

CITY OF REIDSVILLE



MANUAL OF CITY SPECIFICATIONS

WATER AND SEWER

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WATER AND SEWER

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I. GENERAL INFORMATION

A. PURPOSE

The purpose of this Manual of City Specifications for Water and Sewer is to insure that the people in and adjacent to the City of Reidsville will be provided with suitable water and sewer services. To insure that potential developers have easy access to the requirements for water and sewer installations this manual and the "Manual of City Specifications for Land Development" have been compiled to collect, unify and set specific criteria and design and installation of services. It is intended to set sound and uniform standards to allow further orderly expansion of services and to minimize maintenance and operational costs for the future benefit of the City.

B. ENFORCEMENT

The specific requirements of this manual will be enforced by the Department of Engineering of the City of Reidsville with the support of the Department of Planning and Code Enforcement and the Department of Public Works.

C. PERMITS AND APPROVALS

1. The City shall review and approve all plans prior to submittal to any other reviewing agency (State, Federal or Utility).
2. All approvals by all regulating authorities shall be obtained before any construction is started. Copies of these approvals, including all permits, maps, and plans, shall be received by the City before construction begins.
3. Approvals must be obtained from (but not limited to):

Public Water Supply Section
North Carolina Department of
Environment, Health and Natural
Resources, Division of Environ-
mental Health

Water Main Construc-
tion

Public Water Supply Section
North Carolina Department of
Environment, Health and Natural
Resources, Division of Environmental
Management

Sewer Construction

North Carolina Department of Environ-
ment, Health and Natural Resources
Land Quality Section

Sediment and Erosion
Control

North Carolina Department of
Transportation

Driveway and Street
access & encroachments

Railroads and Utilities

Encroachments and
crossings

Private property owners

Easements, rights of
way and access

City of Reidsville

Driveway permits,
building permits,
plumbing, electrical
and mechanical
permits, easements
and encroachments

4. Special emphasis shall be placed on water and sewer line designs, particularly as it relates to provisions for extension of mains to service. The city shall review the measures that the developer has proposed to comply with the "Water and Sewer Extension Policy".

D. APPROVAL BY THE CITY

Approval by the City shall be obtained by the following procedures:

1. Drawings shall be made on 24"x36" sheets. If available digital data shall be furnished.
2. Submit three (3) sets of plans and one (1) reproducible set of plans with a letter requesting approval of the plans.
3. The City will review the plans for conformance with the City's ordinances and standards. The City will make appropriate comments and return the plans. The City will return an approved set of plans with a letter of review when no comments are warranted.
4. Obtain all other approvals, easement and rights-of-way, and submit copies to the City.
5. The City will allow construction to begin when all fees have been paid and all permits have been obtained and approved copies have been accepted by the City.

E. QUALITY ASSURANCE

1. Construction

- a. Construction shall be observed by a Engineer registered in

North Carolina, or his authorized representative. Testing and inspection shall be made by a testing agency selected by the Engineer. Testing may include but not be limited to compaction, asphalt pavement and installation, concrete strength, air entrainment, and affidavits for strengths and specifications requirements of manufactured products. Inspections shall be provided for all installations.

- b. The right is reserved for the City to enter upon any portion of the contract or works at anytime, or to grant permits to other parties so to do, for the purpose of carrying out any work which in the opinion of the City is necessary or advisable. The owner/developer shall not obstruct nor place any obstacles or impediments in the way of any person who maybe duly authorized by the said City to perform any such work. The rights is also reserve by the City at any time to enter upon said work or any part thereof by any officer, employee or contractor for the purpose of doing any other work that may be necessary or desirable to be done by the City in connection with the work.
- c. The City will provide inspection at a rate of two (2) times salary costs provided the owner/developer pays all other expenses. Such inspection does not relieve the owner/developer of the guarantee.

2. Guarantee of Work

- a. The work shall be guaranteed and maintained by the owner-developer for a period of one year. The guarantee shall cover materials, maintenance, and workmanship. Any defective work or materials shall be repaired or replaced, at no expense to the City. Any other incidental maintenance shall be performed at no expense to the City.

F. CONSTRUCTION RECORDS

As-built drawings from field surveys shall be prepared by the owner/developer during construction. As-built drawings furnished to the City shall be referenced to fixed points so as to be easily located in the vent that the markers are destroyed. All easements shall be shown on the as-built drawings with deed book and page number.

G. ACCEPTANCE OF FACILITIES BY THE CITY

The City shall accept new facilities upon completion to the following:

1. Letter from Engineer stating that all construction is complete and all tests satisfactory.

2. Plans originals and digital data with all as-built revisions are received.
3. All permanent easements, rights-of-way and permits in the City's name and copies filed in the proper offices.
4. All sediment and erosion control structures are removed and site is clear of debris and equipment.
5. Any releases required by the City are reviewed.
6. Guarantee is provided.

H. WATER USE

All water used for flushing lines or other construction activities shall be purchased from the City at prevailing rates: Meters shall be purchased from the City water department. Upon return cost of the meter will be refunded. The use of water (time and quantity) shall be coordinated with the Director of Engineering. This coordination shall be accomplished by submittal of a proposed schedule of water use for approval by the Director of Engineering. The proposed schedule should be submitted ten (10) working days prior to any water use.

II. WATER LINE SPECIFICATIONS

A. WATER LINE MATERIALS

1. Ductile Iron Pipe

- a. All ductile iron pipe shall be Class 50, 51, or 52 designed in accordance with AWWA Standard C-150. Design shall be done for external and internal pressures separately, using the larger of the two for the net design thickness. An additional allowance shall be made for corrosion and casting tolerances. The thickness design for external and internal pressures shall use the following conditions:
 1. 3' minimum cover and maximum cover as shown on the plans;
 2. Laying condition - Type 1;
 3. A minimum working pressure of 150 psi.
 4. A surge pressure of an additional 100 psi.
- b. The minimum class thickness shall be Class 50.
- c. The ductile iron pipe shall be manufactured in accordance with applicable requirements of AWWA Standard C-151. The ductile iron pipe shall be supplied in nominal lengths of 18 or 20 feet.
- d. The ductile iron pipe shall be cement-mortar lined with a seal-coat in accordance with AWWA Standard C-104, and bituminous coated in accordance with AWWA C-151.
- e. Pipe joints shall be mechanical or "push-on" manufactured in accordance with AWWA Standard C-111.
- f. Each joint of ductile iron pipe shall be hydrostatically tested to 500 psi at the point of manufacture before the outside coating and inside lining are applied. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.
- g. All materials used in the production of the pipe are to be tested in accordance with AWWA Standard C-151 for their adequacy within the design of the pipe, and certified test results are to be provided to the City upon request. All certified tests, hydrostatic, and material, are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.
- h. Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, Griffin Pipe Products Company, McWane Cast Iron Pipe Company.

- i. Restrained joints shall be TR Flex or Lok Tyte as manufactured by U. S. Pipe, Lok-Fast or Lok-Ring as manufactured by American Pipe or Super-Lock as manufactured by Clow. Restrained joints shall be used when the pipe locations excludes the use of thrust blocks for proper support.

