

SANITARY SEWER SYSTEM



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Section 2

Sanitary Sewer System

2.01 Sanitary Sewer Extensions

A. General

1. All new developments proposing to construct sanitary sewer system improvements for ownership and maintenance by the Town of Granite Falls shall conform to these Standard Specifications and Details, as well as, to the requirements of the N.C. Department of Environment and Natural Resources.
2. Plans and specifications for sewer line extensions must be prepared and submitted by the developer's Engineer, licensed to practice in North Carolina, and must be approved prior to beginning construction.
3. Copies of all Engineering Design data, assumptions, calculations, etc. shall be submitted to the Town at the time the plans are submitted.
4. All proposed sewer extensions must be approved by the North Carolina Department of Environment and Natural Resources.
5. Sufficient data shall be shown so as to accurately locate the facilities in the field. Plans shall indicate the deflection angles at all manholes. Profile elevations shall be base USGS datum and benchmarks shall be shown and described on the drawings.
6. When applicable, Owner/Developer will be responsible for preparing a soil erosion sedimentation control plan. This plan, along with appropriate fees, shall be submitted to the Land Quality Section of the N.C. Department of Environment and Natural Resources, Asheville Regional Office, for approval.
7. Owner/Developer will be responsible for securing all required easements and rights-of-way needed for the construction and maintenance of the sewer system.
8. Where applicable, Owner/Developer shall obtain appropriate encroachment approvals from the N.C. Department of Transportation.
9. All Contractors performing any construction activity involving the Town of Granite Falls' utility system shall be licensed to practice general contracting in the State of North Carolina. The Contractor shall be classified in the appropriate area of license for the type of construction to be performed and

shall not perform construction activity which exceeds the limitations of the designated Contractor's license.

10. During construction, the Contractor shall be responsible for all project safety requirements. Additionally the Contractor shall adhere to all State and Local Health Department regulations as they pertain to their employees.
11. After the installation of improvements, the Owner/Developer or designee shall contact the Town and schedule a Completion (pre-final) Inspection. The Town will accept the improvements or respond with a punch list within 30 days of the request. The Owner/Developer or designee must complete all items indicated on the punch list, and any additional items noted, within 60 days or the punch list will be void. The Owner/Developer or designee must then request a Final Inspection. At this time the Owner/Developer must provide the Town with a complete set of As-builts that accurately reflects the improvements as they were installed.
12. Upon the acceptable completion of all punch list items and payment of any outstanding fees, the Owner/Developer or designee will receive an acceptance letter from the Town. This acceptance begins a warranty for materials and workmanship including pavement repairs for two (2) years from the date of acceptance. The warranty will be to the Town from the Owner/Developer or designee.
13. The Town will perform routine maintenance during the warranty period but all materials and workmanship are the responsibility of the Owner/Developer. If repairs resulting from faulty materials and/or workmanship are needed during the warranty period, the Owner/Developer or designee shall be notified by the Town. If the repairs are not made in a timely fashion or if the repairs are of an emergency nature, the Town may choose to make the repairs and bill the Owner/Developer or designee for the total cost of the repair.
14. Upon completion of, or just prior to the end of, the warranty period, the Owner/Developer or designee shall request a Final Warranty Inspection from the Town. The Town will respond with final acceptance or a punch list on workmanship or materials within 30 days of the request. The Owner/Developer or designee must complete all items indicated on the punch list, and any additional items noted within 60 days or the punch list will be void. The Owner/Developer or designee must then request another Final Warranty Inspection.
15. Upon the acceptable completion of all punch list items, the Owner/Developer or designee will receive a Letter of Final Acceptance from the Town. The Town will assume all maintenance responsibility as of the date of the Letter of Final Acceptance.

2.02 Gravity Sewer Mains

A. Design

1. Location

- a. All public sanitary sewer mains shall be located within dedicated rights-of-way or easements having the following minimum width.
 - i) 8", 10" and 12" mains - 20 feet
 - ii) 15", 18" and 24" mains - 30 feet
- b. Additional easement widths may be required by the Town should conditions, such as depth of the main, warrant.
- c. Sewer mains shall be centered within the easements unless otherwise approved the Town.
- d. In natural drainage ways, sewers shall be extended to the adjacent property line to readily enable future connections.
- e. Sewer mains, including force mains shall be located at least the minimum horizontal distance from the following:
 - i) Any public water supply source, including wells, springs, and Class I or Class II reservoirs:
 1. 100 feet, unless constructed of leak proof pipe, such as ductile iron pipe with mechanical joints equivalent to water main standards, in which case the minimum setback may be reduced to 50 feet.
 - ii) Any private water supply source, including wells and springs:
 1. 50 feet, unless constructed of similar, leak proof pipe such as ductile iron pipe with mechanical joints equivalent to water main standards, in which case the minimum setback may be reduced to 25 feet.
 - iii) Any waters classified as WS-I, WS-II, WS-III, B, SA, or SB:
 1. 50 feet, unless constructed of similar leak proof pipe, such as ductile iron pipe with mechanical joints equivalent to water main standards, in which case the minimum setback may be reduced to 10 feet.
 - iv) Any other stream, canal, marsh, coastal waters, lakes and

other impoundments, or other surface waters; 10 feet.

- v) Any basement; 10 feet
- vi) Top of slope of embankments or cuts of 2 feet or more vertical height; 10 feet
- vii) Drainage Systems
 - 1. Interceptor drains, storm drains, and storm water diversions; 5 feet
 - 2. Ground-water lowering ditches and devices; 10 feet
- viii) Any swimming pool; 10 feet
- ix) Any other nitrification field, 5 feet
- f. Sewer lines may cross a water line if 18 inches clear separation distance is maintained, with the sewer line passing under the water line. When conditions prevent an 18-inch clear separation from being maintained or whenever it is necessary for the water line to cross under the sewer, the sewer line shall be constructed of ductile iron pipe or its equivalent and the water line shall be constructed of ferrous materials equivalent to water main standards for a distance of at least ten feet on each side of the point of crossing, with full sections of pipe centered at the point of crossing.
- g. Sewer lines may cross a storm drain if:
 - i) 12 inches clear separation distance is maintained; or
 - ii) The sewer is of ductile iron pipe or encased in concrete or ductile iron pipe for at least five feet on either side of the crossing.
- h. Sewer lines may cross a stream if at least three feet of stable cover can be maintained or the sewer line is of ductile iron pipe or encased in concrete or ductile iron pipe for at least ten feet on either side of the crossing and protected against the normal range of high and low water conditions, including the 100-year flood/wave action. Aerial crossings shall be by ductile iron pipe with equivalent to Griffin Pipe Products, Mech-Lock or Rigid-Lok restrained joints. Pipe shall be anchored for at least ten feet on either side of the crossing.

