc. or approved equal.

12.11 CLEAN-OUTS

Clean-outs shall conform to the design shown in the Standard Plates. Clean-outs are required every 100 feet on services and at all dead ends where no manhole is present. A steel fence post shall be placed flush with the top of the cleanout cap on all exterior cleanouts to aid in locating these structures in the future. A metal cover shall be required for all clean outs placed on main line sewers.

12.12 WEEP HOLES

The Contractor shall provide weep holes, as required by the City Engineer, for catch basin locations where water sits due to the wear course not being placed. Generally, this will apply to low points where the wear course is being placed the next construction season.

The weep holes shall consist of core drilling a hole in the adjusting rings to allow water to drain into the structure. After placement of wear course, the Contractor shall grout the hole and back plaster as required. All costs associated with the weep holes shall be considered incidental.

13.00 BACKFILLING

13.01 GENERAL

All excavation in trenches shall be backfilled to the original ground surface or to such grades as specified or shown on the plans. The backfilling shall begin as soon as practicable after the pipe has been placed. Prior to any backfilling, the excavation shall be cleaned of all trash, debris, organic material, and other undesirable material. All trenches must be completely backfilled at the end of each day. No open trenches shall be allowed after daylight hours without written approval from the City Engineer.

13.02 BACKFILL PROCEDURE AT PIPE ZONE

Backfilling and compacting shall be done as thoroughly as possible so as to prevent settlement. Depositing of the backfill shall be done so the shock of falling material will not injure the pipe or structures. Grading over and around all parts of the work shall be done as directed by the Engineer.

Bedding material as specified in Sewer Specifications 7.02 or other suitable material as determined by the Engineer, free from rocks and boulders, shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to a height above the top of the pipe as specified, shovel placed and plate tamped to fill completely all spaces under and adjacent to the pipe. In the event that natural, suitable, granular material is not encountered during the normal excavation of the trench, or when the material encountered is determined unsuitable by the

Engineer for backfilling around the pipe as required above, the Contractor shall provide and place such approved material obtainable from other excavation on the project at no additional compensation. If suitable material is not available as stated above, the Contractor shall purchase suitable material as specified for backfilling around the pipe.

The Contractor shall be paid for only that select material required for filling or backfilling as may be stated in the Special Provisions or as they may be directed to purchase and place by the Engineer. All quantities of such material used shall be verified by the Engineer.

13.03 BACKFILL PROCEDURE ABOVE THE PIPE ZONE

Unless otherwise specified, suitable backfill material shall be furnished and the following backfill procedures as applicable shall be used above the "pipe zone" to either the existing surface elevation or design grade, as specified, with the cost of such considered incidental to the installation of the pipe unless specified for a particular section of the project by the Special Provisions and/or plans, or allowed in writing by the Engineer, and a unit price has been established.

A. Type I

Under improved or proposed roads and streets and under existing utilities, "Fill Material" (Item 13.05) shall be placed by mechanical or other means as approved by the Engineer so that excessive settlement will not result. The material shall be compacted at or near the optimum moisture content.

The trench shall be backfilled in no greater than one foot (1') lifts to the top of existing ground. Backfill material shall be compacted to 95% of the standard moisture density relationship of soils (ASTM D698-70) except the top three feet (3') of the trench which shall be compacted to 100% density. All material shall be plate tamped on either side of the pipe to completely fill all voids regardless of the type of pipe being installed.

Any settlement greater than one inch (1") as measured with a ten foot straight-edge within the warranty period of this contract shall be considered failure of the mechanical compaction and all street surfaces, driveways, boulevard and ditch areas shall be repaired by the Contractor at no cost to the City.

B. Type II

Under areas where settlement is allowable, in the judgment of the Engineer, "Fill Material" (Item 13.05) may be placed in layers thicker than twelve inches, and a high degree of compaction shall not be necessary. When backfilling with loose soil types, the material may be backfilled above the existing ground surface or design grade so that the backfill in settling will more nearly conform to the design grade.

