Town of Spring Hope
North Carolina

Standard Specifications And Details

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SECTION REVISED	DATE ADOPTED	DESCRIPTION OF CHANGE	APPROVAL AUTHORITY

INTRODUCTION

PART 1 GENERAL

1.01 PURPOSE OF MANUAL

A. The purpose of this Manual is to provide a standard guideline to the contractor, developer and engineer for the design and construction of water and wastewater utility system extensions that will become a part of Spring Hope's water and wastewater systems. This publication serves to consolidate the multitude of information on policy, design, materials, construction and standard detail drawings used by the Town of Spring Hope.

B. The materials, design and construction standards contained within this Manual are established as the minimum for water and sewer replacements and extensions which will be accepted for ownership and maintenance by the Town.

C. It is the intent and purpose of this Manual to explain the requirements of Spring Hope relating to utility system extensions such that all can comprehend these requirements and to provide a consistent, orderly, and sound extension of the Town's utility systems. The extensions or modifications to the system are inclusive of any project type (residential, commercial, industrial, institutional, etc.)

1.02 DEFINITIONS AND ABBREVIATIONS

A. Definitions: Wherever used in this Manual the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof. There are other terms used in this document which are defined in the sections to which they apply.

1. **Approved Plans** – Water system, sewer system, stormwater and/or roadway extension and design plans which have been reviewed by and received the approval of the Town of Spring Hope and the appropriate state and local agencies.

2. **Contract Documents** – The term "Contract Documents" shall refer to the project plans and specifications for water system, sewer system, stormwater and/or roadway extensions and designs.

3. **Contractor** – The person, business, or corporation responsible for the performance of water, sewer, stormwater, or roadway system construction work.

4. **Developer** – The person(s) or corporations financially responsible for the design and construction of a development for which water, sewer, stormwater, or roadway service by the Town of Spring Hope will be requested.

5. **Engineer** – The Professional Engineer responsible for the design or construction administration of a water system, sewer system, stormwater and/or roadway extensions and designs.

6. **Manual** – The term "Manual" shall refer to all applicable standards, specifications, standard details, and policies contained in or referenced by this document.

7. **Owner** – The term "Owner" shall refer to the Town of Spring Hope as a chartered municipality within the State of North Carolina and shall be inclusive of the ownership of the collection, distribution, and treatment utilities which provide service to the citizens and customers of the Town.

8. **Professional Engineer** – A person who has been duly registered and licensed as a Professional Engineer by the North Carolina State Board of registration for Professional Engineers and Land Surveyors.

9. **Town Engineer** – The term "Town Engineer" refers to a Professional Engineer on the staff of Spring Hope or the Town's designee.

B. Abbreviations

1. **AASHTO** – American Association of State Highway Transportation Officials

2. **ANSI** – American National Standards Institute

3. **ASTM** – American Society for Testing and Materials

4. **AWWA** – American Water Works Association

5. **DEQ** – Department of Environmental Quality

6. **NCDEH** – North Carolina Division of Environmental Health

7. **NCDOT** – North Carolina Department of Transportation

8. **NCDWQ** – North Carolina Division of Water Quality

C. Standards

1. Where reference is made by this Manual to published standards such as ASTM, ANSI, AWWA, etc., the latest revisions of such standard shall apply.

PART 2 GUIDELINES FOR THE CONSTRUCTION PHASE

2.01 GENERAL

A. This section shall describe certain conditions and requirements of the Town of Spring Hope concerning water and wastewater system extension construction which shall be addressed in all Contract Documents receiving the approval of the Town of Spring Hope.

2.02 PRECONSTRUCTION CONFERENCE

A. Prior to commencing any water or sewer replacement or extension construction work, the Town Engineer shall be contacted to schedule a preconstruction conference. No construction shall occur until after the preconstruction conference is

held. As a minimum, the Engineer and the Contractor shall attend the preconstruction conference.

2.03 UTILITIES LOCATION SERVICES

A. NC One Call Center shall be contacted a minimum of seventy-two (72) hours prior to any excavation. The utilities contacted shall have the opportunity to take the steps which they deem necessary to protect their utilities. The Contract Documents shall note that utilities location by NC One Call Center is not valid after the expiration of a ten (10) day period beginning on the date of such location.

2.04 NORMAL WORK HOURS

A. Unless approved otherwise by the Town of Spring Hope, all construction shall be performed during the regular office hours of Spring Hope, i.e., 8:00 a.m. to 5:00 p.m. After hours, holiday, or weekend work should include only such tasks that do not require observation by the Town's Representative. Under certain conditions, the Town of Spring Hope may agree to provide construction observation after hours or on weekends and holidays. The Contractor shall bear the costs of provision of such construction observation.

2.05 OPERATION OF EXISTING FACILITIES

A. The Contractor performing water or sewer extension work shall contact the Town Engineer or the Public Works Supervisor whenever operation of the Town of Spring Hope's valves or hydrants is necessary to request scheduling of such operation. The Town shall require the contractor to estimate the length of time service will be interrupted and the number of customers to be affected.

B. Facilities and equipment belonging to the Town of Spring Hope may not be operated or adjusted without the express permission of the Town's Representative. In the case of any emergency, the Contractor shall be allowed to take such steps with valves and hydrants as necessary for the protection of life and property.

C. Valves which control networks not yet accepted but which are connected to the existing system shall be considered system valves. Valves within a network not yet accepted and which do not control the flow of water between new and existing systems are not considered system valves and do not require permission to operate.

D. Notification to the Town of Spring Hope must be made by the Contractor upon breakage of any Spring Hope maintained water or sewer line or appurtenance thereof. Repair of the Town of Spring Hope's facilities shall be made by the Contractor upon approval of the Town Engineer. Any repairs made with Town of Spring Hope's forces will be billed to the Contractor at cost.

E. Where interruption of service is required, the Town of Spring Hope shall be notified to request approval and subsequent scheduling of such interruption. The Town shall notify the affected customers should the interruption be approved. A minimum (forty-eight) 48-hour notice shall be given to the affected customers.

2.06 QUALITY CONTROL

A. General

1. In order to ensure that water and sewer system replacements and extensions are constructed in accordance with the standards of the Town of Spring Hope; testing, inspection, and surveying for construction work shall meet the requirements set forth herein.

B. Materials Testing

1. All materials testing and testing equipment and procedures shall be in accordance with the applicable industry standards.

C. Inspection Services

1. The Developer shall provide complete engineering services, including design, survey and grade control, and construction observation. These services shall be rendered by competent, experienced, personnel with a clear understanding of the work at hand. The Town's Representative shall periodically observe the work while the construction is in progress. It shall not be the duty of the Town's Representative to supervise construction, establish grades, or to provide solutions to grade, construction, or design problems. The Developer shall ensure that the installation of the water or wastewater system extensions is in accordance with the approved Contract Documents. Failure of the Town's Representative to discover deficiencies at the time of construction shall not relieve the Developer of responsibility to correct such defects. Each construction crew of the Contractor shall always have a set of Contract Documents bearing the Town's stamp of approval at the project site.