2. Ductile Iron or Cast Iron Fittings

- a. All fittings shall be manufactured in accordance with AWWA C-110 or C-153 for standard fittings and ductile iron compact fittings, respectively. The fittings shall be tested, and the manufacturer shall provide certified test results when requested by the City. This testing shall include hydrostatic proof testing of the fittings.
- b. All fittings shall be all-bell and of the mechanical joint type. Mechanical joints shall be manufactured in accordance with AWWA Standard C-111.
- c. All fittings shall be cast iron or ductile iron and shall have a minimum working pressure rating of 250 psi and a minimum iron strength of 25,000 psi.
- d. All fitting interiors shall be cement-mortar lined in accordance with AWWA Standard C-104, and the outside shall be bituminous coated.

3. Polyvinyl Chloride Pipe (PVC) and Fittings

- a. All PVC pipe is to be in accordance with ASTM D2241. PVC material shall conform to ASTM D1784. Pipe shall have push-on joints with integral bell and locked in gasket and shall conform to ASTM D3139. The bell shall consist of an integral wall section with a locked-in, solid cross section elastomeric ring which meets the requirements of ASTM F-477. Pipe will also be the type ring which meets the requirements of ASTM F-477. Pipe will also be the type approved by the National Sanitation Foundation, and shall bear the NSF logo for potable water application.
- b. All pipe for 6-in and larger mains shall conform to AWWA-Standard C900, or 14, Class 200, rated with a working pressure 200 psi. All fittings shall be mechanical joint cast iron as specified above.
- c. PVC pipe may be used only in 2 inch size and in areas where the highest working pressure is 125 psi or less. Ductile iron pipe will be required in all locations where the working pressure exceeds 125 psi as measured or calculated.

- d. All pipes and materials are to be tested according to the requirements of AWWA Standard C-900. Certified test results are to be provided to the City when requested. These tests shall be performed by an independent testing laboratory at the expense of the pipe manufacturer.

4. Gate Valves

- a. All gate valves, including tapping valves, shall be Mueller, American (Darling), Kennedy, or approved equal, in accordance with AWWA C-500 specifications.
- b. Gate valves twelve (12) inches in diameter and smaller, shall be mechanical joint or hub-end all-bell. They shall be "O" ring, open-left valves of the nonrising stem type. These valves shall be designed for a minimum of 175 psi working pressure and 300 psi hydrostatic test pressure with a two (2) inch operating nut. Valves shall be cast iron or ductile iron.
- c. Tapping valves shall be manufactured in accordance with AWWA specifications. They shall be of the Mueller or American "O" ring, open-left type.

5. Air Release Valves

- a. Air release valves shall be two (2) inch Crispin Pressure Air Valves, Model P 20, with a vacuum check unit, two (2) inch Val-Matic, Model VM-45, with a vacuum check unit or equal as approved by the Public Utilities Director. These valves shall be suitable for 150 psi working pressure and designed to allow air to escape automatically while the main is in service and under pressure. The valve shall be housed in an approved essentric manhole and shall be installed in accordance with the Standard Detail of these specifications. Air release valve locations shall be approved by the Public Utilities Director, and shown on the plans.

6. Tapping Sleeves and Tapping Saddles

- a. Tapping sleeves shall be Mueller mechanical joint Mueller Outlet Seal, or Kennedy Square Seal. All sleeves shall have a minimum of 150 psi working pressure. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled, no burned taps will be allowed.
- b. Tapping saddles may be used on mains sixteen (16) inches and larger. Tapping saddles shall be manufactured of ductile iron providing a factor of safety of 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110

flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molder rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddle. Straps shall be of alloy steel. The American tapping saddle, U. S. pipe ductile non-tapping saddle, or an approved equal shall be used. All taps shall be machine cut, no burned taps will be allowed. Saddles may be used for taps one-half the size of the main or less (i.e. 8-inch tapping saddle for use on a 16-inch main). Sleeves shall be used on taps over one-half the size of the main.

7. Valve Boxes

- a. Adjustable valve boxes shall be gray cast iron of the dimensions specified in the Standard Details of these specifications. The word "Water" shall be cast into the lid. The valve box shall be Dewey Brothers or approved equal.

8. Fire Hydrants

- a. Hydrants will be three way compression type with two 2-1/2" hose nozzles and a 4-1/2" pumper nozzle, all with National Standard hose threads and operating nut, and will have 5-1/4" valve opening and a 6" mechanical joint base connection and will be as manufactured by Mueller Company Centurion with bronze bushed shoe, or approved equal. Hydrant shall be of sufficient length to provide a minimum of three feet bury and be of the break-away impact type.
- b. Hydrants shall be open-left type and shall have a six inch hub-end or mechanical joint elbow. Hydrant barrels shall measure 3-1/2 feet minimum from the ground line to the bottom of the connection pipe and will be equipped with safety flanges and "O" ring seals. Hydrant barrell shall be longer where necessary to obtain proper pumper nozzle height. All cast iron parts below ground line will be hot-dipped in black asphaltum varnish and all parts above ground will be painted and color normally used by the City of Reidsville. Hydrants will further be in accordance with AWWA Specifications C502-73.
- c. Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seat attaching assembly. All hydrants must include cast or ductile epoxy lined shoe, rubber drain seals and positive, protective valve stop device.

WATER SERVICES

1. Taps

- a. Taps 1" and smaller may be made directly into ductile iron pipe with a corporation cock. For taps 2" diameter or less into PVC and taps greater than 1" but less than 2" in ductile iron, saddles and corporation cocks shall be used.
- b. Corporation cocks shall be as manufactured by Ford or approved equal, having AWWA standard tapered threads. Unions shall be three piece, copper to copper.
- c. Service saddles shall be all bronze with double straps and neoprene "O" ring gaskets attached to the body. The clamp shall have corporation cock threads and be Mueller Series H16100 or approved equal.
- d. Taps larger than 2" or greater than 1/2" the diameter of the main line shall be made using the appropriate size tapping sleeve and valve. On a "dry line", the connection shall be made with a tee and valve.
- e. The City shall make all taps to existing lines unless otherwise specifically authorize by the Director of Engineering. Such taps shall be made at developer's expense. In the event the City does not make the tap, the Director of Engineering shall be notified 48 hours before any "wet line" is tapped.

2. Service Lines

- a. Service lines shall be a minimum of 3/4". Lines 3/4"-1" shall be type "K" soft copper. Fittings shall be flared copper type brass fittings. Lines greater than 1" up to 2" in diameter shall be type "K" soft copper. Service lines greater than 2" shall be ductile iron pipe with cast or ductile iron fittings.

3. Metersetters and Boxes

- a. Residential meter boxes and metersetters shall be subject to approval the City. Metersetters shall be Ford-502 or equal. Metersetters shall be installed with locking wings on the City side of the meter. Meter boxes shall be Dewey Brothers, Brooks concrete, or approved equal with traffic lid.
- b. Commercial and industrial meters shall be of a size and configuration approved by the City. All meters over 1" shall have a bypass with a lockable valve. If meter by-pass is to be used for purposes other than emergency fire protection, a meter shall be installed.

- c. Meters shall be purchased from the City and set by the City at the Owner's expense.