C. Type III

Under State or county highways and roads, the Contractor shall obtain the necessary permits, at the Contractor's expense, before commencing any type of work within a State or

county right-of-way. All such work, especially backfilling, shall conform to State and county standards and specifications.

13.04 DISPOSAL OF EXCESS MATERIAL AND DEBRIS

Unless otherwise specified, excavated material, either not suitable or not required for fill material, shall be disposed of by the Contractor outside of the right-of-way at the Contractor's expense in any manner the Contractor may elect subject to the provisions of the following paragraph.

Before dumping such materials or debris on a private or public land, the Contractor must obtain from the Owner of such land written permission for such dumping and a waiver of all claims against the Owner for any damage to such land which may result therefrom together with all permits required by law for such dumping. A copy of such permission, waiver of claims and permit shall be filed with the Engineer before said disposal is made.

13.05 FILL MATERIAL

Normal, allowable "fill material" used in backfilling shall be sand, gravel, or clay, free from pieces of rock, concrete or clay lumps more than one-third (1/3) cubic foot in volume, roots, stumps, organic soil, vegetation, tin cans, rubbish, frozen materials, and similar articles and substances whose presence in the backfill would cause excessive settlement. In that portion of the backfill which is within six inches (6") of a road subgrade or 12" of the top of the pipe, there shall be no stones which will be retained on a three inch (3") sieve.

13.06 DENSITY TESTS

Density tests will be performed by an approved soils testing firm at various locations and depths throughout the project as directed by the Engineer. The Contractor shall cooperate fully and provide assistance, including equipment and labor, as necessary to complete these tests with no additional compensation being made to the Contractor.

All testing costs pertaining to passing tests shall be paid for by the City. All testing costs pertaining to failing tests will be charged to and paid for by the Contractor.

13.07 TEMPORARY STRUCTURE COVERS

Immediately after backfilling is completed all sanitary sewer and storm sewer manholes and catch basins shall be covered with MnDOT Type 5 geotextile fabric and have either the structure casting or a metal plate placed over the fabric. The fabric and plate (casting) should be placed so that when covered, they don't slide off of the structure during gravel lay down or grading operations. The fabric and plate (casting) shall remain in-place until iron is raised prior to the first lift of bituminous pavement being placed.

Storm sewer catch basins and catch basin manholes shall also have 1 1/2" rock placed on and around them to allow for drainage. Rock shall be placed as directed by the Engineer.

All such work shall be considered incidental to the project.

13.08 TEST ROLLING

Test rolling shall be in accordance with Section 2111 of the current Minnesota Department of Transportation Standard Specification, at no additional cost to the owner. Fully loaded trucks maybe used instead of rollers.

14.00 SURFACE RESTORATION, CLEANUP AND GUARANTEE

14.01 RESTORATION OF SURFACE

All surfaces disturbed during the construction period, whether caused by actual excavation, deposition of excavated material, or by the construction equipment, shall be returned to its original conditions or better. Exceptions to the above, if any, or special instructions pertaining to any particular section of the project will be outlined in the "Special Provisions". Any excess dirt shall be removed by the Contractor in accordance with Section 13.04 of these Specifications.

14.02 DUST CONTROL DURING CONSTRUCTION

The Contractor, at the Contractor's own expense, shall maintain dust control as necessary and in a manner satisfactory to the Engineer until final acceptance of the project or until restoration has been completed.

14.03 MAINTENANCE OF STREETS UNTIL SURFACED

After backfilling, the Contractor shall maintain the streets as required and blade as necessary to provide a passable, rut free, pothole free surface for traffic until the surfacing is completed or to the date of final acceptance.

14.04 CLEANING UP

Surplus pipe material, tools, and temporary structures shall be removed by the Contractor, and all dirt and/or rubbish caused by the Contractor's operations and excess earth from excavations shall be hauled to a dump provided by the Contractor, and the construction site shall be left in a condition satisfactory to the Engineer.

14.05 GUARANTEE

The Contractor shall be held responsible for any and all defects in workmanship and materials which may be developed in any part of the entire installation furnished by the Contractor and upon written notice from the Engineer shall immediately replace and make good, without expense to the owner, any such faulty part or parts and damage done by reason of same, during the period as prescribed in Section 31 of the General Conditions.