2. Size

- a. The minimum size of a public gravity sanitary sewer shall be 8 inches.
- b. Gravity sewer mains shall be designed to serve the total natural drainage basin.
- c. Sewers shall be designed flowing half full at the average daily flow.
- d. Sewage flow rates for design units shall be as established by the N.C. Department of Environment and Natural Resources.
- e. Pipe diameter changes shall occur only in manholes with the invert of the larger (downstream) pipe being sufficiently lower so as to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.
- f. Sewer extensions shall be designed for projected flow even when the diameter of the receiving sewer is less than the diameter of the proposed extension at a manhole.
- g. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula using an "N" value of 0.013. Following are the minimum slopes which shall be provided, however slopes greater than these are recommended.

<u>Diameter of Pipe (inches)</u>	<u>Minimum Slope ft./100 ft.</u>
8	0.40
10	0.28
12	0.22
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

- h) The maximum velocity in sanitary sewers, unless otherwise approved by the Town, shall be 15 ft./sec. As calculated by the following:

$$V = \frac{1.486}{N} \times (R_H)^{2/3} \times S^{1/2}$$

Where: V= Velocity in feet per second
 N= Manning's co-efficient of roughness = 0.013
 S= Slope of energy gradelines, ft/ft
 R_H= Hydraulic radius, ft
 = $\frac{\text{Cross-sectional of flow (ft}^2\text{)}}{\text{wetted perimeter}}$
 or
 $\frac{\text{diameter (in.)}}{48}$

- i) Sanitary sewer mains shall be deep enough to serve the adjoining property. Three (3) feet minimum cover shall be provided unless ductile iron pipe is used.

B. Material

1. Ductile Iron Pipe

- a. Pipe shall be designed and manufactured in accordance with AWWA C150 and C151 and shall be pressure class 350psi.
- b. Joints shall be of the push-on type as per AWWA C111.
- c. Pipe lining shall be cement mortar with a seal coat of bituminous material in accordance with AWWA Standard C104. Should there be a concern of Hydrogen Sulfide in the line, the pipe should be lined with SEWPER COAT as manufactured by LaFargre Calcium or a similar coating. Lining shall be applied in accordance with the manufacturer's recommendation.

2. Polyvinyl Chloride (PVC) Pipe - SDR 35

- a. 8 inch through 15 inch PVC gravity sewer pipe shall comply with all requirements of ASTM D-3034 for SDR 35.
- b. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.

- c. Pipe shall have integral elastomeric-gasket bell end.
 - d. Pipe shall be supplied in nominal laying lengths of 12.5 feet.
3. PVC Composite (Truss) Pipe
- a. 8 inch through 15 inch PVC composite (truss) pipe shall comply with all requirements of ASTM D-2680.
 - b. PVC materials shall comply with ASTM D-1784 with a cell classification of 12454-B.
 - c. Joints shall be chemically welded or gasketed in accordance with ASTM D-3212. Solvent cement shall comply with ASTM D-2564.
4. Reinforced Concrete Pipe
- a. Reinforced concrete pipe (RCP) shall be used only on interceptor line 18 inches and larger unless otherwise approved by the Town.
 - b. Reinforced concrete pipe shall comply with all requirements of ASTM C-76.
 - c. Pipe shall be Class III for depth of cover to 12 feet. Where depth of cover exceeds 12 feet, the pipe shall be Class IV.
 - d. Joints shall be bell and spigot in conformance with ASTM C-361. Use confined "O" ring rubber gasket in conformance with ASTM C-443.
 - e. The interior pipe wall shall have (2) coats of black bituminous (coal tar) protective coatings. The coatings shall have a minimum thickness of 16 mil.
 - f. Pipe laying lengths shall not be less than 8 feet.
5. Vitrified Clay Pipe
- a. Vitrified clay pipe (VCP) shall be extra strength in accordance with ASTM C-700.
 - b. Joints shall be of the mechanical compression type in accordance with the requirements of ASTM C-425
 - c. Pipe shall be tested in accordance with the requirements of ASTM C-301.
6. Ribbed PVC Pipe

- a. Ribbed PVC pipe 8 inch through 15 inch in diameter shall have a smooth interior with a solid cross-sectional rib exterior. The ribs shall be perpendicular to the axis of the pipe to allow placement of the sealing gasket without additional cutting.
- b. Pipe shall meet the requirements of ASTM F-794 and Uni-Bell Uni-B-9.
- c. PVC materials shall comply with ASTM D-1784 with a cell classification of 12454-B.
- d. Joints shall meet the requirements of ASTM D-3212. Gasket material shall meet the requirements of ASTM F-477.
- e. Laying lengths shall be 13 feet or greater.

C. Excavation

1. General

- a. All construction relating to the utility improvements must be performed by Contractors licensed by the State of North Carolina to perform the proposed activity.
- b. The Owner/Developer and the Contractor shall be responsible for Project Safety.
- c. All work shall be performed in accordance with applicable State and Federal Safety Regulations including, but not limited to the following:
 - i) N.C. Safety and Health Standards for the Construction Industry (29CFR 1926 Subpart P).
 - ii) NC OSHA Industry Guide No. 14 - Excavations.
 - iii) NC OSHA Industry Guide No. 20 - Crane Safety.
- d. Contractor shall provide barriers, warning lights and other protective devices at excavations as necessary for safety of workers and the public.
- e. Should it be necessary to close or partially close a street, the Contractor shall notify the town and all other emergency response

agencies at least 24 hours prior to closing the street.

- f. No work is to begin until the Plans and Specifications have been approved by the Town and the appropriate state agencies and all required permits have been obtained.

2. Definitions

- a. Backfill: A specified material used in filling the excavated trench and placed at a specified degree of compaction.

- i) Materials: Materials listed herein include processed materials plus the soil classifications listed under the Unified Soil Classification System, (USCS) (Method D2487 and Practice D2488). The soil materials are grouped into five broad categories according to their suitability for this application.