D. Construction Staking

1. The Contract Documents shall require that construction staking be performed by a Registered Land Surveyor at least twenty-four (24) hours and three hundred feet (300') in advance of construction and shall identify the party responsible for payment for same.

2. The Drawings shall identify the permanent baseline and all references from which dimensions are to be measured. In addition, benchmarks shall be shown on the drawings as required by the Town of Spring Hope.

3. Staking

    a. The contract Documents shall require stakes or hubs at the following locations: Along the centerline of proposed water lines, at all points of horizontal curvature and tangency, and at maximum intervals of one hundred feet (100') in tangent sections and twenty-five (25') in curved sections.

    b. In addition to (1) above, the Town of Spring Hope reserves the right to require that the centerline of proposed water lines be marked by

a continuous paint stripe where there is concern for quality of work being provided.

c. At offsets out of the way of construction operations for each point on the centerline required by (1) above.

d. At all valves, fittings, hydrants, air release valves, cleanouts, water meters and other appurtenances. Such stakes shall have offsets out of the way of construction.

e. Hubs shall be provided for all pump station plot property or easement corners and at the wet well and valve vault locations.

f. Hubs shall be provided at all manhole locations. Each hub shall have a guard stake indicating the manhole number and station number and shall have an offset out of the way of construction.

g. The Contract Documents shall require the Contractor to stake the easement line location when requested to do so by the Town of Spring Hope.

2.07 PROJECT CLOSE-OUT

A. Pre-Final Inspection

1. Upon completion of construction, the Contractor or Developer shall contact the Town's Representative to schedule a pre-final inspection. At the scheduled pre-final inspection, the Town's Representative shall perform a visual inspection of the work in the presence of the Contractor. Any deficiencies discovered shall be recorded by the Town's Representative and the Contractor. Any defective items noted shall be corrected prior to the final inspection.

B. Final Inspection

1. Upon completion of the items on the pre-final punch list, the Contractor or Developer shall contact the Town of Spring Hope to schedule the final inspection. The final inspection will not be scheduled until the following requirements are met:

a. The work shall be in accordance with the requirements of the Town of Spring Hope.

b. A copy of the final estimate has been submitted and approved by the Town of Spring Hope.

c. The easements and dedicated property required for the work by this Manual have been obtained and are recorded at the Register of Deeds.

d. The as-built plans for the work have received the approval of the Town Engineer.

e. All fees applicable to the project have been received by the Town of Spring Hope.

f. When a project includes sewer system extensions, the Town of Spring Hope has received certification by a Professional Engineer stating that the sewer system installation conforms with the requirements of the approved Contract Documents as required by the DEQ regulations (G.S. 143-215.1).

g. When a project includes water system extensions, the Town of Spring Hope has received certification by a Professional Engineer stating that the water system installation conforms with the requirements of the approved Contract Documents as required by the DEQ regulations (G.S. 130A-315; 130A-317).

2. At the scheduled final inspection, the Pubic Works Director or his Designated Representative shall perform a visual inspection in the presence of representatives of the Contractor and the Engineer. The Engineer or his representative shall prepare a detailed punch list of any deficiencies discovered and provide copies to the Developer, Contractor, and the Town of Spring Hope. Any defective items noted shall be corrected prior to acceptance.

3. No service shall be provided prior to project acceptance.

C. As-Built Drawings

1. No Service shall be provided until after the as-built plans are reviewed and accepted. The initial submittal shall consist of two (2) prints. Upon approval, the Contractor shall submit to the Town either a mylar reproducible or a digital copy of the approved as-built drawings. One (1) print of the final as-built drawing shall also be provided. The as-built shall include both water and sewer combined on each drawing. The sewer as-built shall include plan and profile. The Contractor shall submit two (2) prints of the as-built drawings with each partial pay estimate to the Owner's engineer. The minimum sheet size for as-built drawings shall be 18” x 24”.

2. Town of Spring Hope shall require at least two (2) weeks from date of receipt to complete its review and a reasonable time for review of any resubmittals.

3. The scale for as-built plans shall be the same as that of the construction plans.

4. Revised construction plans are acceptable if standard drafting techniques and practices are followed.

5. If the project has developed in phases, all lines should be clearly indicated and the title block of the plan sheets shall indicate the phase number and section number (where applicable) and all building units/lots being served with the particular phase being submitted. Lots and building unit numbers must reflect the numbers that will later accompany the service application (request for service).

6. The as-built drawings shall show the location by station number, referenced to the downstream manhole, and the length of all services and shall indicate by lot, unit number or address of the unit which each connection will serve.
7. The plans shall indicate street names, pavement widths, rights-of-way, and easements.
8. Apartments, condominiums, and other developments with walkways and off-street parking shall have these facilities shown on the as-built drawings.
9. New water lines shall be located by horizontal dimensions from highly visible, permanent, fixed objects; such as the back of the street-curb and gutter, the edge of a walkway, street centerline, etc.
10. Valves shall each be located by reference to two (2) permanent, visible objects, such as right-of-way monuments, fire hydrants, manholes, catch basins, etc.
11. Indicate the type and size of each water line, sewer line, and service installed.
12. Station numbers identifying location of services, fittings, crossings, etc., shall begin at zero at each in-line valve. The distance between valves shall be shown.
13. Where more than one (1) type of material is used for water or sewer pipe, note the station of change from one material to another at the beginning of each change.
14. Designate on the as-built drawings if metallic detectable tape has been installed.
15. All appurtenances of water mains and force mains such as valve boxes and blow-offs shall be provided with station numbers. Indicate by station the location of all fittings for water mains and wastewater force mains.
16. Lengths of gravity sewer between manholes shall be shown on the drawings. The plan section should indicate lengths as measured horizontally between manhole centerlines. The profile section should indicate grades as measured from inside manhole wall to inside manhole wall (invert out to invert in).
17. The actual elevation, based on USGS datum only, of manhole tops, inverts (including services and taps) and the actual gravity sewer slopes shall be shown.
18. Sewer services are to be stationed from the center line of the downstream manhole ring and cover.
19. All privately owned sewer and water lines shall be indicated “as private”.
20. As-built drawings shall be prepared by and bear the seal and signature of a Professional Engineer.
21. The recorded plat or standard easement forms conveying easements and rights-of-way for the property to be served shall accompany the as-built

drawings. Drawings submitted without the required plat or easement document will be returned as incomplete.

2.08 WARRANTY

A. The Developer shall warrant the project work to be free of defects in materials and workmanship for a period of one (1) year from the date of the Town of Spring Hope's acceptance of the water or sewer system for permanent operation and maintenance.