14.06 FAILURE TO REPLACE DEFECTIVE PARTS

Should the Contractor fail to make good the defective parts within a period of thirty (30) days of such notification, after written notice has been given to the Contractor, the Owner may replace these parts, charging the expense of same to the Contractor.

15.00 TURF ESTABLISHMENT

15.01 GENERAL

All turf establishment shall be in accordance with Article 13.00, Turf Establishment, of the Street Specifications which is included as part of this Standard Specification.

16.00 OPEN DITCH CONSTRUCTION

16.01 GENERAL

The work covered by this specification may be performed with any means and equipment capable of doing a proper job.

16.02 EXCAVATION

The Contractor shall excavate whatever substances are encountered to the size and dimensions shown by the drawings, plans, profiles, and cross-sections, or as instructed by the Engineer.

Wherever seeding or sodding has been specified, the black topsoil shall be selectively stripped and stockpiled to both sides of the right-of-way for use as topsoil for the seeding and sodding portion of the project.

The side slopes and bottom of the ditch are to be dressed as smooth and even as can be done by the skillful operation of the machinery employed to do the work. All waste material shall be removed therefrom to the satisfaction of the Engineer.

During the course of construction, the Contractor shall conduct their operation in such a way that the completed work shall be in reasonable facsimile to that shown on the plans for any particular section. Extra excavation and cost incurred for this purpose shall be at the expense of the Contractor.

16.03 WASTE BANKS

Unless otherwise directed, the Contractor shall place the waste banks on both sides of the ditch and level them to correspond with the slope of the ground surface as closely as possible. The material shall be finished smooth by a bulldozer, grader or dragline to the satisfaction of the Engineer. Openings shall be left in the waste banks for the drainage of adjacent land, crossings or waterways. Proper erosion control methods will be required.

16.04 OBSTRUCTIONS

The Contractor shall remove all bridges, trees, stumps, rocks, brush, culverts, and other obstruction to their work within the right-of-way. Bridge or culvert material which may be usable again shall be piled outside of the right-of-way.

16.05 SILT REMOVAL

The ditch will be checked for grade and widths as the work progresses. Any work not to grade or of proper width shall be corrected. All work shall be maintained to the proper depth and width in

which that part of the ditch is constructed until the end of the working season and until turf and other erosion control measures have been installed.

In case silt washes into the ditch or the banks cave into it later, the silt or cave in shall be removed if necessary, for which the Contractor shall be paid on a time and material basis, or some other method of compensation, if the same is agreed upon by the Contractor, Engineer and representative of the Owner.

17.00 RIPRAP AND EROSION CONTROL MATERIALS

17.01 GENERAL

The Contractor shall furnish and install riprap as designated by the plans or as directed by the Engineer to prevent the possibility of erosion.

17.02 RIPRAP MATERIALS

The riprap material shall conform to Section 3601 of the Minnesota Department of Transportation Standard Specifications. The stone shall be durable field or quarry stone of approved quality, sound, hard, and free from seams, cracks or other structural defects. Unless otherwise specified, the stone may be round, flat, or other shapes in between.

A. Class or Size of Random Riprap Rock

Unless otherwise specified, Class III rock shall be used for all installation and shall conform to MnDOT Spec. 3601.

B. Class or Size of Hand Placed and Grouted Riprap

The individual stones, except those used for chinking, shall not weigh less than 50 pounds each.

C. Size of Rock Versus Weight

As a guide, the following table is included which compares the approximate average diameter with the various weights of round stone. Of course, flat stones of an equivalent weight would have a greater diameter.

<u>Weight</u> <u>(lbs.)</u>	<u>Avg. Diam.</u> <u>(Inches)</u>	<u>Weight</u> <u>(lbs.)</u>	<u>Avg. Diam.</u> <u>(Inches)</u>
10	6	150	15
30	9	180	16
50	10	250	18
80	12	300	19
110	14	400	21

17.03 RANDOM RIPRAP

This work shall conform to MnDOT Specification 2511.