- 1. Class I: Angular, 6 to 40-mm (1/4 to 1-1/2 in), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shell.

- 2. Class II: Coarse sands and gravels with maximum particle size of 40 mm(1-1/2 in), including various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class.

- 3. Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM and SC are including in this class.

- 4. Class IV: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials shall not be used for bedding, haunching or initial backfill.

- 5. Class V: This class includes the organic soils OL, OH, and PT, as well as, soils containing frozen earth, debris, rock larger than 40 mm (1 1/2 in) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching, or initial backfill.

- b. Backfill Zones: Each backfill zone shall extend the full width of the trench bottom.

- i) Foundation: Extending down the specified amount from 4 inches below the pipe bottom.
- ii) Pipe Embedment
 - 1. Bedding: Extending from 4 inches below the pipe bottom to the pipe bottom.
 - 2. Haunching: Extending from the bedding (bottom of the pipe) to the pipe spring line.
 - 3. Initial Backfill: Extending from the haunching (pipe spring line) to 1 foot above the top of the pipe.
- iii) Final Backfill: Extending from 1 foot above the top of the pipe to the finish ground elevation.
- c. Compaction: Process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. “Degree of compaction” shall be expressed as a percentage of the maximum dry density obtained by the text procedure presented in ASTM D698 (Standard Proctor).
- d. Excavation: The removal of soil, or rock to obtain a specified depth or elevation.
- e. Hard Material: Solid, homogeneous material which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment with ripper teeth or the use of jack hammers for removal. Material having a standard penetration resistance as determined by ASTM D1586 between 60 and 600 blows per foot is defined as “hard material”.
- f. Lift: Layer of soil placed on top of a previously prepared or placed soil.
- g. Rock: Solid, homogeneous material which cannot be removed with the systematic drilling and blasting exceeding 1 cubic yard in volume. Material having a standard penetration resistance as determined by ASTM D1586 greater than 600 blows per foot is defined as “rock”. Removal of “hard material” will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.
- h. Topsoil: Natural, friable soil, representative of productive soils in the vicinity of the site. Topsoil shall be free from roots, stones larger than 1 inch, objectionable weed seeds, toxic substances, and materials that hinder grading, planting, and maintenance operations.

3. Use of Explosives

- a. Obtain required permits for blasting from the Town and other applicable agencies.
- b. Store, handle, and use explosives in accordance with local and state regulations or in the absence of such, in accordance with the provisions of the “Manual of Accident Prevention and Construction” of the Associated General Contractors of America, Inc.
- c. Conduct survey and document existing conditions of facilities prior to blasting. Provide seismographic monitoring during progress of blasting operations.
- d. Use explosives in such a way to minimize vibration to existing utilities and structures.
- e. Provide only experienced individuals for blasting in accordance with accepted practices. Project Foreman shall have a minimum of 2 years experience in the type of blasting activity being proposed.
- f. Contractor is responsible for safety of life and damage to property resulting from the use of explosives.

4. Excavating

- a. Excavation shall be by open cut. Short sections of trench may be tunneled or direct bored with the approval of the Town.
- b. Stockpile excavated material in such a manner that it will not obstruct the flow of runoff, streams, endanger Work, impair the use or appearance of existing facilities, or be detrimental to the completed Work.
- c. Trench dimensions shall be as follows:
 - i) Minimum width: Pipe outside diameter plus 18 inches.
 - ii) Maximum width: Pipe outside diameter plus 24 inches.
 - iii) Sides shall be vertical to a minimum of one foot above the top of pipe.
- d. Shape trench bedding to provide uniform bearing for the full pipe length. Bottom shall be free of protrusions which could cause point loading on pipe. Provide bell holes as required for properly making pipe joint.

- e. Excavation of trench shall not advance more than 200 feet ahead of the completed utility installation. In no case should the excavation extend beyond that which can be backfilled by the end of the work day.
- f. Excavate rock and hard material to a minimum depth of four (4) inches below the pipe.

D. Installation

1. General

- a. Lay pipe in the presence of the Town, unless specifically approved otherwise.
- b. The Contractor shall demonstrate to the Town that he has adequate experience installing the type of sewer pipe proposed for the project.
- c. Handle pipe and accessories in accordance with manufacturer's recommendations. Care shall be taken to not damage pipe coatings.
- d. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
- e. Lay pipe to grade and alignment indicated on the approved Drawings.
- f. Provide proper equipment for lowering pipe into trench.
- g. Provide tight closure pipe ends when work is in progress.
- h. Keep pipe interior free of foreign materials.
- i. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
- j. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.

- k. A three (3) inch wide polyethylene plastic tape manufactured for identification of utilities shall be installed 18 inches above the top of all sewer lines. The tape shall be green with the wording "Caution - Buried Sewer Line Below" in bold black letters.

E. Backfilling and Compaction

1. General
 - a. Maintain backfill operation within 200 feet from pipe laying operation.
 - b. Backfill trench to existing ground surface with select excavated material at the specified compaction.
 - c. If excavated material is unsuitable to obtain specified compaction, provide suitable off-site borrow material for backfill.
 - d. Re-excavate trenches improperly compacted. Backfill and compact as specified.
 - e. Provide appropriate tamping equipment, and water to obtain proper moisture content, to achieve specified compaction of backfill.
 - f. Conduct operation of heavy equipment above pipe installation as to prevent damage to pipe.
2. Plastic Pipes
 - a. PVC SDR 35, PVC Truss Pipe and PVC Ribbed Pipe shall be installed in accordance with ASTM D-2321 and UNI-B-5.
3. Vitrified Clay Pipe
 - a. Vitrified Clay Pipe shall be installed in accordance with ASTM C-12.
4. Ductile Iron Pipe
 - a. Ductile Iron Pipe used for gravity sewer lines shall be installed in accordance with AWWA C-600.
5. Backfill in Pipe Embedment Zone
 - a. Backfill with material as specified below. Material shall be free from objects larger than 2 inches.
 - b. Where rock and hard material has been excavated below pipe bottom or where unstable material has been encountered, the entire Pipe Embedment Zone shall be backfilled with Class I material.
 - c. Place backfill material to assure placement of material under pipe haunches.