PART 3 PREAMBLE TO WATER AND SEWER SYSTEMS

3.01 INITIAL CONFERENCE

A. Prior to finalizing any plans for water or wastewater system replacements or extensions, the Developer or his Engineer shall consult the Town Manager so that he may determine if an initial conference will be necessary prior to the submission of plans for approval. If the scope of the proposed development, in the opinion of the Town Manager, is such that an initial conference will be beneficial prior to the development of final plans and specifications, the Developer or his Engineer will request scheduling of an initial conference. The Developer or his Engineer shall present, at the time of this conference, conceptual schematics or layouts of the proposed extensions and the estimated water and wastewater demands resulting from the proposed development. The Developer or his Engineer shall also provide the Town of Spring Hope with all other information necessary to determine the probable effect of the proposed development on the Town of Spring Hope's existing facilities. This data shall include a projected cost estimate of the extensions, the nature of water usage (domestic, commercial, etc.), the probable character of the wastewater generated, a description of any proposed private water distribution and sewer collection systems, and other pertinent information.

B. The Town Manager and his staff will take into consideration the proposed plans and decide if, in the best interest of Spring Hope, the plan is satisfactory as presented, needs to be revised, or is not at the present time feasible.

3.02 PRE-APPLICATION PACKAGE

A. When required by the Town, the Engineer shall file a pre-application package with the Town Manager. The purpose of the pre-application package is to present to the Town Manager and his staff sufficient and detailed information concerning the proposed water and sewer extensions and to permit the determination of their compatibility with and impact upon the overall Town's water and wastewater systems. The pre-application package shall include the following information and any other information deemed necessary by the Town Manager and his staff to enable them to make a determination of the acceptability of the proposed plans. All information shall be submitted to the Town Manager and his staff in a package and not in a "piece-meal" manner. After review of the entire pre-application package, the Town Manager will advise the applicant if the proposed project is acceptable to the Town of Spring Hope.

1. Conceptual Plans

a. The applicant shall submit two (2) copies of subdivision plans or site plans at a scale of 1-inch equals 400 feet (or larger scale) showing the proposed layout of the water, and sewer extensions. The conceptual plans should show all proposed pipelines and sizes, manholes, valves, fire hydrants and pump stations and the nearest existing water and sewer facilities to which the proposed new extensions will connect. All proposed easements shall be shown.

2. Design

a. The applicant shall submit in his pre-application package preliminary engineering design calculations used to determine line and pump station sizes and fire protection requirements including expected initial and future populations to be served.

3. Estimated Time Schedules

a. The applicant shall submit in the pre-application package estimated time schedules identifying the expected dates of completion of the final plans and specifications and expected beginning and completion dates of construction.

4. Projected Cost Estimate

a. The applicant shall submit in the pre-application package a cost estimate prepared by an engineer for the proposed water and sewer extensions. The cost estimate shall be as detailed as possible with estimated quantities of specific items of work and their projected unit costs.

3.03 REQUIRED FEES AND CHARGES

A. The Developer and his Engineer shall thoroughly familiarize themselves with the fees and charges established by Spring Hope. Based upon the submittal of the pre-application package, the Town Manager and his staff shall determine and furnish the applicant in writing the estimated fees and charges relating to the proposed water and sewer extensions. The final value of the fees and charges will be determined by the Town Manager and his staff upon approval of the plans and specifications.

END OF INTRODUCTION

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SECTION 1

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 Section Includes

A. Work under this section includes, but is not limited to, piping, valves, fire hydrants, water service line, and appurtenances for a complete potable water distribution system.

B. The Engineer and Developer shall become familiar with the water extension policies of the Town of Spring Hope prior to making conceptual plans for developments which will require water service by the Town, and to the policy in regard to water replacements and extensions.

C. It shall be the responsibility of the Engineer or Developer to obtain the approval of the Town of Spring Hope Council for any proposed projects under their respective jurisdiction prior to submission of Contract Documents for Town approval.

D. The Developer or his selected Contractor shall provide assistance to the Town in notifying potential impacted customers as a result of the new and/or re-development project. Assistance shall be provided in placing door-hangers (either physically provided by the Town or instructions on content provided by the Town in writing) on all customers reasonably assumed to be impacted. Town will assist Developer in identifying customers.

1.02 Design Criteria and Permitting

A. The design of all public water system improvements, which are to become a part of the Town of Spring Hope's water distribution system, shall be in accordance with Title 15A Subchapter 18C of the North Carolina Administrative Code and the rules and policies of practice of the N.C. Department of Environment and Natural Resources' Public Water Supply Section. These rules and policies are consolidated in the publication "Engineering, Planning and Development Guidance Document".

B. Engineer/Developer shall prepare and submit all applicable permit applications required by federal, state and local authority. All fees are the responsibility of the Developer.

C. Water lines shall be installed in street rights-of-way or permanent easements. Minimum easement width shall be 20 feet.

D. Main line valves shall have the following maximum spacing:

Main Size	Maximum Spacing
2-inches	400 feet
4-inches	500 feet
6-inches	600 feet
8-inches	800 feet
12-inches	1,200 feet
16-inches	1,600 feet

E. Air valves shall be located at all high points along the water lines and at a spacing of approximately 2,500 feet on horizontal pipelines. Final locations to be approved by the Town.

1.03 References

A. Publications are referred to in the text by basic designation only.
   1. American Society of Sanitary Engineering (ASSE) Standards
      a. 1013 Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principal Fire Protection Backflow Preventers
      b. 1015 Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
      c. 1060 Outdoor Enclosures for Fluid Conveying Components
   2. American Society for Testing and Materials (ASTM)
      a. C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
      b. C478 Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
      c. C828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
      d. C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
      e. C923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
      f. D1784 Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
      g. D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
      h. D2241 Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
      i. D2466 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
      j. D2467 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
      k. D3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
      l. D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
      m. F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
      n. F1483 Standard Specification for Oriented Poly(Vinyl Chloride) PVCO, Pressure Pipe
   3. American Water Works Association (AWWA)
      a. B300 Hypochlorites
      b. B301 Liquid Chlorine
      c. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
      d. C105 Polyethylene Encasement for Ductile-Iron Pipe Systems
      e. C110 Ductile-Iron and Gray-Iron Fittings
      f. C115 Flanged Ductile-Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges

g. C150 Thickness Design of Ductile Iron Pipe
h. C151 Ductile-Iron Pipe, Centrifugally Cast
i. C153 Ductile-Iron Compact Fittings
j. C502 Dry-Barrel Fire Hydrants
k. C504 Rubber-Seated Butterfly Valves
l. C508 Swing-Check Valves for Waterworks Service, 2 inch through 48-inch NPS
m. C509 Resilient Seated Gate Valves for Water Supply Service
n. C510 Double Check Valve Backflow-Prevention Assembly
o. C511 Reduced-Pressure Principle Backflow-Prevention Assembly
p. C512 Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
q. C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
r. C550 Protective Interior Coatings for Valves and Hydrants
s. C600 Installation of Ductile Iron Water Mains and Their Appurtenances
t. C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
u. C651 Disinfecting Water Mains
v. C700 Cold-Water Meters-Displacement Type, Metal Alloy Main Case
w. C701 Cold-Water Meters-Turbine Type, for Customer Service
x. C702 Cold-Water Meters-Compound Type
y. C704 Propeller-Type Meters for Waterworks Applications
z. C800 Underground Service Line Valves and Fittings
aa. C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 60 inch
bb. C901 Polyethylene (PE) Pressure Pipe and Tubing, 3/4 inch through 3 inch, for Water Service
cc. C904 Cross-Linked Polyethylene (PEX) Pressure Tubing, ½ inch through 3 inch for water service
dd. C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 inch and larger
ee. M23 PVC Pipe – Design and Installation