17.04 HAND PLACED RIPRAP

This work shall conform to MnDOT Specification 2511.

17.05 GROUTED RIPRAP

This work shall conform to MnDOT Specifications 2511.

17.06 EROSION CONTROL

The Contractor shall install appropriate erosion control materials at all storm sewer outlets and other potential erosion problem areas along lakes, streams or ponds as noted on the plans or as directed by the Engineer. This work shall be considered incidental to the project.

17.07 FILTER BLANKET MATERIAL

Type I filter blanket material that meets MnDOT Specification 3601.2B shall be placed beneath the riprap material at each storm sewer outlet as described on the standard plate.

17.08 LINER MATERIAL

Erosion control liner material shall be placed beneath the filter blanket material at each storm sewer outlet as described on the standard plate. The liner shall be Staff Permaliner plastic filter material #M1195, or equal.

18.00 TREATED WOOD PILING

18.01 GENERAL

All treated wood piling shall be in accordance with Article 13.00, Treated Wood Piling, of the Watermain Specifications of these Standard Specifications, and as identified on the applicable Standard Plates or Plans.

19.00 FORCEMAIN

19.01 DUCTILE IRON PIPE

The ductile iron pipe covered by this specification shall be of the push-on joint type or the mechanical joint type, centrifugally cast to conform to all requirements of AWWA Specification C151, latest revision. To prevent cracking of the cement lining, the maximum allowable deflection of the pipe shall not exceed 2 percent of the pipe diameter.

Minimum thickness of ductile iron pipe shall be as follows:

4"	Ductile Iron Pipe	0.26"	Class 51
6"	Ductile Iron Pipe	0.25"	Class 50
8"	Ductile Iron Pipe	0.27"	Class 50
10"	Ductile Iron Pipe	0.29"	Class 50
12"	Ductile Iron Pipe	0.31"	Class 50
14"	Ductile Iron Pipe	0.33"	Class 50
16"	Ductile Iron Pipe	0.34"	Class 50
18"	Ductile Iron Pipe	0.35"	Class 50

20"	Ductile Iron Pipe	0.36"	Class 50
24"	Ductile Iron Pipe	0.38"	Class 50
30"	Ductile Iron Pipe	0.39"	Class 50
36"	Ductile Iron Pipe	0.43"	Class 50
42"	Ductile Iron Pipe	0.47"	Class 50
48"	Ductile Iron Pipe	0.51"	Class 50
54"	Ductile Iron Pipe	0.57"	Class 50

All pipes shall have a cement mortar lining in accordance with AWWA Specification C104, latest revision.

All ductile iron pipe shall be marked "DUCTILE IRON" in large letters. The nominal wall thickness shall be plainly marked on each piece of pipe.

- A. RUBBER GASKET JOINTS: All rubber gasket joints are to be in accordance with AWWA Specification C111, latest revision. Adequate means for electrical conductivity shall be provided for the gasket joint.
- B. FITTINGS: All fittings are to be in accordance with AWWA Specification C110, latest revision. All fittings are to have short body laying dimensions.

19.02 POLYVINYL CHLORIDE PRESSURE PIPE

The polyvinyl chloride pressure pipe (P.V.C. pressure pipe) covered by this specification shall conform to ASTM D-1784, Type I, Grade I, and A.S.T.M. D-2241 SDR-PR 26 100 psi, latest revision, and shall have a minimum working pressure of 100 psi.

All pipes shall be marked P.V.C. ASTM D-1120 and ASTM D-2241. The class pressure rating or SDR shall be plainly marked on the pipe.

- A. RUBBER GASKET JOINTS: All P.V.C. pressure pipe shall have rubber gasket joints in accordance with ASTM D-1869. Joints shall be kept clean and properly lubricated prior to installation.
- B. FITTINGS: All fittings shall be compatible with the pipe supplied and shall have a minimum working pressure of 100 psi (SDR-PR 26).