4. Multiple Meter Assemblies

- a. The use of multiple meter assemblies must be approved by the Director of Engineering. When allowed, meter assemblies shall be as shown in the standard details. All piping shall be provided with unions for easy disassembly. All pipe shall be of the same quality as used for individual meters. Boxes and setters shall be subject to approval by the City. Meters shall be purchased from the City and set by the City at the Owner's expense.

5. Backflow Preventers

- a. Meters 3/4" and smaller shall be supplied with integral backflow preventers, supplied by the City.
- b. For meter services larger than 3/4" and up through 2", reduced pressure type backflow preventer, Model FRP as manufactured by Beeco, or approved equal, installed in a separate meter box on the customer's side of the meter shall be furnished and installed by the customer.
- c. For meter services larger than 2" inches, reduced pressure type backflow preventers, Model 6CM as manufactured by Beeco or approved equal, shall be installed by the customer in a separate vault on the customer's side of the meter.
- d. All backflow preventers shall meet approval of the U.S.C. Cross Connection Control Lab.

WATER SYSTEM DESIGN CRITERIA

1. Minimum main line pipe size shall be 6 inches.
2. Minimum pressure in system shall be 20 psi at peak demand (fire flow).
3. Minimize dead ends, and where they must occur provide a fire hydrant per standard detail. The fitting required at a dead end line shall be determined by the Director of Engineering.
4. Minimum cover shall be 3 feet.
5. Install valves as follows: three at a cross; two at a tee; one on a single hydrant branch.
6. Install valves on loops so a maximum of 600 feet can be taken from service without effecting other areas.
7. Water mains shall be installed with a minimum of 10' horizontal separation from sewer lines. Where this is not possible, as determined by the Director of Public Works, both the water line and sewer line shall be ductile iron pipe.
8. Maximum spacing between fire hydrants shall be 800 feet, (400) foot radius).
9. Backflow preventers shall be supplied for every service connection. For services up to 3/4 inch it shall be integral with the meter, for services larger than 3/4 inch up to 2 inch it shall be in a separate meter box and for backflow preventers larger than 2 inches, a vault shall be provided.
10. Vaults shall have aluminum hatch doors with lift assist and shall be capable of withstanding expected traffic loads.
11. All bypasses, other than those with locking valves shall have detector check valves installed.
12. Reduced pressure principle backflow preventers are to be installed on all lines to installations involving wet manufacturing processes, chemical or boosted sprinkler systems, irrigation systems, or any other hazardous locations as determined by the Director of Engineering.

13. Water line drawings and specifications shall bear the seal of a Registered Professional Engineer licensed to practice in North Carolina and the installation of the system shall be inspected and certified by the Engineer in accordance with N.C.A.C.IOD.0903.

14. Water lines shall have a 25' permanent easement (12.5' each side of center line) in the City's name. A 50' temporary construction (25' each side of center line, unless directed otherwise) easement shall be provided.

WATER PLANS CHECKLIST

Water line plans should, at the minimum, show the following information:

1. Locations and dimension of all existing and proposed street and sanitary sewer rights of way.
2. Sanitary sewer and storm drain systems dotted in.
3. Invert of storm drains at crossings, storm drains closely paralleled by water lines.
4. Invert of sanitary sewers at crossings and at upstream and downstream manholes.
5. Size, lengths (or stationing), and type of lines (water, storm, sanitary).
6. All tees, gate valves, fire hydrants and blow offs properly labeled.
7. Legend of symbols.
8. North arrow.
9. Street names.
10. Location(s) of nearest existing valves.
11. Existing pavement, and if applicable, width and length of cut.
12. Include "General Notes on all plans.
13. Registered Engineer's seal and signature.
14. Vicinity map, showing location of lines and a visual plan page index.
15. Location of existing utilities.

E. WATER LINES - GENERAL NOTES

1. Concrete blocking (3000 psi) shall be placed at all bends & tees or as required.
2. Standard depth of cover shall be 3 feet except at valve or hydrant locations or other special situations. Cover is based on ground elevation or as indicated on the plans.
3. Provide concrete pad (30" x 30" X 6") at all valve boxes.
4. Extensions for valve boxes, when required, shall be 5" soil pipe.
5. All pavement cuts, concrete or asphalt, shall be replaced according to the standard details of the NC Department of Transportation.
6. Pavement cuts shall be replaced immediately after backfilling initial cut either with permanent replacement or a temporary replacement of 1-1/2" of I-2 or 4" of H-Binder.
7. Repairs to main breaks:
 - (a) Bell clamps will not be allowed, except in special situations and as directed by the Director of Public Works.
 - (b) Solid sleeves shall be used for connecting spigot ends and be of the long pattern type.
8. In any instance where it will be necessary to have the water shut off on existing mains in order to make a tie-in, the work shall be done under the direct supervision of the Director of Public Works and at the time least inconvenient to the water customers involved.
9. When a water main crosses an existing sewer main, the contractor shall replace the sewer pipe spanning the ditch with ductile pipe when the following conditions occur:
 - (a) Anytime a water main is installed under a sewer main.
 - (b) When a water main is over a sewer main and the vertical distance between the two mains is 18" or less.
10. Water mains shall be installed with a minimum of 10' horizontal separation from sewer lines. Where this is not possible, as determined by the Director of Public Works, both the water line and sewer line shall be ductile iron pipe.
11. Water lines shall be disinfected and hydrostatically tested in accordance with all State and City of Reidsville requirements.

**SEWER SYSTEM
SPECIFICATIONS**

SEWER LINE MATERIALS

1. Ductile Iron Pipe
 - a. All ductile iron pipe shall be in accordance with AWWA C151-latest revision (ANSI A21.51) and shall be in 18 to 20 foot lengths with single rubber gasket (push-on) joints in accordance with AWWA C111-latest revision (ANSI A21.11). All 8-inch pipe will be minimum Class 50 in accordance with AWWA C150-latest revision (ANSI A21.50).
2. Extra Strength Vitrified Clay Pipe (VCP)
 - a. Vitrified clay sewer pipe shall be of bell and spigot design and shall be extra strength, designed and manufactured as per ASTM C-700 latest revision. Unless approved otherwise, vitrified clay pipe may be used for 8, 10, 12 and 15 inch sewer mains and shall be unglazed. All vitrified clay pipe joints shall be manufactured in accordance with the requirements of ASTM C-425.
 - b. No pipe with cracks or other defects will be used.
3. Polyvinyl Chloride Gravity Sewer Pipe (PVC)
 - a. PVC gravity sanitary sewer pipe and related fittings shall be manufactured in accordance with all the requirements of ASTM C3034, SDR 35, Type PSM polyvinyl chloride sewer pipe and fittings. PVC gravity sewer pipe may be used for 8 inch mains and shall be supplied in 12.5 foot lengths with bell-and-spigot joints. All fittings shall use rubber gaskets which conform to the requirements of ASTM F477.
4. Steel Pipe
 - a. Steel pipe for aerial creek crossings or boring installations (without encasement and carrier pipe) shall be high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139 and A283 and consisting of grade "B" steel with a minimum yield strength of 35,000 psi. On 8 and 10 inch pipe, the minimum wall thickness shall be 0.375 inches.
 - b. The outside of the pipe shall have one coat of zinc chromate primer conforming to Federal Specification TT-86a and afterwards painted with a compatible black paint.
 - c. Pipe ends shall be right-angled and shall be compatible to receive a "dresser style 62" - type I or approved equal mechanical transition coupler.