4. National Sanitation Foundation (NSF) Standards
   a. 14 Plastic Piping Components and Related Materials
   b. 60 Drinking Water Treatment Chemicals – Health Effects
   c. 61 Drinking Water System Components - Health Effects
   d. 372 Drinking Water System Components – Lead Content

1.04 Submittals

A. Submit the following in accordance with Section, Submittal Procedures:
   1. Affidavit of Compliance: Affidavit shall attest that supplied products conform to the referenced standard and this specification and that all tests set forth in each applicable referenced publication have been performed and that all test requirements have been met. Submit for each of the following materials:
      a. Pipe and Fittings
         1) Ductile iron
         2) Polyvinyl Chloride (PVC)
            i) AWWA C900
            ii) Pressure rated

iii) Schedule 40 & 80
3) Copper pipe and tubing
4) Polyethylene (PE) pressure pipe and tubing
5) Cross-Linked Polyethylene (PEX) pressure tubing

b. Valves
1) Gate
i) Resilient-Seated
ii) Tapping
2) Butterfly
3) Check
4) Air release
5) Post indicator

c. Fire hydrants
d. Pre-cast concrete manholes
e. Service valves and fittings
1) Corporation valves
2) Meter setter with meter valve and check valve

f. Backflow prevention assembly
g. Meters

2. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Clearly indicate equipment to be furnished for the Project including options to be provided.

a. Pipe and Fittings
1) Ductile iron
2) Polyvinyl Chloride (PVC)
i) AWWA C900
ii) Pressure rated
iii) Schedule 40 & 80
3) Copper pipe and tubing
4) Polyethylene (PE) pressure pipe and tubing
5) Cross-Linked Polyethylene (PEX) pressure tubing

b. Valves
1) Gate
i) Resilient-Seated
ii) Tapping
2) Butterfly
3) Check
4) Air release
5) Post indicator

c. Pre-cast Concrete Manholes and appurtenances
1) Manhole steps
2) Pipe connectors
3) Joint material

d. Castings
e. Tapping sleeves
f. Valve boxes
1) Valve markers
2) Valve box collars

g. Fire hydrants
h. Service valves and fittings
1) Service saddles
2) Corporation valves

3) Brass fittings
4) Meter setter with meter valve and check valve
5) Meter box

i. Backflow prevention assembly(ies) and enclosure(s)
j. Fire Department Connection
k. Meters
l. Blowoff assembly
m. Pressure Gauge
n. Rodding

3. Reports:
   a. Field test report for each section of pipe for the following:
      1) Measured chlorine residual
      2) Bacteriological test
      3) Pressure test
   b. Field test report for each backflow prevention device.
4. Operation and Maintenance Instructions: Submit complete operation and maintenance manual for the following:
   a. Valves
   b. Fire hydrants
   c. Meters
   d. Backflow prevention assembly(ies)
   e. Other items as requested by the Town

1.05 Delivery, Storage, and Handling

A. Provide a suitable pipe hook and/or rope sling properly certified for the load when handling the pipe with a crane, excavator, or backhoe. Lifting of the pipe shall be done in a vertical plane. Under no conditions shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to both the tongue and groove ends.

B. Deliver pipe in the field as near as practicable to the place where it is to be installed. Distribute pipe along the side of the trench opposite to the spoil bank. Where necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe or coating.

C. Shield PVC pipe, PEX tubing and associated fittings stored on site from the sun's ultraviolet rays by suitable cover, or indoor storage.

1.06 Quality Assurance

A. All parts and materials incorporated into a project shall be new and unused.

B. Contractors must be licensed by the N.C. Licensing Board for General Contractors and have a classification and a cost limitation appropriate for the work to be performed.

1.07 Warranty

A. Line Work

1. Unless otherwise required, all materials and workmanship shall have a one-year warranty from the date of final acceptance by the Town. A warranty inspection will be made jointly by the Town and Contractor/Developer approximately eleven (11) months after acceptance to identify needed repairs. All labor, equipment

and materials needed to make these repairs shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.01 General

A. Products with surfaces intended to be in contact with the drinking water shall be certified and listed in accordance with NSF 61 for potable drinking water.

2.02 Ductile Iron Pipe

A. Pipe and fittings 3-inch to 64-inch shall conform to AWWA C150 and C151 and the following requirements:
   1. Size shall be as indicated on the Drawings.
   2. Minimum pipe pressure class shall be 350 with a Type 2 laying condition unless indicated otherwise on the Drawings. Minimum Pipe pressure class for mains greater than 12-inches shall be 250 with a Type 2 laying condition unless indicated otherwise on the drawings.
   3. Suitable for a system working pressure of 150 psi at the depth indicated on the Drawings with a laying condition as indicated in Section, Trenching for Utilities.
   4. Interior lining to be used in a drinking water system shall be certified and listed in accordance with NSF 61.
   5. Interior shall be lined with cement-mortar with seal coat in accordance with AWWA C104.

B. Ductile-iron pipe for below ground service shall have push-on or mechanical joints, conforming to AWWA C150 and C151, and to the following requirements, unless noted otherwise on the Drawings:
   1. Provide mechanical joint fittings.
   2. Encase pipe in polyethylene conforming to AWWA C105.

C. Ductile-iron pipe for above ground service shall have flanged joints, unless noted otherwise on the Drawings, conforming to AWWA C115.
   1. Pipes to be painted shall have only a shop primer on the outside by the manufacturer. Verify that proposed manufacturer's primer is compatible with the proposed paint system.

D. Fittings for ductile-iron pipe shall conform to AWWA C110, or C153 and to the following requirements:
   1. Joint type shall be as specified above for the supplied ductile-iron pipe.
   2. In lieu of exterior asphaltic coating and interior cement lining, fittings may be provided with a 6-8 mil nominal thickness fusion bonded epoxy coating inside and out in conformance with AWWA C550.
   3. Fittings shall be made of ductile-iron.