19.03 AIR AND VACUUM VALVES

Sewage air and vacuum valves shall be Apco sewage valves, Model Number 401, as manufactured by Valve and Primer Corporation, or approved equal.

The valve shall be furnished with a 2" inlet, a 2" shut off valve and all other accessories needed for back flushing such as a 1" blow off valve, a 1/2" shut off valve and a quick disconnect coupling with back flushing hose.

An operating and maintenance instruction manual shall be included with the valve.

19.04 AIR RELIEF MANHOLE

Air relief manholes shall be constructed of precast concrete sections with R-4 joints as designed on the plans and shown on the standard plate in accordance with A.S.T.M. designations C-139.

19.05 PIPE INSTALLATION

All pipes shall be laid to the depth shown on the contract drawings. The Contractor shall satisfactorily maintain the specified cover by the use of grade boards or lasers. If additional bends are required, where not shown on the drawings to maintain alignment around curves, the Contractor shall provide the required number and be compensated at the unit price as proposed on the bid form. The following is the maximum allowable joint deflection for the ductile iron pipe.

Pipe Size	Mechanical and Lead Joints	Slip Joint
4 inch	4° 25'	5°
6 inch	4° 25'	5°
8 inch	3° 51'	5°
10 inch	3° 42'	5°
12 inch	3° 8'	5°
14 inch	2° 39'	3°
16 inch	2° 21'	3°
18 inch	2° 7'	3°

19.06 LAYING PIPE

- A. Handling of Forcemain Material into Trench: Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings and valves shall be carefully lowered into the trench in such a manner as to prevent damage to forcemain materials and protective coatings and linings. Under no circumstances shall forcemain materials be dropped or dumped into the trench.
- B. Jointing: All types of joints shall be made in strict accordance with manufacturer's specifications. All pipe ends shall be wire brushed, wiped clean, and kept clean until joints are made. For the assembly of the push-on type of joint, additional cleaning shall be required with a power driven wire brush or other means just prior to assembly until clean, bright, metallic surface shows in the locations where the metal inserts of the gasket will contact the socket and spigot after assembly.
- C. Cutting Pipe: Untapered spigot ends may be encountered when pipes are cut in the field. Before assembly, the cut end should be beveled with a heavy file or other suitable apparatus, removing any sharp or rough edges to protect the gasket from injury and ensure ease of assembly.

- D. Blocking: All fittings, at points of bends in the line, shall be solidly braced against the end or sides of the trench. All fittings shall be blocked with concrete. The concrete to have a minimum compressive strength of 2000 psi and the block to be of sufficient size so as not to exert more than 2000 lbs. per square foot pressure against the soil.

19.07 TESTING PIPE LINES

- A. Hydrostatic Tests Required: A pressure test shall be required for all installations of forcemain and all appurtenances.
- B. Pressure Test: The pressure test shall be held at a hydrostatic pressure equal to twice the maximum design pressure or a minimum hydrostatic pressure of 70 pounds per square inch for a period of one hour in the presence of the Engineer. At the end of the one hour period, the pressure drop shall be read. Next, the Contractor shall add water to the system through a water meter capable of measuring increments to a tenth of a gallon until the water system has been restored to the original hydrostatic pressure as stated above. The quantity of water added to the system shall then be read to the nearest tenth of a gallon. The maximum allowable quantity of water which may be added to the water system is one pint per hour for each section of force main tested between consecutive valves or plugs. A suitable container graduated in increments of one pint shall be used as the source of water.
- C. Procedure: Each valved section of pipe shall be slowly filled with water from a safe source, and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a water pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connections, gauge and all necessary apparatus shall be furnished by the Contractor and shall be approved by the Engineer before any test is made. All necessary pipe taps shall be made by the Contractor as may be directed by the Engineer.
- D. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this in those instances where air relief manholes exist, the pipe shall be filled with water until all air has been expelled through the air relief valve. Then the shut off valve between the force main and air relief valve shall be closed and the air relief valve disconnected from the system. The pressure test on the force main can then proceed as outlined above.
- E. Examination Under Pressure: Any cracked or defective pipes, valves and fittings discovered in consequence of the pressure test shall be removed and replaced by the Contractor with sound material and the test shall be repeated until satisfactory to the Engineer. The pressure test shall be performed in a manner approved by the Engineer. The Contractor shall correct all faulty materials or workmanship discovered during the tests and all such corrections shall be made to the satisfaction of the Engineer at the Contractor's expense.