5. Steel Encasement Pipe

- a. Steel encasement pipe shall be spiral welded or smooth-wall seamless, consisting of grade "B" steel with a minimum yield strength of 35,000 psi and manufactured in accordance with ASTM A139 and A283.
- b. The pipe thickness shall be as required by the encroachment agreement obtained from the controlling agency, but in no case be less than 0.250 inches and the ends shall be beveled and prepared for field welding at the circumferential joints. Thicker encasement pipe may be required by the North Carolina Department of Transportation, Railroads and other agencies.
- c. The pipe shall be coated inside and outside, in accordance with AWWA C203 or the N. C. Department of Transportation or the American Railway Engineering Association's specifications. All encasement pipe must be approved by the appropriate controlling agency (i.e. NCDOT, RR, etc.) prior to ordering the material.
- d. If the encasement pipe is used to carry a sewer main, then a vent pipe shall be installed. The vent pipe shall be made from ASTM A139 and A283, grade "B" steel, with a minimum yield strength of 35,000 psi and coated as described above. The vent pipe location shall be approved by the appropriate agency prior to installation.
- e. All carrier piping shall be slip joint ductile iron and the minimum inside diameter casing shall be 8 inches greater than the inside dimension of the carrier pipe as follows:

<u>Carrier Pipe Inside Diameter</u>	<u>Steel Casing Pipe Minimum Inside Diameter</u>
4 inch	12 inch
6 inch	14 inch
8 inch	16 inch
12 inch	20 inch
16 inch	24 inch

6. Manholes

- a. Manholes shall be D.O.T. certified. Manholes shall be manufactured in accordance with ASTM C478-80 and shall be precast with monolithic base and eccentric cone. All manholes will be 4'0" inside diameter with 5 inch walls or 5'0" with 6 inch thick walls and have a 6 inch minimum base.
- b. All manholes over 10'0" deep (top rim to lowest point) shall be 5'0" diameter. All manholes with 21 inch or larger pipes will

be 5'0". The standard joint shall be sealed with plastic cement putty meeting Federal Specifications SS-C-153. "O" ring joints shall conform to the requirements of ASTM C443. A rubber water stop shall be supplied with the manholes to tie the pipe to the barrel section. These gaskets and clamps shall meet the requirements of ASTM C923.

- c. Manholes deeper than 3'0" shall have steps. Manhole steps will be press set plastic, or approved equal. Steps will also be provided on the outside of raised manholes when the top elevation is greater than 3 feet above the existing ground elevation.
- d. All commercial and industrial dischargers shall provide a monitoring manhole easily accessible and in accordance with ordinance 87.35, section 25-44. All discharge from the property must pass through one monitoring manhole before entering the public sewer system.

7. Manhole Rings and Covers

- a. Manhole rings and covers will be Dewey Brothers MHRCR-2001 for all off-street locations and Dewey Brothers MHRCR-2001-EC for all in-street locations. All covers will be perforated and marked "SEWER" unless otherwise required by the Director of Public Works or these specifications.
- b. Manholes located in off-street locations shall be extended one foot above finished grade. Manholes in flood plains shall extend 2 feet above the 100-year flood elevations or be provided with sealed covers and vented.

8. Service Connections to Sewer System

- a. Where sewer lines are already in place, the City will tap the sewer line. Where taps are made at the time of installation of the sewer, the following shall apply.
 - a.1 Where feasible, service connections shall be made into the nearest manhole. Connections into manholes shall be by cored holes into the manhole and the lateral shall be grouted watertight.
 - a.2 Where making a service connection directly to the main line, the following shall apply:
 - (a) On VCP, use hole saw or provide wye fittings at location of service connection.
 - (b) On PVC, cut hole in pipe using appropriate saw, glue and clamp service saddle over hole.

- a.3 The lateral shall be installed from the main line to the edge of the right-of-way or beyond the limits of pavement. The location of the end of the lateral shall be marked with a steel post painted yellow for easy identification.
- a.4 The service connection shall be located by distances from manhole to manhole. The distances shall be recorded on a reproducible medium and submitted to the City for their records.
- a.5 Sewer laterals shall be a minimum of 4" diameter cast iron. Service grade bell and spigot.
- a.6 Service saddles shall be cast iron. Service saddles shall be "Romac" catalog #CB 4.63 UN or approved equal.

B. SANITARY SEWER DESIGN CRITERIA

1. Sanitary sewer plans and specifications shall be sealed by a Professional Engineer, licensed to practice in North Carolina.
2. Minimum manhole depth shall be 4 feet.
3. Minimum pipe size shall be 8 inch diameter.
4. Minimum slope on an 8 inch pipe shall be 0.5%. Maximum slope shall be 15.0% on 8" pipe.
5. Minimum velocity shall be 2 fps.
6. Minimum cover shall be 3.0 feet, unless ductile iron pipe is used.
7. Maximum cover shall be 18 feet, unless ductile iron pipe is used.
8. Manholes in off-street locations shall be extended 1 foot (minimum) above finished grade.
9. Manholes shall extend 2 feet above the 100-year flood elevation or be sealed cover and vented 2 feet above the 100-year flood elevation. If the 100-year flood elevation cannot be readily established, the Director of Public Works shall establish the elevations to which the manhole rims or stack shall be extended.
10. Horizontal and vertical alignment between manholes shall be straight.
11. Provide .02 drop through each manhole.
12. Maximum distance between manholes shall be 400 feet.
13. Use drop manhole where difference between incoming and outgoing pipe inverts is 24" or greater.
14. Provide wye with lateral to the property line and plug for each lot in a subdivision. Provide metal post painted yellow extending at least 3 feet above ground to mark end of lateral.
15. Separate water lines 10 feet horizontal distance from sewer lines (existing or proposed) or keep water line 18 inches clear above sewer line. Where 18 inches clear vertically cannot be maintained below or above the sewer line, both lines shall be mechanical joint ductile iron a minimum of 10 feet on either side of the crossing. Center the crossing at the center of the pipe, both lines.

16. Sewer lines shall have a 25' permanent easement (12.5' each side of center line) in the City's name. A 50' construction easement (25' each side of center line, unless directed otherwise) shall be provided.

SANITARY SEWER PLANS CHECKLIST

Sanitary sewer plans shall contain the following minimum information:

1. Plan and profile on 24" x 36" page.
2. Vertical sea level elevation scale on left of profile and station numbers along bottom of profile.
3. North arrow, all sheets.
4. Plan and profile both run left to right.
5. Centerline intersections of line crossings with sewer noted on profile.
6. Street names above or below corresponding profile, when more than one street is on a page.
7. Identify location of drop manholes in both plan and profile.
8. Invert elevations of all proposed and all existing pipes and pipe sizes entering and leaving all manholes to 0.01' on profile.
9. Rim elevation and vent elevation to 0.1' on profile; existing and proposed grades.
10. Pipe grade to 0.01% and size and type of pipe between manholes.
11. Size and type of existing pipe and direction of flow between each manhole on plan.
12. Station numbers and designation of "Existing" or "New" on each manhole on plan and profile.
13. Indication of "identical" manholes where profile is broken.
14. Location and size of all existing and proposed street and sewer rights of way.
15. Existing pavement on plan, indicate width, and any portion to be cut.