E. Gaskets shall be nitrile material for installation in areas as designated on the Drawings.

F. Ductile iron pipe on piers shall have Mech-Lok™ rigid restrained joint by U.S. Pipe Company or approved substitute.

G. Special Pipe Joints
   1. Restrained

a. Provide restrained joint pipe at fittings and valves on water mains. Length of restrained pipe shall be as indicated on the Drawings. Restrained joints shall be Flex Ring and Lok-Ring (American), TR Flex and HP Lok (U.S. Pipe) or approved equal.
b. Restrained joint pipe and fittings shall meet all AWWA standards and other requirements as specified above for standard ductile iron pipe and fittings unless addressed herein.
c. Field made joints may be considered allowable if approved by the Engineer, but should be avoided where possible. Careful planning to locate field cuts in standard pipe sections is preferred. For field made joints in restrained piping, use field weldments or an insert equal to TR Flex Gripper Rings or approved equal. Gasket type field made joints will not be allowed.
d. Restrained joint fittings shall be provided by the restrained joint pipe supplier where located within restrained joint pipe sections. Fittings shall be of the same model / type as the pipe supplied from the pipe manufacturer.
e. Restrained joint fittings may be push-on joint type.
f. Megalugs, Series 1100, as manufactured by EBAA Iron Sales or approved equal shall be allowable for restraint where fittings or valves are not available with restrained joints from the pipe manufacturer.
g. Where additional fittings/valves are required for pipes not shown on Drawings, consult with Engineer for length of restrained joint pipe necessary each side of fittings/valve prior to installation of pipe/fitting.
h. Tees for hydrants do not have to be restrained along the main line except where they are within required restrained length of nearby fittings or valves.
i. Contractor shall develop a field layout schedule and drawing for restrained joint pipe installations.

2.03 Polyvinyl Chloride (PVC) Pressure Pipe

A. General
1. Pipe and fitting size shall be as indicated on the Drawings.
2. PVC materials shall comply with ASTM D1784 with a cell classification of 12454.
3. Pipe shall be certified and listed for potable water distribution products in accordance with NSF 14 or 61 and bear the NSF seal on each section of pipe.
4. Pipe shall be blue in color for potable water use.
5. Pipe shall be white in color for raw water transmission use.

B. AWWA C900: C900 PVC pipe 4-inch to 60-inch shall conform to AWWA C900 and the following requirements:
1. Outside diameter shall conform to ductile-iron pipe.
2. Pipe shall be pressure class 235 with a standard dimension ratio of DR 18
3. Pipe shall have plain end and elastomeric-gasket bell ends.
4. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.

C. Pressure Rated: Pressure Rated (PR) PVC pipe 1-1/2-inch to 12-inch shall conform to ASTM D2241 and the following requirements:
1. Pipe shall be pressure rated 200 with a standard dimension ratio of SDR 21.
2. Pipe shall have an integral elastomeric-gasket bell end. The joints and gaskets shall comply with ASTM D3139 and ASTM F477.
3. Fittings for pipe 3-inch and larger shall conform to AWWA C110, or C153 and have mechanical joints with transition gaskets as required for the pipe outside

diameter. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.

D. Schedule 40 & 80: Schedule 40 & 80 PVC pipe 1/2-inch to 12-inch shall conform to ASTM D1785 and the following requirements:
   1. Outside diameter shall conform to iron pipe.
   2. Pipe shall be schedule 40 or 80.
   3. Pipe shall have an integral elastomeric-gasket bell end or solvent weld joints.
   4. Fittings for the pipe shall conform to ASTM D2466 or D2467 as appropriate for the pipe schedule.

2.04 Polyethylene Pressure Pipe and Tubing

A. Polyethylene pressure pipe and tubing, 1/2-inch through 3-inch, shall conform to AWWA 901 and the following requirements:
   1. The line shall be the size indicated on the Drawings and shall be polyethylene tubing.
   2. The line shall be made from material having standard PE code designation PE 3408.
   3. The line shall have a minimum pressure class of 160 psi with a dimension ratio (DR) of DR-9.

2.05 Cross-linked Polyethylene (pex)

A. PEX tubing, 1/2-inch through 3-inch, shall conform to AWWA C904 and the following requirements:
   1. The line shall be the size indicated on the Drawings and shall be PEX tubing and blue in color.
   2. The line shall be made from material having standard PEX code designation PEX 1306, or higher.
   3. The line shall have a minimum pressure class of 160 psi at 73°F and 100 psi at 180°F with a dimension ratio (DR) of DR-9.

2.06 Encasement Pipe

A. Encasement pipe installed under Town maintained and NCDOT maintained roadways shall be in accordance with NCDOT's "Policies and Procedures for Accommodating Utilities on Highway Rights-of-Way".

B. Encasement pipe installed under railroads shall be in accordance with "Part 5.3, Specifications for Pipelines Conveying Non-Flammable Substances" as developed by the American Railway Engineering Association (AREA).

C. Pipe materials used for the carrier pipe shall be adjusted as needed to meet the requirements of the roadway or railroad owners.

D. Pipe supports used in the encasement pipe designed and manufactured for the support of the carrier pipe shall be as follows:
   1. Band and Riser Material: 14 gauge steel for band and riser except if the riser is over 6-inches high, the steel shall be 10 gauge for riser. Riser shall be of the channel shape. Band with risers shall have a fusion bonded PVC coating of a minimum of 10-mil thickness. Band shall be bolted together with stainless steel bolts, nuts and washers.
   2. Band Liner: Provide PVC liner a minimum of 0.09 inches.

3. Runners: Glass Reinforced Polyester of UHMW Polymer plastic. Runner shall be a minimum of 1-inch wide and not more than 1-inch shorter than the bandwidth. Provide 2 top and 2 bottom runners for pipe sizes through 12-inches and 2 top and 4 bottom runners for pipes over 12-inches.

E. End seals installed on the encasement pipe may be a wrap around or a pull-on type. Seal shall be made of 1/8-inch thick synthetic rubber and shall be secured with stainless steel banding straps with worm gear tightening device.

2.07 Tapping Sleeve

A. Tapping Sleeve: Tapping sleeves shall be 304 stainless steel, flanged for the tapping valve and manufactured for a working pressure of 150 psi. Sleeve shall have a full body 360-degree gasket. Sleeve shall have a 3/4-inch test plug. Bolts and nuts shall be stainless steel.

2.08 Valves

A. General: Valves shall meet the following requirements:
   1. 12-inch and smaller valves shall be suitable for a working pressure of not less than 200 psi, and a minimum of 150 psi for valves greater than 12-inch.
   2. Open by **counterclockwise** (**Open Left**) rotation.
   3. Provide an interior protective epoxy coating in accordance with AWWA C550 on ferrous surfaces in contact with the liquid.
   4. Components in contact with the liquid shall be in compliance with NSF 61.
   5. Standard system working pressure is 150 psi.
   6. Equip valves with a suitable means of operation.
   7. Ends shall be mechanical joint for underground location and flanged joint for above ground location/underground utility vaults.
   8. For buried valves over 5 feet deep, provide extension stems of cold rolled steel to bring the operating nut to within 2 feet of the ground surface. Extension stems shall also be provided as required for floor stands and to floor valve box.
   9. Provide valve accessories as required for proper valve operation for valve locations as indicated on the Drawings and as recommended by valve manufacturer.
   10. Valves for the Town of Spring Hope shall be manufactured by Clow Corporation.