- d. Take care during placement and compacting of material to avoid movement of pipe.
- e. Place pipe zone backfill in 6 inch maximum layers and compact as specified below.
- f. For ductile iron pipe, reinforced concrete pipe and vitrified clay pipe:
 - i) Excavation in Class I, Class II, Class III and stable Class IV soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material to pipe spring line and compact to 90 percent.
 - ii) Excavation in Class V, unstable Class IV soils, running water, and other unstable soil conditions, excavate a minimum of 4 inches below pipe bottom and provide Class I material for bedding and haunch zone.
- g. For PVC pipe, PVC ribbed pipe and PVC composite pipe:
 - i) Depth 0-14 ft.; Provide Class I material for bedding and haunching.
 - ii) Depth over 14 ft.; Provide Class I material for bedding, haunching and initial backfill.
 - iii) Compact Class I material to 90 percent density.

6. Final Backfill

- a. Backfill with materials free of stones and debris larger than 6 inches in dimension. Place backfill in layers not exceeding the thickness and compacted to the minimum density specified below.
- b. Trench backfilled with non-cohesive materials may be compacted with water flooding; except under roadways, shoulders of roadways, and other areas subject to vehicular movement, provided the method of compaction is approved by the Town and provides the degree of compaction required.
- c. Lifts and Density
 - i) Underdeveloped areas (i.e., forest, fields, and crop lands): Trench may be filled with bulldozer blade provided material fall will not damage pipe. Mound soil over the trench area sufficiently to settle level over time. Degree of compaction shall be 85 percent density as per ASTM D698.

- ii) Lawns: Backfill in 12 inch layers and compact to 90 percent. Top 12 inches shall be free of material with dimension over 2 inches.
- iii) Roads (including right-of-way), drives, parking areas (including areas within 20 feet), and adjacent to existing utilities: Backfill in 6 inch layers compact to 95 percent.
- iv) Within 20 feet of foundations: Backfill in 6 inch layers compacted to 95 percent.

2.03 Manholes

A. General

1. Manholes shall be placed at all changes in grade and/or horizontal alignment at all changes in pipe sizes and at all changes in pipe materials.
2. The maximum spacing of manholes shall be 400 feet.
3. Manholes for sewers 15 inches in diameter and less shall have an inside diameter of 4 feet. Manholes for sewers larger than 15 inches through 30 inches shall have an inside diameter of 5 feet.
4. Steps shall be installed at a maximum of 1' - 4" on centers.
5. Inverts channels through manholes shall be smooth, accurately shaped and carefully constructed with sufficient fall to prevent any ponding of water.
6. Outside drops in accordance with the standard details shall be installed for a sewer entering a manhole at an elevation greater than 2.5 feet above the manhole invert.

B. Precast Manholes

1. The design of all manholes shall conform to ASTM C-478.
2. Manhole walls shall be a minimum of 5 inches thick and the base slab shall have a minimum thickness of 6 inches.
3. Cones shall be the eccentric type. When top slabs are required they shall be satisfactory for H-20 highway loading.
4. Joint sealants shall be preformed butyl rubber based sealant material conforming to Federal Specifications SS-S-Z10A, Type B-Butyl Rubber or O-ring rubber gasket conforming to ASTM C-443.

5. The outside of all joints shall be wrapped with a butyl resin sealant conforming to Federal Specification SS-S-00210. The minimum width shall be 4 inches and the minimum thickness shall be 0.05 inches. The barrier shall be ConWrap CS-212 manufactured by Concrete Sealants or approved equal.
6. Steps shall be cast iron conforming to Class 25, ASTM A-48-56 and have one coat of asphalt base paint or shall be PVC molded over a #3 deformed steel bar.
7. Pipe connections to manholes shall be by a resilient connector cast into the wall of the base. Connector shall conform to ASTM C-923.
8. Manholes shall be as manufactured by D&M Concrete Specialties, Inc., N.C. Products, Adams Concrete Company or equal.

C. Manhole Ring and Cover

1. Ring and covers shall be made of gray iron, ASTM A-48-Class 30, or ductile iron, ASTM A-536, grade 65-45-12.
2. Ring and cover shall have a minimum clear opening of 24 inches.
3. Ring and cover shall weigh a minimum of 300 pounds and be suitable for H-20 Highway Traffic Loads.
4. The cover shall have (2) 1-inch perforated holes unless the manholes are to be watertight.
5. The words "Sanitary Sewer" shall be cast on the covers.
6. Ring and covers shall be constructed so that the cover will fit snugly without rattling and rocking under traffic.
7. Castings shall be as manufactured by Neenah Foundry Co., U.S. Foundry and Manufacturing Corp., or Vulcan Foundry.

D. Installation

1. Precast manholes shall be installed in accordance with the manufacturer's recommendations.
2. The bottom unit shall be placed on a leveling bed of No. 57 stone, a minimum of 12 inches in thickness.
3. All joints shall be water tight.

4. Manholes shall be built up so that the cover will be placed at the required grade.
5. The tops of all manholes shall be elevated above the 100 year flood elevation or shall be provided with water tight lids.

2.04 Sewer Services

A. General

1. Sewer services shall be provided to all lots along the proposed extensions.
2. Minimum sewer service shall be 4 inches in diameter.
3. Service stub-outs shall terminate at the right-of-way or easement line with a combination wye and 1/8 bend. A vertical riser shall extend slightly above grade. The riser shall have a watertight screw-in cap.
4. 4 inch services shall have a minimum slope of 1.0 ft./100 ft. And 6 inch services shall have a minimum slope of 0.6 ft./100 ft.
5. All service connections to the main shall be accomplished by the use of in-line wyes or by service saddles installed in strict compliance with the manufacturer's guidelines, unless in the opinion of the Town, a manhole connection is warranted. All service connections greater than 6" shall be made at a manhole.
6. Service lateral connections to re-enforced concrete pipe main shall be made only at manholes.

B. Materials

1. Cast iron soil pipe shall be service weight hub and spigot meeting Federal Specifications WW-401. The joints shall be rubber type elastomeric as per ASTM C-425.
2. PVC pipe and fittings for sewer laterals shall conform to ASTM D2665 and shall be SDR 35 conforming to sewer main requirements. Joints shall be solvent weld type.
3. Service saddles for connections of laterals to vitrified clay or ductile iron mains shall be cast iron, 45 degree deflection equipped with a 304 stainless steel clamp. Saddle shall be furnished with adapters as required to properly receive the service pipe to be used.
4. Service saddles for connection to PVC mains shall be of the same material as the main. The saddle shall include a gasket suitable for the type of pipe

being tapped and be fastened with two (2) 304 stainless steel bands.