16. Where a line is to be bored indicate location and length of casing and type of pipe on plan and profile.
17. All existing underground utilities in the area.
18. Where ductile iron is to be used, indicate limits on plan and profile. Show shaded on profile.
19. Use ductile iron where storm drain and sewer have less than 2 feet vertical clearance.
20. On aerial crossings, use concrete piers at 18' intervals, indicate on plans and profile, include details of design for the piers and anchorage.
21. Total distance between existing manholes or proposed manholes on the plan and the bearing if the line is not within the street right of way.
22. All lot lines.
23. All street names on plan.
24. Flood plain elevation in all flood plain areas.
25. Creek flow line.
26. All Railroad crossings must be accompanied by a separate encroachment map showing plan and profile and all other information required by the railroad in accordance with their standards.
27. Registered Engineer's seal and signature.
28. Vicinity map showing the location of lines and a visual index of plan sheets.

**INSTALLATION
SPECIFICATIONS**

A. WATER AND SEWER INSTALLATION

1. Clearing

- a. Where the lines are to be constructed in wooded areas, permanent easements shall be fully cleared. Cleared materials shall be disposed of off of the construction site. Disposal shall be made in accordance with all local and state laws. Trees cut down on the construction site will be hauled away from the site for proper disposal. Stumps of all trees cut down outside of the excavation area shall be removed. Ground surfaces shall be graded so as to promote proper drainage and allow mowing by vehicular equipment.

2. Site Grading

- a. All rough grading shall be completed prior to the installation of the sewers and appurtenances.

3. Earthwork

3a. Explosives and Blasting

- a. Explosives for blasting shall be stored, handled, and used in accordance with the North Carolina Department of Transportation Standard Specifications - latest revision, all local regulations, and practices outlined in the "Blaster's Handbook" published by E.I. Dupont de Nemours and Company, Inc. Blasting shall be conducted so as not to endanger persons or property, and shall be covered or otherwise satisfactorily confined. The blaster shall be responsible for, and shall make good, any damage of whatever nature caused by blasting or accidental explosions.

3b. Removal of Water

- a. The bottom of all excavations shall be free from water when pipe is laid in the excavation, when concrete is placed and until work is carried about the groundwater level and is safe from flotation.
- b. If any of the subgrade or underlying materials is disturbed by movement of groundwater, surface water, or any other reason, it shall be replaced with crushed stone or gravel.

4. Clean-Up of Site

- a. At the completion of the work, all debris and excess construction materials shall be removed and the right-of-way shall be left clean and presentable.

5. Materials

a. Select Backfill

a1. Select backfill material shall contain no man-made or organic material or clay pockets and shall be free of rocks, clods, or other materials larger than 2 inches in nominal diameter. Materials from on-site excavations may be used for select backfill provided they meet the specified requirements and contain optimum moisture content for proper compaction. Water saturated material shall not be used as select material. If sufficient on-site select backfill material is not available, acceptable material from an off-site borrow area shall be secured.

b. Backfill

b1. Backfill shall be free of all organic materials and shall not contain any rocks larger than 4 inches in diameter, or be in a water saturated condition.

c. Crushed Stone or Screened Gravel

c1. Crushed stone or screened gravel shall meet the requirements of the North Carolina Department of Transportation Standard Specifications latest revision.

c2. Crushed stone or screened gravel shall conform to standard size No. 5. Any rock excavated on site which meets this gradation may be used. Specifically the stone shall meet the following gradation:

<u>Sieve Size</u>	<u>Percentage Dry Weight Passing Designated Sieve Size</u>
1-1/2 inch	100
1 inch	90-100
3/4 inch	20-55
1/2 inch	0-10
3/8 inch	0-5
No. 200	0-0.6

d. Pipe Bedding

d.1 All material used for pipe bedding shall conform to North Carolina Department of Transportation Standard Specification latest revision for standard size 67 material. Any rock, run-of-bank sand, or gravel excavated on site which meets the following gradation may be used.

<u>Sieve Size</u>	<u>Percentage Dry Weight Passing Designated Sieve Size</u>
1-inch	100
3/4-inch	90-100
3/8-inch	20-35
No. 4	0-10
No. 8	0-5
No. 200	0-0.6

e. Riprap

e.1 The stone for riprap shall consist of field stone or rough un-hewn quarry stone. The stone shall be sound, tough, dense, and resistant to the action of air and water. The riprap shall be Class I as specified in the NCDOT Standard Specifications. The stone shall vary in weight from 5 to 200 pounds. At least 30 percent of the total weight of the riprap shall be in individual pieces weighing a minimum of 60 pounds each. Not more than 10 percent of the total weight of the riprap may be in individual pieces weighing less than 15 pounds each.

e.2 During placing, the stone shall be graded so that the smaller stones are uniformly distributed through the mass. The stone may be placed by mechanical methods, augmented by hand placing where necessary. The placed riprap shall form a properly graded, dense, neat layer of stone. The placed riprap shall have a minimum depth of 12 inches.

6. Excavation

a. General

a.1 All excavation shall be made in such a manner, and to such widths, as will give ample room for properly constructing and inspecting the structures they are to contain, and for such sheeting, timbering, pumping, and drainage as may be required within the limits shown in Standard STD-2.

a.2 Except where otherwise specified, excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade, or damage to adjacent areas. Intercept and collect surface runoff both at the top and bottom of cut slopes.

a.3 All excess excavated material and all excavated material which is unsuitable shall be removed from the site and replaced with suitable material.

b. Sheeting and Bracing

b.1 Place and maintain such sheeting and bracing as may be required to support the sides of the excavation, or to protect pipes and structures from possible damage, and to provide safe working conditions. The Contractor shall be responsible for the adequacy of all sheeting and bracing used, and for all damage resulting from sheeting and bracing failure or from placing, maintaining, and removing it. All sheeting and bracing shall be removed upon completion of the work. The City may permit sheeting to be left in place at the request and expense of others for the purpose of preventing injury to structures or property. Any sheeting or bracing left in place shall be cut off at least 2-feet below the finished ground surface.

c. Rock Excavation

c.1 All rock encountered within the limits of excavation shall be excavated. Rock shall be excavated so that generally there will be a clear space of at least 12-inches from the outside barrel of the pipe to the side of the trench. Isolated points of rock shall not come nearer than 6-inches to the pipe. At the trench bottom, the rock shall not come nearer than 6-inches to the pipe. In addition, sufficient rock shall be removed at joints to facilitate proper installation. Rock shall be fully removed at least 15-feet in advance of the laying of pipe.

d. Protection of Subgrade for all Excavations

d.1 To minimize the disturbance of the bearing materials and provide a firm foundation:

(a) Excavation shall be carried out below subgrade in limited areas, should disturbed soil or material with natural low bearing capacity be encountered. Stabilizing of these areas shall be done with select backfill or coarse aggregate as required. Soils disturbed through the operations shall be excavated and replaced with select backfill or coarse aggregate, as required.

(b) Provide positive protection against penetration of frost into materials below the bearing level during work in winter months.