B. Gate Valves, Resilient-Seated: Gate valves 3-inch to 20-inch shall conform to AWWA C509 or AWWA C515 and to the following requirements:
   1. O-ring stem seal on non-rising (NRS) stem valves.
   2. Ends shall be mechanical joint for underground locations and flanged joint for above ground locations.
   3. Valves shall be non-rising stem (NRS) with wrench nut for underground locations and Outside Screw and Yoke (OS&Y) with handwheel for above ground locations unless noted otherwise on the Drawings.
   4. Valves 16-inch and larger shall be equipped with gearing to facilitate opening. Gear cases shall be enclosed type. Geared valves shall be equipped with indicators to show the position of the gate in relation to the water.
   5. Valves 16-inch and larger shall be equipped with a by-pass.
   6. Special material for bolts and nuts.

C. Tapping Valves: Tapping valves shall conform to the specifications for the gate valves as indicated in this Section and the following:
   1. Valve shall be specifically modified for the passage and clearance of the tapping machine cutter.
   2. The mating end to the tapping sleeve shall be raised male surface to provide true alignment to the sleeve and tapping machine. The valve shall be compatible with the tapping sleeve.

D. Butterfly Valves: Butterfly valves 3-inch through 72-inch shall conform to AWWA C504 for potable water and to the following requirements:
   1. Valve body shall be ductile iron and mechanical joint for below ground locations and flanged short body in underground vaults and above ground locations. End mechanical joints shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11. End flanges shall conform to ANSI B16.1, class 125 and ANSI/AWWA C110/21.10.
   2. Valves shall be class 150B.
   3. Rubber seats shall mate with stainless steel or nickel-copper alloy seat surfaces.
   4. Valve shafts shall consist of one-piece unit extending completely through the valve disc for valves under 12-inches. Above this size, shaft shall be one piece or the stub-shaft type. Shafts shall be type 304 stainless steel.
   5. Valve discs shall be cast iron, ductile iron, or stainless steel.
   6. Valve Actuator
      a. Manual Actuator: Manual actuator shall be of the traveling nut type. Valves for buried service shall have a standard AWWA nut. Valves for above ground shall have a handwheel, or chain wheel as indicated on the Drawings.

E. Swing-Check Valves: Swing-check valves 2 to 24-inch shall conform to AWWA C508 and to the following requirements:
   1. Provide lever and weight for swing check control.
   2. Metal to Metal seat construction.
   3. Ends shall be flanged.

2.09 Air Valves

A. Provide air valves in conformance with AWWA C512 and the following:
   1. Valve type shall be an Air Release valve.
      a. Inlet size: 2 inch
      b. Small orifice minimum: 1/8 inch
   2. Valve shall be designed for the following automatic operation:
      a. Release accumulated air while the main is in operation and under pressure.
   3. Valve shall be designed for a system pressure of 150 psi.
   4. Provide threaded inlet.
   5. Provide stainless steel ball float and wetted internal parts.
   6. Provide isolating bronze ball valve for connection to main line.

2.10 Manholes

A. Provide manholes made of precast concrete sections in conformance with ASTM C478, NC Department of Transportation, and the following requirements:
   1. General
      a. Provide manholes to the depth as indicated on the Drawings. Manhole inside diameter shall be 4 feet unless noted otherwise on the Drawings.

b. Precast concrete manholes shall be as manufactured by Oldcastle Infrastructure, Carr Precast Concrete, Inc., Carolina Pipe and Precast, Lindsay Precast, Mack Industries, Tindall Concrete Products, Inc. or approved substitute.

2. Precast Concrete Sections
   a. Minimum wall thickness shall be 5-inches.
   b. Base: Cast monolithically without construction joints or with an approved PVC waterstop in the cold joint between the base slab and the walls. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness.
   c. Riser: Minimum lay length of 16 inches.
   d. Eccentric Cone: Top inside diameter shall be 24 inches. Width of the top ledge shall be no less than the wall thickness required for the cone section.
   e. Transition Cone: Provide an eccentric transition from 60-inch and larger manholes to 48-inch diameter risers, cones, and flat slab top sections. Minimum slope angle for the cone wall shall be 45 degrees.
   f. Transition Top: Provide an eccentric transition from 60-inch and larger manholes to 48-inch diameter risers, cones, and flat slab top sections. Transition Top sections shall be furnished with vents as shown on the manhole details. The maximum amount of fill over the transition top section shall be 20 feet. Transition Tops shall not be used in areas subject to vehicle traffic.
   g. Flat Slab Top: Designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops shall be sized to fit within the manhole ID and the top and bottom surfaces. Provide a float finish for exterior slab surface.
   h. Precast or core holes for pipe connections. Diameter of hole shall not exceed outside diameter of pipe by more than 3-inches.
   i. Grade Rings: May be used to adjust ring and covers to finished grade. No more than 12 vertical inches of grade rings will be allowed per manhole. Grade Rings shall be no less than 4 inches in height.
   j. Lifting Devices: Devices for handling precast components shall be provided by the precast manufacturer and comply with OSHA Standard 1926.704.
3. Joints
   a. Manufacturer in accordance with tolerance requirements of ASTM C 990 for butyl type joints.
   b. Minimize number of joints. Do not use riser section for manholes up to 6 feet tall and no more than one riser for each additional 4 feet in height.
   c. Flexible Joint Sealants: Provide preformed butyl rubber-based sealant material conforming to Federal Specification SS-S-210A, Type B - Butyl Rubber or O-ring rubber gasket conforming to ASTM C443.
4. Flexible Pipe Connectors:
   a. Provide flexible connectors for pipe to manhole that conform to ASTM C923. Location of connectors shall vary from Project Drawings no more than 1/2-inch vertically and 5 degrees horizontally.
   b. Provide stainless steel pipe clamp type ban around flexible connection to water pipe.
5. Manhole Steps:
   a. Steps shall be made of 1/2-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.

b. Secure steps to the wall with compression fit in tapered holes or cast-in-place. Align steps along a vertical wall and shall not be located over a pipe opening. First step shall be a maximum of 26 inches from the bottom.
c. Steps shall be by American Step Co., Inc., Bowco Industries, Inc., M. A. Industries, Inc. or approved substitute.

2.11 Castings

A. General
1. Made of gray iron, ASTM A-48 - class 30, or ductile iron, ASTM A536, grade 65-45-12.
2. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16 inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame.
3. Castings shall be as manufactured by Neenah Foundry Co., U.S. Foundry & Manufacturing Corp., Vulcan Foundry, or approved equal.