- F. Electrical Conductivity Test: After the backfilling operation has been completed, the Contractor will be required to conduct an electrical conductivity test in the presence of the Engineer. The test shall be run after complete backfilling to assure that no electrical connections have broken loose in the joints during the backfilling operation.

Direct current of 350 amperes, plus or minus 10 percent, shall be passed through the pipe line for 5 minutes. Current flow through the pipe shall be measured continuously on a suitable ammeter and shall remain steady without interruption or excessive fluctuation throughout the 5 minute test period.

Insufficient current or intermittent current or arcing, indicated by large fluctuations of the ammeter needle, shall be evidence of defective electrical contact in the pipeline. The cause shall be isolated and corrected, and the section retested to meet the requirements.

Cables from the power source to the ends of the section of pipe under test should be of sufficient size to carry the test current without over heating or excessive voltage drop. Usable size will be in the range of 2/0 to 4/0 A.W.G.

Connections to the pipe or appurtenances should be of a type that will not cause arcing or welding action. Any pipe coating or paint that may be removed for the test, shall be replaced when the test is completed.

Caution shall be exercised at all times, when the electrical conductivity test is conducted.

The electrical conductivity test shall not be required for P.V.C. forcemain.

20.00 METHOD OF PAYMENT

The work shall be measured and the compensation determined in the following manner:

20.01 SEWER PIPE

Sewer pipe shall be paid for at the contract price per lineal foot, which shall include the cost of furnishing all pipe, pipe bend sections, jointing material, bedding material and other material and of delivering, handling, laying, dewatering, trenching, sheeting and backfilling, restoring of the surface, necessary permits, and all material or work necessary to install the pipe complete in place at the depth specified. The length of pipe for which payment is made shall be the actual overall length measured along the axis of the pipe without regard to intervening manholes, tee sections or bend sections. Lengths of branches will be measured from the center of manhole to the center of manhole. All lengths will be measured in a horizontal plane unless the grade of the pipe is more than fifteen (15) percent. The depth of cut for payment shall be defined as the distance between the invert of the pipe at a particular point and the intersection of a vertical or plumb line extended from the said point to the point of intersection of the line with the ground surface as it exists at time of construction.

20.02 CAST IRON PIPE OR DUCTILE IRON PIPE IN LIEU OF OTHER SEWER PIPE

C.I.P. or D.I.P. not shown on the plans, but placed upon direction of the Engineer in lieu of other sewer pipe shall be paid for as sewer pipe in accordance with Section 20.01 above plus the contract unit price per lineal foot bid as "Additional cost per foot for substituting C.I.P. or D.I.P. in lieu of other Sewer Pipe" as listed on the Proposal Form for the diameter of pipe furnished.

C.I.P. or D.I.P. fittings shall be paid for at the contract unit price per pound for the standard weight of fittings and specials installed, including glands, gaskets, bolts or other accessories.

20.03 MANHOLES

The standard manholes and drop manholes shall be paid for at the contract unit price which shall include the cost of furnishing all pipe, tees, horseshoes, precast selections, sewer block, concrete slabs, adjusting rings, mortar, castings, water proofing, jointing and other material and of delivering, handling, excavating, sheeting, backfilling, dewatering, restoring of the surface and all material or work necessary to install the units complete in place at the depth specified for the depth of 0-10 feet plus an additional payment at the contract unit price per lineal foot of depth greater than ten feet. Manholes shall be measured from the invert of the sewer to the top of the cover.

20.04 WYES, TEES AND SPECIAL FITTINGS

Wyes, tees and special fittings will be paid for at the contract price for each unit furnished of the size and classification specified in the Proposal Form.

20.05 CATCHBASINS

Catchbasins will be paid for at the contract unit price, including base and casting.