7. Backfilling

- a. Backfill shall be placed in maximum 8-inch lifts and compacted with tampers to 95 percent of Standard Proctor AASHTO-T99 density, excepting backfill under structures, which shall be compacted to 98 percent of Standard Proctor Density. Backfill in the roadways shall be tamped to NCDOT requirement.
- b. Pipe trenches shall be backfilled as soon as possible after pipe installations.
- c. Where sheeting is used, use all reasonable measures to prevent the loss of support of the pipe or backfill when the sheeting is removed. If significant volumes of soil cannot be prevented from clinging to the extracted sheets, the voids shall be continuously backfilled as rapidly as possible. Thereafter limit the depth below subgrade that sheeting will be driven in similar soil conditions or employ other appropriate means to prevent a loss of pipe support. Sheeting embedded in granular fill or backfill materials shall be left in place.

8. Pipe Laying

- a. Pipe laying shall in all instances be accomplished in a workman-like manner laid true to line and grade with bell ends facing (up-grade) in the direction of laying. The various pipes shall be handled, bell-up and laid in accordance with the manufacturer's requirements and good engineering practices.

9. Pipe Bedding

- a. Shaped Bottom Bedding (STD-1): Shall be so the pipe bears uniformly upon undisturbed native earth. Soil is then back-filled and tamped by hand around the pipe (and completely under the pipe haunches) in uniform layers not exceeding six (6) inches in depth to 1'-0" above the top of pipe.

Each 6" layer shall then be placed, then carefully (so as not to disturb or damage the pipe) and uniformly tamped, eliminating the possibility of lateral movement.

- b. Type II - Granular Material Embedment (STD-3): Shall be when the trench bottom is undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone as shown in the standard details.
- c. Type III - Granular Material Embedment (STD-4): Shall be when the trench bottom is undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone to an elevation such that the pipe will be completely and uniformly bedded.

- d. Concrete Encasement and Cradles (STD-5): Shall be as shown in the standard details.

10. Installation Limitations

- a. The following are limitations and bedding requirements for supportive strength and shall be adhered to at all times:
- (a) 6- & 8-Inch Pipe: Installation of 8-inch VCP or PVC pipe with more than fourteen (14) feet of cover use Type II, Granular Embedment.
 - (b) 10-Inch and 12-Inch Pipe: Installation of 10-inch and 12-inch VCP or PVC pipe with more than twelve (12) feet of cover, use Type II, Granular Embedment.
 - (c) Ductile Iron Pipe: Installation of Ductile Iron Pipe with more than twenty (20) feet of cover use Type II - Granular Embedment. More than thirty (30) feet of cover use Type III - Granular Embedment. This is regardless of found water and/or soil conditions.
- b. In areas having 3.00 feet and less or 18.00 feet and more of cover, use Ductile Iron Pipe.

11. Portland Cement Concrete

- a. Acceptance of Concrete: The Director of Public Works shall require all and as many tests as he deems necessary to insure the concrete acceptability. The cost of the test shall be at the suppliers or contractors expense.
- b. Depositing: Concrete will not be used if it cannot be placed within ninety (90) minutes of the dispatch time. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to rehandling or flowing. Segregated concrete and/or concrete consisting of foreign material will not be used. Depositing will not be done when temperature has not exceeded 35 degrees Fahrenheit and ring by 10:00 A.M. Concreting shall cease when the descending air temperature rise falls below 40 degrees Fahrenheit. It shall not resume until the ascending air temperature rises to 35 degrees Fahrenheit. All concrete shall be kept from freezing. Frozen concrete shall be replaced. Free fall shall not exceed 3 feet in any case.
- c. Forms: Forms may be made of wood, plywood, metal, or any other suitable material. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such

that the finished concrete shall be of the proper form and dimensions. The design of the forms shall take into account the effect of vibration of concrete as it is placed and also the rate of speed at which the forms will be filled.

- d. Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.
- e. Curing: All concrete shall be cured by one of the following methods:
 - e.1 Forms left in place for a period of seven (7) days. Exposed concrete shall be moist cured.
 - e.2 Moist curing performed when forms are removed before seven (7) days. All construction joints shall be moist cured.
 - e.3 Curing compound used immediately after forms are removed and all surface water has disappeared.
- f. Finishing: The structure shall have a uniform and textured surface. All form marks exposed to view shall be rubbed off with a stone.

12. Testing

- a. Testing is required on all lines and shall be done in the presence of the Director of Engineering or his representative. A minimum of 48 hours notice shall be given to the Director of Engineering before testing begins unless other schedules can be arranged. All testing and disinfection shall be completed prior to connection to any existing line.
- b. Sewer Line Testing
 - b.1 Air Test
 - (a) A low pressure air test shall be used to determine acceptability of completed work. The Contractor shall furnish men, equipment and materials necessary to conduct the test. The Contractor shall perform the air test in the presence of the Engineer or a qualified representative of the Owner.
 - (b) All air used shall pass through a single control panel. Individual air hoses shall be used from control panel to pneumatic plugs, from control panel to sealed line for introducing low pressure air, and from sealed line to

AIR TEST TABLE

SPECIFICATION TIME (min:sec) REQUIRED FOR PRESSURE DROP FROM 3.5 TO 2.5 PSI

WHEN TESTING ONE PIPE DIAMETER ONLY

Length (ft.)	Pipe Diameter Inches															
	4	6	8	10	12	15	18	21	24	27	30	33	36	39	42	
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	8:05	
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	16:10	
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	16:48	18:12	19:36	
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:36	14:00	15:24	16:48	18:12	19:36	
125	0:22	0:50	1:28	2:17	3:18	5:09	7:26	9:48	11:12	12:36	14:00	15:24	16:58	19:55	23:06	
150	0:26	0:59	1:46	2:45	3:58	6:11	8:24	9:48	11:12	12:36	14:09	17:07	20:22	23:54	27:43	
175	0:31	1:09	2:03	3:12	4:37	7:00	8:24	9:48	11:12	13:22	16:30	19:58	23:46	27:53	32:20	
200	0:35	1:19	2:21	3:40	5:17	7:00	8:24	9:48	12:04	15:16	18:51	22:49	27:09	31:52	36:58	
225	0:40	1:29	2:38	4:08	5:36	7:00	8:24	10:24	13:35	17:11	21:13	25:40	30:33	35:51	41:35	
250	0:44	1:39	2:56	4:35	5:36	7:00	8:29	11:33	15:05	19:06	23:34	28:31	33:57	39:50	46:12	
275	0:48	1:49	3:14	4:40	5:36	7:00	9:20	12:42	16:36	21:00	25:56	31:22	37:20	43:49	50:49	
300	0:53	1:59	3:31	4:40	5:36	7:04	10:11	13:52	18:06	22:55	28:17	34:14	40:44	47:48	55:26	
350	1:02	2:19	3:44	4:40	5:36	8:15	11:53	16:10	21:07	26:44	33:00	39:56	47:31	55:46	64:41	
400	1:10	2:38	3:44	4:40	6:02	9:26	13:35	18:29	24:08	30:33	37:43	45:38	54:19	63:44	73:55	
450	1:19	2:48	3:44	4:43	6:47	10:36	15:16	20:47	27:09	34:22	42:26	51:20	61:06	71:42	83:10	
500	1:28	2:48	3:44	5:14	7:33	11:47	16:58	23:06	30:10	38:11	47:09	57:03	67:53	79:40	92:24	
550	1:37	2:48	3:44	5:46	8:18	12:58	18:40	25:25	33:11	42:00	51:51	62:45	74:40	87:38	101:38	
600	1:46	2:48	4:01	6:17	9:03	14:09	20:22	27:43	36:12	45:49	56:34	68:27	81:28	95:36	110:53	
650	1:52	2:48	4:21	6:49	9:48	15:19	22:04	30:02	39:13	49:38	61:17	74:09	88:15	103:34	120:07	
700	1:52	2:48	4:42	7:20	10:34	16:30	23:46	32:20	42:14	53:28	66:00	79:52	95:02	111:32	129:22	

control panel for continually monitoring the air pressure rise in the sealed line. All monitoring gauges shall be subject to calibration as deemed necessary.