B. Manhole Ring and Cover:
1. Minimum clear opening shall be 22 inches.
2. Minimum weight for frame and cover shall be 300 pounds and suitable for Heavy Duty Highway Traffic Loads of H-20.
3. Frame shall have four 3/8-inch anchor bolt holes equally spaced.
4. "Water" shall be cast on the cover as appropriate. Casting shall bear the name of the manufacturer and the part number.
5. Provide solid cover.
6. Provide cover with two 1-inch perforated holes unless noted as watertight on the Drawings.
7. Provide the following where indicated on the Drawings:
a. Ring and cover shall be watertight.
b. Bolt down cover. Bolt down covers shall be provided with four (4) 3/8-inch stainless steel hex head bolts at 90 degrees.

2.12 Valve Accessories

A. Valve Box, Below Ground: Boxes shall be high strength cast iron of the screw or telescopic type. Box shall consist of a flare base section, center extension as required, and a top section with the word “WATER” cast in the cover. Length of box shall be such that full extension of box is not required at the depth of water main cover. Valve Boxes shall consist of no more than two sections; dis-similar materials (such as PVC pipe) are not permitted for deep installations

B. Extension Stem (if necessary): Stem shall be sized so as to transmit full torque from the operating mechanism to the valve stem without binding, twisting, or bending. Stem shall be made from extra heavy steel pipe . Stem shall be complete with couplings for connection to valve and floor stand where required. When valve extension kits are used they must be as recommended by the valve manufacturer.

2.13 Indicator Post

A. Indicator post shall be made of carbon steel or ductile iron. Post shall be UL Listed and FM approved. Design shall allow for the addition of a supervisory switch. The operating wrench shall be easily removed by Owner. Wrench shall also be able to be locked to the post with a padlock (owner supplied) to prevent unauthorized operation.

B. Post Indicator shall be the vertical type, having two large window openings covered with a heavy clear plexiglass at the post top. Aluminum target plates shall be provided with the words OPEN and SHUT cast in large, easy-to-read, raised letters located directly behind each window.

C. Stem, indicators and working parts shall be fully protected from moisture and weather damage by complete enclosure.

D. Operating nuts shall be 1-1/4 inches square. Provide wrench with the indicator post.

E. Provide tamper switch to allow for connection to building security system. Gate valve tamper switches shall be installed on valve in accordance with manufacturer's instructions. The mechanism shall be contained in a weatherproof die cast aluminum housing, which shall provide a 3/4 inch tapped conduit entrance and incorporate the necessary facilities for attachment to the valve. Switch housings shall be finished in red baked enamel. Switch mechanism shall have a minimum rated capacity of one amp, 125 volt AC - .25 amp. 24 volt DC. Assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting. Gate valve switches shall be Underwriter's Laboratories listed and Factory Mutual approved. Provide and turn over to Owner a wrench for tamper boxes.

2.14 Service Valves and Fittings

A. Water service valves and fittings shall conform NSF 61 and AWWA C800 for normal pressure and the following requirements:
   1. For services connecting to the new or existing main on the opposite side of roadway centerline from customer, conduit shall be 2-inch until the meter box.
   2. Service valves and fittings shall conform to Owner's standards. If Owner's standards conflicts with these specifications, consult with Engineer before proceeding.
   3. Service saddle: Provide service saddle for service pipe connection to main pipe material. Saddles shall meet the following requirements:
      a. Brass body to conform to the outside dimension of the main.
      b. O-ring, Buna N rubber gasket to provide watertight connection.
      c. Hinged, double bottom strap design.
      d. Threaded outlet to match threads on corporation valve.
   4. Corporation valve
      a. Stop size shall be the same as service line.
      b. Inlet thread shall be as per AWWA C800.
      c. Outlet thread shall be as required for the pipe material specified.
   5. Pressure reducing valve
      a. Shall meet ASSE 1003.
      b. Bronze body, renewable stainless steel seat.
      c. Suitable for reducing from an inlet pressure range of 100 – 150 psi to an outlet pressure of 40 psi.
   6. Meter boxes
      a. Boxes and cover shall be cast iron
      b. Minimum 18 inches deep.
      c. Sized for required water meter.
   7. Meter setter
      a. Setter shall be made of copper and compatible with the Owner's meter and other fittings to be supplied.
      b. Setter shall have a meter valve on the public side of the meter. Valve shall be O-ring sealed and capable of being locked in the closed position. Setter

shall have an ASSE approved dual check valve on the private side of the meter.

2.15 Fire Hydrants

A. Fire hydrants shall conform to AWWA C502 and to the following requirements:

1. Nozzles: Two (2) 2-1/2-inch hose and One (1) 4-1/2-inch pumper connections
1. Nozzles: Two (2) 2-1/2-inch hose and One (1) Storz Nozzle quarter turn pumper connections
2. Nozzle threads: “Spring Hope Standard”.
3. Main valve diameter: 5-1/4- or 4-1/2 inch.
4. Minimum depth of bury: 42-inches.
5. Inlet connection: 6-inch mechanical joint.
6. Open **counterclockwise (open left)**.
7. Close with water pressure.
8. O-ring seals
9. Traffic model with frangible sections near the ground line designed to break on impact.
10. Provide extension for hydrant standpipe as required to set centerline of hydrant nozzle a minimum of 15-inches and a maximum of 24-inches.
11. Exterior color above ground line shall match Owners.
12. Hydrants shall be manufactured by Kupferle, Clow, Mueller, or American Darling.

2.16 Post Hydrants

A. Blow-offs for 4-inch and smaller water mains shall be constructed by use of iron bodied self-draining, non-freezing post hydrants similar to fire hydrants except smaller and easily discernible from true fire hydrants due to their size and paint color. The post hydrant shall be equipped with at least a 2-3/16-inch valve opening with a mechanical joint base elbow of size equal to the branch piping to which it is connected. The barrel size shall be 3 inches with a 1-15/16-inch single nozzle (National Standard threads) and a tamper proof recessed pentagon operating nut. Internal operating parts shall be of brass or stainless steel with the valve assembly removable by withdrawal through the hydrant barrel leaving the hydrant in place. Hydrant shall be designed so that no excavation or extension wrenches are required to accomplish valve removal. Hydrants shall be equipped with a traffic breakaway feature and shall receive thrust blocking and crushed stone at the shoe as shown on the details for hydrant installation. Exposed exterior surfaces shall be safety yellow to contrast with the coloration of fire hydrants. Post hydrants shall be Kupferle Foundry Company Eclipse No. 2 or equivalent item manufactured by American Flow Control or Mueller.

2.17 Backflow Prevention Assembly

A. General

1. All water services shall be provided with a means of backflow prevention. The type of device will either be a Dual Check (DC) Valve, Dual Check Valve Assembly (DCVA) with test assembly, or a Reduced Pressure Zone Assembly (RPZ) with test assembly and dump port. The type of device used will generally be dependent on the Degree of Hazard posed by the customer being served.

Engineer/Developer shall coordinate with the Town to determine the type of device required.