5. Clean-outs connected to PVC pipe shall also be PVC sewer pipe schedule 40 conforming to ASTM D-3034. Ductile iron clean-out shall conform to the requirement for ductile iron pipe for sanitary sewer mains.

C. Installation

1. Service taps into mains shall be made on the top quarter of the main with the wye angled with the direction of flow.
2. Service lines between 14 feet and 20 feet in depth shall require Class I bedding from four (4) inches below the service line to four (4) inches above the service line.
3. Service lines greater than 20 feet or less than 3 feet in depth must be ductile iron.
4. All service lines which are connected into manholes shall be installed less than 2 ½ feet above the invert.
5. Service lines shall be tapped on to the main lines unless otherwise required by the Town.

2.05 Testing and Inspection

A. General

1. Prior to installation, all materials used must have a preliminary inspection by the Town.
2. The Contractor shall furnish all materials, labor and equipment needed to perform all testing and inspections to the satisfaction of the Town.
3. Notify the Town 24 hours prior to conducting any tests.
4. Test gravity lines between manholes.

B. Light Testing

1. Mains shall be checked for displacement after trench has been filled to two (2) feet above the pipe and tamped as specified, and upon completion of the project.
2. A light will be flashed between the end of the pipe section being tested. If the illuminated interior shows any misalignment or other defects, the

necessary repairs shall be made.

C. Leakage Testing

1. Infiltration shall not exceed 50 gallon per inch of diameter, per mile of pipe per 24 hours.
2. Verification that maximum infiltration rate shall not be surpassed shall be accomplished by air testing.

D. Low Pressure Air Test

1. Air testing of sewer mains shall conform to UNI-B-6.
2. Perform initial air test when each section of main is complete.
3. Wet interior surfaces of porous pipe material prior to testing.
4. Safety
 - a. Provide a Superintendent who has experience in low pressure air testing of gravity sewer mains.
 - b. Follow safety recommendations of air testing equipment manufacturer.
 - c. Properly brace sewer plugs during testing. Test plugs prior to use in air testing.
 - d. No one shall be allowed in manhole or trench when pipe is under pressure.
 - e. Pressurizing equipment shall include a regulator and a pressure relief valve, which are set no higher than 9 psig. Monitor gauges continuously to assure that the pressure does not exceed 9 psig.
5. Equipment
 - a. Sewer plugs shall be specifically designed for low pressure air testing.
 - b. Use two (2) separate air hoses.
 - i) One to connect the control panel to the sealed line for introducing the air.

- ii) One from the sealed line to the control panel to provide constant monitoring of the air pressure in the line.
- iii) If Pneumatic plugs are used, a separate line shall be used to inflate the plugs.
- c. As a minimum the above ground air testing equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psig.
- d. Continuous monitoring pressure gauge shall be at least 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of +/- 0.04 psi.
- e. Monitoring gauges shall be subject to calibration as deemed necessary.
- f. Air used for testing shall pass through a single above ground control panel.

6. Testing

- a. Immediately prior to each air test, determine groundwater level by a method acceptable to the Engineer. Adjust pressure used in air test in accordance with groundwater level.
- b. Apply air slowly to the test section until the pressure reached is 4.0 psi plus an adjustment of 0.433 psi for each foot of ground water above the crown of the pipe. Internal air pressure, including adjustment for ground water, should never exceed 9.0 psi.
- c. When the above required pressure is reached, throttle air supply to maintain internal pressure for at least two (2) minutes to permit stabilization.
- d. When pressure has stabilized at required pressure, shut off air supply.
- e. While observing the continuous monitoring pressure gauge, decrease pressure approximately 0.5 psi from required pressure.
- f. At this reading timing shall commence with a stop watch and allowed to run until pressure has dropped 1.0 psi or allowable time has lapsed. Line shall be "Acceptable" if pressure drop does not exceed 1 psig in the time prescribed for the test in Standard Detail No. 2.11, Low

Pressure Air Testing for Gravity Sewer Mains in the Standard Details.

E. Vacuum Test Each Manhole as Follows:

1. No personnel shall be allowed in manhole during testing.
2. Test manhole after assembly and prior to backfilling.
3. Plug pipes with suitably sized and rated pneumatic or mechanical pipeline plugs. Brace plugs to prevent displacement.
4. Position vacuum test head assembly to seal against interior surface of the top of cone section in accordance with manufacturer's recommendation.
5. Draw vacuum of 10 inches of mercury on manhole. Shut off the vacuum pump and close valve on vacuum line.
6. Measure time for vacuum to drop to 9 inches of mercury. Manhole shall pass if time meets or exceeds the following:

i)	Manhole I.D. (In.)	48	60	72	84	96	120
ii)	Seconds	60	75	90	105	120	150
7. If manhole fails test, remove head assembly, coat interior with a soap and water solution, and repeat vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. Make necessary repairs to the satisfaction of Town and repeat test until manhole passes.

F. Deflection Test

1. All PVC, PVC ribbed and PVC truss pipe shall be tested for deflection with an approved "GO-NO-GO GAUGE" or by an approved recording deflectometer.
2. Initial deflection shall not exceed three (3) percent of the pipe diameter.
3. Measurement for initial deflection shall occur between two (2) weeks and four (4) weeks after installation and backfill.
4. Maximum allowable long term deflection shall be five (5) percent of the pipe diameter.
5. Measurement for long term deflection shall be made three (3) months after installation and backfill.

2.06 Wastewater Pump Stations

A. General

1. In situations where gravity flow is not feasible, the Town will consider the installation of a wastewater pumping station and a force main to be owned and maintained by the Town. Certain factors must be addressed by the Developer for the project for consideration by the Town. The factors include:
 - a. Determine the wastewater flow that would be generated by the total natural drainage basin based upon the existing zoning.
 - b. Evaluate the capacity of the receiving sewer main at the point of discharge and downstream to determine that the line could handle the transferred sewer flow.
 - c. Perform a cost analysis of the pumping versus gravity alternative to demonstrate that gravity service is not feasible. The estimated installed cost of the gravity alternative must be not less than 3.5 times more costly than the pumping station alternative in order for the Town to allow a pumping station.
2. This information shall be furnished to the Town for consideration.