- (c) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe tested. The plugs shall resist internal test pressures without requiring external bracing or blocking. Plugs shall be tested prior to installation in the pipe run. A length of pipe shall be sealed at both ends with the plugs to be used in the sewer test. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall then be pressurized to 5 psig. The plugs shall withstand this pressure without bracing or movement.
- (d) The air test shall be performed when the sewer is complete with all structures in place, the trench backfilled and the lines clean and free of all debris.
- (e) The test shall be performed on a reach-by-reach basis. Test plugs shall be placed in the line at each manhole, secured to the manhole to prevent movement, and inflated to 25 psi. In low-lying or poorly drained areas, the groundwater level shall be determined by the Contractor by a method acceptable to the Engineer. Low pressure air shall be introduced into the sealed line until the internal pressure reaches 4 psi plus water pressure from groundwater as determined by the Engineer. The air pressure shall then be allowed to stabilize at no less than 3.5 psi plus water pressure from groundwater as determined by the Engineer. After the stabilization period, the air test shall commence. The line shall be deemed acceptable if the pressure drop does not exceed 1 psi in the time prescribed for the test in the accompanying table. If the line tested fails to meet these requirements the Contractor shall, at his own expense, determine the source of leakage and shall repair or replace all faulty material and correct the workmanship.

b.2 Test For Displacement of Sewers

- (a) Upon completion of the sewer installation, a displacement test shall be conducted by the Engineer. The test shall consist of flashing a light between manholes in order to detect any misalignment, displaced pipe or other defects. The Contractor shall provide all necessary materials, equipment and personnel required to assist the Engineer and shall be responsible for correction, at his own expense, or any defects as determined by the Engineer.

- (b) An additional test shall consist of inserting a "go, no-go" mandrel or sewer ball into the lines between manholes in order to detect excessive pipe deflection. The minimum allowable diameter for passing the mandrel or sewer ball shall allow for 7-1/2% maximum deflection and shall not be less than 5.31 inches for 6: nominal diameter pipe and 7.09 inches for 8" nominal diameter pipe. The Contractor shall provide all necessary materials, equipment and personnel required to conduct the test and shall be responsible for correction, at his own expense, of any defects as determined by the test.

b.3 Infiltration

- (a) The installer of the sewer line shall check the lines for infiltration or exfiltration before they are put in service. Infiltration in excess of one hundred (100) gallons per day per inch-mile of sewer will result in having the Contractor go over the lines, ascertain where the leakage exists, and repair the lines to the extent necessary to bring the infiltration down within acceptable limits. If exfiltration testing is required or necessary, an allowance of an additional 10 percent of gallonage shall be permitted for each additional 2-ft. head over a basic 2-ft. minimum internal head. The Contractor shall test only pipe of the same diameter and maximum length of one mile at a time. All testing herein shall be satisfactorily completed prior to connecting to the existing sewer system.

b.4 Vacuum Testing of Manholes

All sanitary sewer manholes constructed by the Contractor shall be vacuum tested for leakage in the presence of a City Inspector. The vacuum test will not apply to any existing manholes that have been converted to drop manholes by the Contractor.

The Contractor shall furnish all labor, equipment, and any appurtenant items necessary to satisfactorily perform the vacuum test. All testing equipment shall be approved for vacuum testing manholes.

Each manhole shall be tested after assembly and unless directed otherwise by the Engineer prior to backfilling.

All lifting holes shall be plugged with an approved non-shrink grout.

All pipes entering the manhole shall be plugged. The contractor shall securely brace the plugs in order to keep them from being drawn into the manhole.

b.4 Continued

The test head shall be placed at the inside of the top of the cone section of the manhole and the seal inflated in accordance with the manufacturer's recommendations.

A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time the vacuum to drop to 9-inches of mercury shall not be less than that shown in the table below.

<u>Manhole</u> <u>Depth</u>	<u>Diameter of Manhole</u>		
	<u>48" Dia.</u>	<u>60" Dia.</u>	<u>72" Dia.</u>
10 Ft. or Less	60 Sec.	75 Sec.	95 Sec.
>10 Ft. But <15Ft.	75 Sec.	90 Sec.	105 Sec.
>15 Ft. But <25 Ft.	90 Sec.	105 Sec.	120 Sec.

(Times shown are minimum elapsed times for a drop in vacuum of 1-inch of mercury).

If the manhole fails the initial test, necessary repairs shall be made with an approved non-shrink grout while the vacuum is still being drawn. Retesting shall proceed and continue until a satisfactory test is accomplished.

c. Water Line Testing

- c.1 Hydrostatic and Leakage Tests: On completion of the line or sections of the lines, connections and appurtenances, the lines shall be filled and hydrostatically tested. The water for this purpose can be taken down from existing lines under the supervision of the Public Works Department; the pressure shall be increased to either 150 PSI or 200 PSI and the lowest point in the section being tested as specified by the Director of Public Works. Testing shall be for a minimum of 4 hours to a maximum of 24 hours. The water added during the testing will be metered. All leaks and any defective material shall be repaired or replaced to the satisfaction of the Director of Public Works and the tests repeated until the requirements of this specification are met.
- c.2 Leakage will be allowed on the basis of the formula set forth in AWWA Specification C 600.
- c.3 Field Testing Valves: In addition to manufacturer testing and certification, field tests of all valves as directed by AWWA specification C-500 and C-504 as applicable.

- (a) During the last stages of the test and without any reduction in pressure, first the hydrant valves will be closed, then progressing in an orderly manner from the end opposite from the test pump each main line valve will be closed and pressure released to determine if it is holding pressure (minimum 30 minutes).
- (b) Unless otherwise directed by the Director of Public Works, all Butterfly Valves will be tested to 150 PSI for a minimum of 30 minutes (each) after the pipeline has been successfully tested.