20.06 FLARED END SECTIONS

End sections will be paid for at the contract unit price for each size furnished and shall include placing costs and trash guard. Riprap and erosion control materials will be paid at the contract unit price.

20.07 PILING

Piling up to 20 feet long including caps shall be paid for at the contract unit price for each single pile bent in place. No additional payment will be made for cradles.

Any piling required over twenty feet in length shall be paid for as excess length of piling. Payment will not be made for cut off lengths. Double pile bents shall be paid for according to the length of each individual pile. There shall be no additional compensation for lumber or hardware used to tie the piles together.

20.08 FOUNDATION MATERIAL

Material used for refilling to pipe foundation grade to assure firm foundation for pipe shall be paid for at the contract unit price per ton placed. Payment shall include cost of excavation and placement.

20.09 SPECIAL SECTIONS

Special sections will be paid for at the contract price on a lump sum basis for all work and material necessary for the complete installation or construction.

20.10 PILING FOUNDATION FOR MANHOLES

Payment for "Piling Foundation for Manholes" will be paid at the unit price bid and shall include steel reinforcement of the base, together with four twenty foot piles each.

Piling over twenty feet in length will be paid for at the contract unit price per linear foot for each foot of length over twenty feet driven in place below cut-off.

20.11 SHEETING ORDERED LEFT IN-PLACE

Sheeting ordered left in-place shall be paid for at the contract unit price per 1000 board feet.

20.12 JACKING

Payment for jacking will be paid for at the contract unit price per lineal foot. Sewer used in jacking will be paid at the bid unit price for that diameter sewer in the 0-10' cut category.

20.13 MERGED ITEMS

The cost of all material and labor required to complete this project as specified and shown on the plans, but not specifically included as a pay item, shall be merged with the various unit prices bid.

20.14 ROCK EXCAVATION

Rock excavation shall be paid for at the contract unit price bid per cubic yard excavated. The volume used for payment shall be computed assuming a rectangle, the width of which is equal to the outside diameter of the pipe installed plus one foot (1'), and the depth of which is the distance from the top of the rock formation to a point twelve inches (12") below the barrel of the pipe.

20.15 INCIDENTAL ITEMS

The furnishing and installing of specific items and/or performance of work under certain circumstances shall not be individually paid. The costs shall be included in the unit price bid for the sanitary sewer items, as indicated. Such items of work include but are not limited to:

1. Dye water testing of all service lines encountered and the subsequent plugging of abandoned sewer services, include in the unit price bid for sanitary sewer.
2. The costs of furnishing bends, adaptors, cutting and removing the existing sanitary or storm sewer pipe, include in the price bid for sanitary sewer.
3. Locating and connecting to an existing sanitary or storm sewer service laterals, include in the price bid for sanitary sewer.
4. Adaptors to adjust the diameter of the new service connections to match the existing service lines, include in the price bid for service connections.
5. Leakage, vacuum, air and deflection testing, include in the price bid for sanitary sewer.
6. The wood and/or metal parts necessary to identify the ends of unattached service lines, include in the price bid for sanitary sewer services.

7. If a separate bid item for bypass pumping is NOT included in the *Schedule of Unit Prices*, providing temporary bypass pumping / control of sanitary and storm water flows around the construction zone, include in the price bid for the associated sewer items.
8. Furnishing and installing tracer wire and electrical connections and all appurtenances related to installing services, mainline pipe and/or tracer wires, include in the price bid for sanitary sewer.
9. Locating and connecting to an existing storm sewer, include in the price bid for storm sewer.
10. Use of geotextile fabric to wrap pipe joints in lieu of using mastic, include in the price bid for storm sewer.
11. Maintenance of an appropriate storm water outlet during construction, include in the price bid for storm sewer.
12. The cost of all labor, equipment and materials necessary for testing of storm sewer, if required, included in the price bid for storm sewer.
13. If the sewer is to be installed inside a casing pipe, furnishing and placing the carrier pipe, carrier pipe support materials, sand fill and grout seals, include in the unit price bid for sewer.