B. Design

1. General

- a. Notwithstanding the information contained herein, all pump stations and force mains shall meet the Minimum Design Criteria for Pump Stations and Force Mains as adopted by the N.C. Division of Water Quality.
- b. Submittals to the Town for the approval of a pump station shall show:
 - i) Number of lots or units to be served
 - ii) Off-site drainage area and zoning
 - iii) The average daily flow and peak daily flow
 - iv) The rated capacity of the pumps at a specific total dynamic head
 - v) Minimum 30'x30' lot size
- c. Pump stations shall be the submersible non-clog centrifugal type.
- d. All stations shall consist of two (2) pumps each capable of handling the design peak flow. Peak flow shall be equal to 2.5 times the average daily flow.
- e. Pumps and the force main shall be sized to provide a minimum velocity in the force main of 2.0 fps and a maximum velocity of 10 fps.
- f. Pumping stations, structures, controls, etc., shall be protected from physical damage by the 100 year flood. The station shall remain fully operational and accessible during the 25 year flood.

2. Site Work

- a. The site shall be graded level or with gentle slopes to remove stormwater run-off. Drainage swales shall be provided to direct drainage away from the site to the receiving water course.
- b. The entire site will be paved using 6 inches of concrete (3,000 psi).

- c. An all-weather access road shall be provided to the pumping station site. The road shall be constructed of Aggregate Base Course, compacted to 6" minimum thickness and 1 ½" of I-2 asphalt and shall be a minimum of 10 feet in width, with shoulders and side ditches, as applicable. The maximum roadway grade shall be 10 percent.
- d. The site shall be secured by a six (6) foot high chain link fence meeting the following requirements.
 - i) Chain link fabric shall be galvanized conforming to the requirements of ASTM A392-74, Class 2 coating. Fabric shall be woven from 9 gauge (coated size) wire in a 2 inch mesh. Fabric shall be knuckled at one selvage and twisted and barbed at the other selvage. Bottom tension wire shall be 7 gauge and shall terminate at posts.
 - ii) Posts and rails shall be roll formed, galvanized standard weight pipe conforming to the requirements of ASTM A120-73. Weight of zinc coating shall be 1.6 ounces per square foot of base material surface, provide post caps to accommodate top rail.
 - iii) Line posts shall be C-section roll formed from steel, or 2-3/8 inch O.D. standard weight galvanized pipe with bending strength of 201 pounds under a 6-foot cantilever load.
 - iv) Top and brace rails shall be 1.66 inch O.D. standard weight galvanized pipe with a minimum vertical bending strength of 202 pounds on 10 foot span. Top rail couplings 6 inches minimum in length shall be spaced at maximum 21 foot centers and 9 gauge minimum fabric tie wires shall be spaced at 24 inch maximum centers.
 - v) End, corner, and pull posts and gate posts for gate leaves 6 feet wide and less shall be 2-7/8 inch O.D. galvanized standard weight pipe with minimum bending strength of 381 pounds on 6 foot cantilever load. Gate posts for gate leaves over 6 feet wide shall be standard weight pipe complying with ASTM A120 of diameters as recommended by the gate manufacturer. Attachment of chain link fabric to tubular terminal posts shall be made with a minimum 1/4 inch x 3/4 inch tension bar and 12 ga. x 1 inch wide clamps using minimum 3/8 inch diameter carriage bolts. Provide post caps to accommodate top rail.
 - vi) Provide three (3) lines of 4 point pattern barbed wire. Barb

wire shall be double strand 12-1/2 gauge twisted wire with 14 gauge, 4 point round aluminum barbs spaced on approximately 5 inch centers conforming to the requirements of ASTM A585. Extension arms to accommodate barb wire shall withstand a 250 pound pull-down load from end of arm and have a 3 inch apron around post. The top most barbed wire shall be approximately 18 inches above the fabric and approximately 18 inches out from fence line. Barbed wire shall be securely fastened in slots by heavy wire pins. Arms having projections to bend down over barbed wire will not be acceptable.

vii) Gates shall be a minimum of 12' wide. The frames shall be tubular shaped, 1.90 inch outside diameter with welded steel corners. Braces and trusses shall be furnished when necessary. Hardware shall be of adequate design and strength to provide satisfactory operation of gate. Gate components shall be galvanized as specified herein for fencing components. Hinges shall permit gates to swing back against fence 90 degrees. Provide a padlock for each gate keyed alike with other locks. Locks to meet Federal Spec. FF-P-101, Type EPB, 1-3/4 inch size, with chain. Provide two (2) keys per padlock. Coordinate keying with Town. Provide hold open device and sleeve for center drop rod.

e. The Town may require a vegetative screen around the perimeter of the pump station site if it considers such screening to be necessary.

f. A 150 watt high pressure sodium light fixture shall be strategically located upon a lighting standard or timber utility pole. The light fixture shall be operated by a circuit breaker in the main control panel. Mounting height shall be 20 feet (minimum) above finished grade.

g. Each pumping station shall have a potable water supply service line consisting of a 3/4" service line with approved backflow preventer and terminating at the pump station site with a freeze proof yard hydrant.

3. Pumps

a. Pumps shall be submersible non-clog centrifugal sewage pumps capable of passing a three (3) inch sphere.

b. Pump casing shall be constructed of cast iron of uniform quality and free from blow holes, porosity, hard spots, shrinkage cracks and other

defects.

- c. Casing shall be capable of withstanding pressures 50 percent greater than the maximum operating pressures.
- d. The mating surface, where watertight seal is required, shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between mating surfaces, resulting in proper compression of the O-rings without the requirement of specific torque limits.
- e. The exterior surfaces of the casing in contact with sewage shall be protected by a sewage resistant coating. All nuts and bolts shall be stainless steel.
- f. The impeller shall be of cast iron and shall be of the single or double shrouded non-clogging design to pass the solid size specified, fibrous materials, heavy sludge, or other materials found in sewage. The impeller shall be statically, dynamically, and hydraulically balanced. The impeller shall be securely keyed to the shaft with a locking arrangement whereby the impeller cannot be loosened by torque from either forward or reverse direction.
- g. Renewable wearing rings shall be provided on the impeller and casing and shall have wearing surfaces normal to the axis of rotation. Wear rings shall be constructed of bronze. Wearing rings shall be designed for ease of maintenance and shall be adequately secured to prevent rotation.
- h. The shaft shall be one piece stainless steel of adequate strength to transmit full motor horsepower to the impeller.
- i. A tandem mechanical shaft seal system running in an oil bath shall be provided. Seals shall be of tungsten carbide alloy with each interface held in contact by its own spring washer.
- j. Bearings: Pump shall rotate on a minimum of two (2) permanently lubricated bearings with a L-10 bearing life of 40,000 hours.
- k. Pumps shall be manufactured by Fairbanks Morse, Myers, Flygt or others approved by the Town.