13. Disinfection of Water Mains

- a. All water lines or appurtenances added to or replaced in the City of Reidsville water system shall be properly chlorinated before being placed in service. Chlorination of all lines shall be performed when all lines are filled with water and are free of air. The chlorination shall be performed under the supervision of the Engineer.
- b. Any pipe subjected to contaminating materials shall be treated as directed by the Engineer. Should such treatment fail to cleanse the pipe, the pipe shall be replaced.
- c. The chlorination of a completed line shall be performed in the following manner:
 - c.1 Taps will be made at the control valve located in the upstream end of the line and at all extremities of the line. These taps shall be located in such a manner as to allow HTH solution to be introduced into all parts of the line.
 - c.2 A water solution containing high test hypochlorite (65%) available chlorine shall be introduced into the line by regulated pumping at the control-valve tap. The solution shall contain a concentration of HTH that will produce a uniform concentration of 50 ppm total chlorine immediately after the introduction of the solution into the line has been completed.
- d. The following quantities of 65% HTH compound per 1000 feet of line is required to produce a solution concentration of 50ppm total chlorine as state above:

Pipe Size (Inches)

65% HTH (lbs. per 1000 ft. of line)

2".....	0.11
4".....	0.42
6".....	0.94
8".....	1.68
12".....	3.77
16".....	6.72
24".....	15.70

- e. The HTH solution shall be circulated in the line by opening the control valve and systematically manipulating hydrants and taps at the line extremities. The HTH solution must be pumped into the line at a constant rate for each discharge rate in order that a uniform concentration will be maintained in the line.
- f. The HTH solution shall remain in the lines for a minimum of 24 hours. If directed by the Engineer the HTH solution shall remain in the lines longer than 24 hours. At the end of this period the free residual chlorine shall be a minimum of 25 ppm or the lines shall be rechlorinated.
- g. Extreme caution shall be exercised at all times in order to prevent the HTH solution from entering the City of Reidsville's existing water system.
- h. The lines shall be flushed after the 24 hour or longer period outlined above, provided the free residual chlorine analysis is satisfactory. The flushing shall continue until a orthotolidine check shows that the lines contain only the normal chlorine residual.
- i. Reidsville water treatment plant technicians shall collect samples for bacteriological and analysis 24 hours after flushing of the lines is completed. The cost for each test shall be \$50.00. Samples shall be taken under the direct supervision of the Engineer.
- j. Bacteriological test results will be available 48 hours after the water samples have been taken by the City of Reidsville's Water Treatment Plant technicians.
- k. If test results are unsatisfactory, all lines shall immediately be rechlorinated, then proceed with such measures as are necessary to secure sterile lines. All laterals shall be rechlorinated during this process.

1. At the satisfactory completion of the bacteriological requirements, the lines shall be placed into service under the supervision of the Engineer. All valves shall be fully opened.

14. Drainage of Mains

- a. Mains shall be drained through hydrants or blowoffs to natural drains. Drainage of mains will be accomplished in such a manner as to minimize erosion and siltation to adjoining properties. Water velocity from drainage and/or blow-off will also be dissipated in an acceptable manner to protect the environment.
- b. Hydrants or blowoffs shall not be connected to any sewer, submerged in any streams, or installed in any other manner that will permit back siphonage into the distribution system.

15. Water Use

- a. All water used for testing, flushing disinfection, etc., shall be purchased from the City at prevailing rates. The use of water (time and quantity) shall be coordinated with the Director of Public Works. This coordination shall be accomplished by submittal of a proposed schedule of water use for approval by the Director of Public Works. The proposed schedule shall be submitted ten (10) working days prior to any water use.

16. Final Grading and Landscaping

- a. General
 - a1. Fertilizing, seeding, and mulching of any and all areas disturbing construction will follow within ten (10) working days of the installation of each run of pipe (being from manhole to manhole or 300 feet of water line). All plantings shall be maintained by the installer for a period of one (1) year after the completion of the work.
- b. Materials
 - b.1 Lawn Fertilizer
 - b.2 Origin - Commercial fertilizer shall be a complete fertilizer with components derived from organic sources.
 - b.3 Quality - Commercial fertilizer shall contain the following percentages by weight:

Type 10-10-10
 10% Nitrogen (Ureaform)
 10% Phosphoric Acid
 10% Potash

One-quarter of the Nitrogen shall be in the form of nitrates, one-quarter in the form of ammonia salts, and one-half in the form of natural organic Nitrogen. Available Phosphoric Acid to be free from superphosphate, bone, or tankage. Potash shall be Sulphate or Potash. Elements shall conform to the standards of the Association of Official Agricultural Chemists.

b.4 Storage - Commercial fertilizer shall be stored in weatherproof storage areas and in such a manner that effectiveness will not be impaired.

b.5 Ground Limestone - At least (50%) fifty percent shall pass a No. 200 U.S.S. mesh sieve.

(a) At least (90%) ninety percent shall pass a No. 100 U.S.S. mesh sieve.

(b) One hundred percent (100%) shall pass a No. 10 U.S.S. mesh sieve.

(c) Total carbonates shall not be less than eighty percent (80%) of 44.8% Calcium Oxide equivalent; for purpose of calculation, total carbonates shall be considered as Calcium Carbonate.

b.6 Grass Seed - Grass seed shall be "New Crop" mechanically mixed seeds in the following seed mixture proportions:

<u>% Mixture</u>	<u>Seed Variety</u>	<u>% Purity</u>	<u>% Germination</u>
80	Kentucky 31	98	97
20	Kentucky Bluegrass	98	85

c. **Seed Bed Preparation**

c.1 The seed bed shall be prepared by pulverizing the soil to a depth of three (3) inches. Good surface drainage must be provided, allowances for settlement made and ground elevations adjusted accordingly. Visible ponding will not be allowed. All stones, roots, sticks, rubbish, and other objectionable material shall be removed.

d. **Soil Improvements**

d.1 Soil additives shall be applied incorporated in an approved manner into the topsoil at the following rates:

(a) Fertilizer - 30 pounds per 1000 square feet of 10-10-10 fertilizer.

(b) Lime - 100 pounds per 1000 square feet.

(c) Superphosphate (0.20.0) - 12 pounds per 1000 square feet.

e. Seeding

e.1 The seed bed must be in a good, friable condition and has not become muddy or hard at the time seeding is to be performed.

e.2 Seed shall be applied at the rate of 8lbs/1000 square feet and raked or tilled into the topsoil with the resulting furloughs running across the natural slope of the ground.

f. Mulching

f.1 Dried straw shall be uniformly spread (approximately 1/4 of the ground should remain visible to avoid smothering seedling) over the area at the rate of 90 pounds per 1000 square feet. The straw shall be sprayed with liquid asphalt to bond it together and anchor it in place.

f.2 Liquid asphalt (thinned with kerosene) used during freezing weather shall be either rapid or medium curing, applied at a rate of 200 gallons per ton of straw (approximately 7 gallons per 1000 square feet).

f.3 Emulsified asphalt (thinned with water) used when temperatures are less severe shall be rapid curing only, applied at a rate of 150 gallons per ton of straw (approximately 7 gallons per 1000 square feet).

g. Maintenance

g.1 Maintenance shall consist of watering, weed and pest control (within established lawns), fertilization, erosion repair, reseeding and all else necessary to establish a vigorous healthy and uniform stand of grass. All areas and spots which do not show a uniform stand of grass, for any reason, shall be treated repeatedly until a uniform stand is attained.

17. Erosion and sedimentation Control Measures

g.2 All work shall be done in accordance with and subject to the limitations of the N.C. Rules and Regulations for Erosion and Sediment Control.

- g.3 It shall be the responsibility of the installer of the system to obtain approval of a sedimentation and erosion control plan from the NC Department of Natural Resources and Community Development prior to land disturbing activities.
- g.4 All erosion control measures shall be maintained until no longer required for sediment control, at which time they shall be dismantled and removed from site.