4. Motors

- a. Pump motors shall be sealed squirrel cage induction motors for

submersible operation and shall be three phase, 60 Hertz, 240v/480v motors with a maximum speed of 1750 RPM.

- b. Motors shall be UL listed for Class I, Division I, Group C and D explosive proof for hazardous locations.
- c. Motors shall have Class F insulation.
- d. Two (2) moisture detector probes to detect seal failure shall be wired internally to the control cable.
- e. Two (2) normally closed automotive reset thermostats shall be imbedded in the motor windings to open on excessive heat stopping the motor.
- f. The motor shall be provided with waterproof power and control cable sized to conform to NEC specifications and adequate length to connect to the control panel. The cables shall be sealed at motor entry point to prevent moisture from entering motor housing and cable wicking.
- g. Lifting lugs of adequate strength to lift the pump and motor assembly shall be cast into the motor housing.

5. Installation System

- a. Provide a rail mounted installation consisting of stainless steel guide rails, upper rail guide bracket, sliding bracket, intermediate rail guide bracket (for rails over 20 ft), and a discharge connection elbow.
- b. System shall be of the size and type standard with the pump manufacturer and shall not support the pump weight.
- c. Stainless steel sliding guide bracket shall be an integral part of the pump unit.
- d. Discharge connection elbow and piping shall be permanently installed in the wet well. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection and service without entering the wet well.
- e. A stainless steel lifting chain capable of supporting the pump and to raise and lower the pump through the limits indicated shall be provided.

f. All miscellaneous hardware shall be 304/316 stainless steel.

6. Control System

a. Provide a duplex pump control panel for the following pump operation and controls:

- i) “Lead” pump shall start when liquid level rises to “lead pump” elevation
- ii) If during “lead” pump operation liquid level continues to rise, “lag” pump shall start at “lag pump” elevation and operate with “lead” pump until liquid level drops to “pump off” elevation
- iii) If liquid level continues to rise to “high water” elevation, the high water alarm shall be activated
- iv) Pumps shall alternate between starting cycles. In the event either pump fails to function, the other shall automatically start.
- v) Liquid level elevations shall be controlled by adjustable float switches.
- vi) Provide controls for moisture detection and thermal overload for each pump.

b. Control panel and all disconnect enclosures shall be a NEMA 4X stainless steel enclosure with a dead front with separate removable inside panel. Enclosure shall be supplied with a key-locked, flush mounted handle. Panel shall be UL labeled, as a complete unit, following assembly. Panel shall include, but not limited to, the following items:

- i) A thermal/magnetic circuit breaker and magnetic starter with 3-leg overload protection for each pump.
- ii) Alternating relay to alternate pumps between successive starts.
- iii) Hand-Off-Automatic (H-O-A) control switch for each pump.
- iv) Non resettable elapsed time meter for each pump. Each meter shall read in tenth of hours through 99,999 hours total time.
- v) Alarm horn and light (red) mounted on panel exterior.

Provide horn silence switch on inside panel. Alarm horn and light shall be activated by the following alarms: wet well high water, pump seal failure, and pump thermal overload.

- vi) Operating and warning lights mounted on inside panel for the following. Color indicates required lense color.
 - 1. Power on (green)
 - 2. High water level (red)
 - 3. For each pump
 - a. Running (green)
 - b. Seal failure (red)
 - c. Thermal overload (red)
- vii) Cabinet heater with thermostat
- viii) Control transformer
- ix) Circuit breaker for control circuit
- x) Grounded GFCI duplex receptacle shall be provided on the side of the cabinet for operation of 115 volt A.C. devices.
- xi) Provide on/off switches for the following accessories.
 - 1. Area light
- xii) Surge arrester.
- xiii) True power overload protection device.
- xiv) Provide contacts for the following functions for reporting to WWTP SCADA system.
 - 1. On/off status for each pump.
 - 2. Alarm signal. Alarm contact shall be activated by the following alarms: wet well high water, pump seal failure, and pump thermal overload.
 - 3. Three (3) spare sets of contacts.

- xv) Laminated plastic name tags shall be provided for the name of the control panel and all disconnects, switches, lights, and meters.
- xvi) Provide a plastic laminated electric diagram wire/terminal numbers and color codes permanently fastened to inside enclosure.
- c. Switches, push buttons, and indicator lights shall be oil tight/watertight units.
- d. Provide UL listed mercury float switches encapsulated in buoyant waterproof housing with sufficient cable to extend to control panel. Float and cable shall be designed and manufactured for use in a sewage wet well environment. Sensor levels shall be field adjustable.
- e. An 1/8" thick aluminum weather head with a clear height of 7'-0" and an overhang of at least 4'-0" shall be provided for control equipment exposed to the weather. The back and side panels shall also be 1/8" thick aluminum. The support structures for the weather shield shall be 3" diameter galvanized pipes embedded in concrete.
- f. All miscellaneous hardware shall be 304/316 stainless steel.

7. Structural

- a. The wet well shall be precast concrete manhole sections conforming to ASTM C478. All concrete shall have a minimum 28 day compressive strength of 3,000 psi.
- b. The wet well shall have a minimum diameter of six (6) feet and shall be large enough to easily accommodate the pump and screening basket, if required.
- c. Wet well will be designed to have a diameter sufficient to provide storage for a operating cycle of at least three (3) minutes without being excessively deep.
- d. At the Town's discretion, the wet well shall include a 316 stainless steel screening basket in front of the influent pipe. The basket shall be raised and lowered by means of stainless steel chain. If the Town determines that a basket is needed, the size of the wet-well and openings shall be adjusted accordingly.
- e. Cover slabs shall be re-enforced concrete with integral cast in place

access hatch covers.

- f. Access covers for removal of the pumps and the screening basket, shall be double or single leaf aluminum diamond pattern floor hatch of 1/4 inch (min.) thickness capable of withstanding 150 psf without permanent damage.
- g. The opening shall be sized to accommodate the pumps and screening basket (if applicable) but shall be a minimum of 2'x3'. The door shall have a lock in the open position and vinyl grip handle to release the lock for closing.
- h. Valve vaults shall consist of a precast manhole base section, or a cast in-place custom built section, or a precast rectangular structure all complete with drain, access ladder or steps (as needed) and access cover cast in the structure roof.
- i. All miscellaneous hardware shall be 304/316 stainless steel.

8. Discharge Piping and Valves

- a. Discharge piping shall be flanged ductile iron pipe sized to produce a minimum head loss while maintaining a minimum velocity of 2.0 feet per second.
- b. A check valve and a plug valve shall be provided for the discharge line of each pump. Valve shall be rated for 175 psi working pressure and shall have full port openings equal to 100% of the adjacent pipe area.
- c. Gate valves may be used in lieu of plug valves for discharge pipe sizes 6" and smaller.
- d. Check valves shall be manufactured by Mueller, RedValve, Clow or approved equal.
- e. Plug valves shall be manufactured by Zurick, Mueller, Clow or approved equal.
- f. Gate valves shall be manufactured by Mueller, Clow, Dresser or approved equal.

9. Portable Hoist

- a. Provide one 360-deg, stainless steel portable hoist with a minimum capacity for the pump specified and a lift as required to safely remove pump from the wet well and an overall weight of the hoist of no more

than 100 pounds.

- b. Provide floor mounted stainless steel socket.
- c. Portable hoist shall be as manufactured by Halliday Products, or approved substitute.
- d. All miscellaneous hardware shall be 304/316 stainless steel.

10. Pressure Gauges

- a. Provide 4-inch pressure gauge for each pump discharge pipe which shall read in pounds per square inch (psi).
- b. Pressure gauges shall meet the following requirements.
 - i) Liquid fill: Glycerin
 - ii) Dial: White aluminum with black markings
 - iii) Case & Ring: 300 series stainless steel
 - iv) Dial size: 4-inch minimum
 - v) Gauge reading: 0-60 pounds per square inch (psi)
 - vi) Equipped with a stop cock, pigtail and an isolator for use with sewage
 - vii) Mounted on volute boss provided by the manufacturer or on the discharge flange.

11. Stand-by Power

- a. All wastewater pumping stations shall be equipped with an automatic alternative power source capable of supporting all electrical needs of the pump station.
- b. Alternate power sources include on-site standby power generator or dual power feed from a separate electric substation.

12. Start-up, Test, Warranty

- a. A manufacturer's representative shall check the equipment installation, supervise initial start up and instruct the Town's personnel in the proper operation and maintenance of the equipment.

- b. Pumps shall be run under actual field service and demonstration be made that the pump installed performs to the criteria set forth in the design requirements.
- c. A copy of all tests and checks performed in the field shall be submitted to the Town.
- d. All equipment, materials and workmanship shall be warranted to the Town to be free of defects for a period of 24 months following acceptance of the facility for maintenance by the Town.
- e. After start-up, the Contractor shall provide to the Town two (2) complete copies of the operation and maintenance manual.

2.07 Force Sewer Mains

A. Materials

1. Ductile Iron Pipe

- a. Ductile iron pipe for sewer force mains shall be designed as per AWWA C150 for a working pressure of 150 psi, laying condition 1.
- b. Pipe shall be manufactured in accordance with all applicable requirements of AWWA C151.
- c. Joints shall be of the push-on type as per AWWA C111.
- d. Lining shall be cement mortar with a seal coat of bituminous material all in accordance with AWWA C104.

2. Polyvinyl Chloride (PVC)

- a. PVC pipe may be used for sewer force mains except where conditions warrant the use of ductile iron pipe.
- b. PVC pipe shall meet the requirements of AWWA C900, pressure class 150.
- c. Joints shall be of the bell and spigot type utilizing a rubber ring elastomeric bell joint which shall be an integral and homogeneous part of the pipe barrel.

3. Fittings

- a. Fittings for ductile iron or PVC pipe force mains shall be ductile iron

with mechanical joints and conform to AWWA C110 for standard fittings and AWWA C153 for compact fittings.

- b. Fittings shall be cement mortar lined with a bituminous seal coat in accordance with AWWA C104.

B. Installation

1. General

- a. All force main construction methods, including trench excavation, bedding, backfill, etc. shall conform to the Town's requirements for water main installation.
- b. A three (3) inch wide polyethylene plastic tape manufactured for utilities shall be installed 18 inches above the top of all force mains. The tape shall be green in color with the wording "Caution - Buried Force Main Below" in bold black letters.
- c. PVC force mains shall also have a 12-gauge insulated stranded wire taped to the top of the pipe. The tracer wire shall be green. The Town will test the tracer wire prior to acceptance of the line. Should any section of the line be undetectable, the contractor shall make the needed repairs.

2. Ductile Iron Pipe

- a. Ductile iron pipe shall be installed in accordance with AWWA C600.

3. PVC Pipe

- a. Install PVC C900 pipe in accordance with AWWA C605.

4. Sewer Air Valves

- a. Combination sewer air and vacuum valves shall be installed at all high points on the force main.
- b. The sewer air valve shall be installed in a precast concrete manhole. All interior surfaces shall receive a coal tar epoxy coating.

C. Testing

1. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe.
2. The piping system shall be subjected for two (2) hours to a hydrostatic pressure test equal to 200 psi.
3. Before applying the specified test pressure, air shall be expelled completely from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged, or left in place at the discretion of the Town.
4. Where any section of main is provided with concrete reaction blocking for fittings or hydrants, the hydrostatic pressure test shall not be made until at least five (5) days after installation of the concrete reaction blocking, unless otherwise approved.
5. Test pressure shall:
 - a. Equal test pressure specified at the highest points in the section tested.
 - b. Not exceed pipe or thrust restraint design pressures.
 - c. Not vary by more than +/-5.0 psi.
6. Repair defective joints, pieces of pipe, jointing material, valves or other defective areas, and repeat pressure testing until pipe system meets test criteria.

7. A leakage test shall be conducted concurrently with the pressure test.
 - a. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
 - b. No pipe installation will be acceptable if the leakage exceeds ten (10) gallons per inch of pipe diameter per mile of pipe per 24 hours.
 - c. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified, the Contractor shall locate and repair the defective material until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

END OF SECTION