2. Examples of the various Degrees of Hazards and required backflow devices are as follows:
   a. Low Hazard: Any of the following or similar uses unless the use includes a use clearly identified as a higher hazard. These activities shall have a minimum of a Dual Check Valve (DC) installed at the meter service two (2) inches or less.
      1) Two-family residential homes (duplexes).
      2) Multi-family residential units.
      3) Duplexes that have a master meter.
      4) Office buildings.
      5) Retail stores with only one (1) meter under two (2") inches in diameter.
      6) Warehousing (detached and with only restrooms).
      7) Churches (with only restrooms).
   b. Moderate Hazard: Any of the following or similar uses unless the use includes a use clearly identified as a higher hazard. The following is a partial list of facilities, activities and processes which require the installation of an approved Double Check Valve Assembly (DCVA).
      1) A private water system or building, any portion of which is elevated less than 50 feet above any service connection between such private water system and the public water system.
      2) Beauty shops/barber shops.
      3) Fire sprinkler or standpipe systems without chemical additives without booster pumps. Fire lines shall also include a properly sized water meter with shut off valves.
      4) Gas stations (with no food preparation).
      5) Industrial or manufacturing facilities (that do not include a high hazard).
      6) Apartment houses or complexes that have a master meter.
      7) Mobile home parks/Manufactured home parks.
      8) Restaurants, bakeries, commercial kitchens or convenience stores with food service with no water supplied fire suppression system.
      9) Churches (with kitchen facilities).
   c. High Hazard: Any of the following uses. The following is a partial list of facilities, activities and processes which require the installation of a Reduced Pressure Zone Assembly (RPZ).
      1) Any private water system used or designed for use with a booster pump or which may become pressurized for any reason to the extent that backpressure may occur.
      2) Any service connection having irrigation tied in (irrigation not on a separate tap) including residential irrigation systems.

3) Any private water system which contains water which has been or is being recirculated.
4) Connection of a non-potable water use (fire lines, fire suppression systems, irrigation systems, cooling towers, auxiliary water supplies, used water, etc.) to a potable water supply.
5) A private water system or building any portion of which is elevated 50 feet or more above any service connection between such private water system and the public water system.
6) Automotive plans and service bays.
7) Beverage bottling plants.
8) Breweries.
9) Campgrounds, RV parks.
10) Canneries, packing houses and other rendering houses.
11) Commercial carwashes.
12) Chemical plants.
13) Churches (containing a baptismal or operating a multi-functional facility).
14) Commercial greenhouses.
15) Commercial laundries.
16) Concrete/asphalt plants.
17) Dairies and cold storage plants.
18) Dentist offices.
19) Dry cleaning.
20) Dye works.
21) Morgues, mortuaries, and embalming facilities.
22) Film laboratories.
23) Fire sprinkler or standpipe systems with chemical additives.
24) Hospitals, clinics, medical buildings.
25) Hotels, apartment houses, public and private buildings or structures 50 feet or more in height.
26) Industrial facilities that utilize water in their industrial process.
27) In-ground irrigation systems, with or without chemical additives.
28) Laboratories.
29) Law care companies.
30) Malls, strip malls, or multi-tenant strip malls (frequent tenant change and photo labs, etc.) that are master metered.
31) Master metered buildings or facilities with multi-use tenants.
32) Metal processing plants.
33) Nursing homes
34) Oil and gas production, storage or transmission properties.
35) Paper and paper products plants.

36) Pest control (exterminating and fumigating).
37) Pharmaceutical plants.
38) Photo labs.
39) Plating plants.
40) Power plants.
41) Radioactive materials or substances, plants or facilities handling.
42) Restaurants, bakeries, commercial kitchens, convenience stores with food services, any of which have water-supplied fire suppression systems.
43) Rubber plants (natural or synthetic).
44) Sand and gravel plants.
45) Schools and colleges.
46) Swimming pools, spas, hot tubs, with fixed water lines.
47) Tanks or reservoirs filled by water from public water supply.
48) Tire manufacturers.
49) Truck wash facilities.
50) Veterinary hospitals, clinics, offices.
51) Wastewater treatment plants, lift stations, and storm drain facilities.
52) Waterfront facilities and industries.

B. Backflow prevention assemblies shall conform to USC Foundation for Cross Connection Control and Hydraulic Research and to the following requirements:
   1. Dual Check Valve (DC) shall meet the requirements of ASSE Std. #1024.
   2. The size and type shall be as indicated by the Degrees of Hazard as approved by the Town.
   3. Double Check Valve Assembly (DCVA) in conformance with AWWA C510 and ASSE 1015.
   4. Reduced Pressure Zone Assembly (RPZ) in conformance with AWWA C511 and ASSE 1013.
   5. Assembly unit shall include a flow Detector consisting of an auxiliary line with an approved backflow preventer and water meter. Flow detector assembly shall comply with ASSE 1047 or 1048.
   6. Service shall be for cold water.
   7. End connection shall be threaded or flanged.
   8. Assembly shut-off valves shall be:
      a. 2-inch and under: 1/4 turn, full port, resilient seated, bronze ball valve.
      b. Over 2-inch: OS&Y resilient seated gate valves.
   9. Valves shall be internally epoxy coated in accordance with AWWA C550.

2.18 Backflow Preventer Enclosures

A. Enclosures for backflow preventers (BFP) shall meet the following requirements:
   1. Aluminum or fiberglass reinforced construction sized to totally enclose “wet” portion of BFP.
   2. Provide access through lockable doors or hinged lid for testing of BFP.
   3. Shall be totally removable for maintenance of BFP.
   4. Lined with unicellular, non-wicking, insulation.
   5. Provide thermostatically controlled heat source within enclosure to provide freeze protection to minus 30 degrees F.
   6. For enclosure of reduced pressure zone BFP provide drain openings at each end to accommodate full port discharge form device. Openings shall be protected against intrusion of wind, debris, and animals.
   7. Provide means of permanent anchor to concrete pad.

2.19 Meters

A. All meters shall be manufactured by Neptune Technology Group.

B. Displacement Type Meters: Displacement type meters shall conform to AWWA C700 and to the following requirements:
   1. Meter size shall be as indicated on the Drawings.
   2. Meter ends shall match pipe fittings.
   3. Provide magnetic drive with sealed gear housing.
   4. Totalizer shall have:
      a. 4-inch dial reading in gallons
      b. Six-digit totalizer
   5. Must be capable of remote readout to match Owner’s existing system.

C. Turbine Meters: Turbine meters shall conform to AWWA C701 and to the following requirements:
   1. Class meter: II
   2. Meter size shall be as indicated on the Drawings.
   3. Meter ends shall match pipe fittings.
   4. Provide magnetic drive with sealed gear housing.
   5. Flow tube shall be cast iron with 2 mil epoxy coating.
   6. Register shall have:
      a. Direct reading six-digit totalizer reading in gallons.
      b. Circular test dial
      c. Must be capable of remote readout to match Owner’s existing system.

D. Compound Meters: Compound meters shall conform to AWWA C702 and to the following requirements:
   1. Meter size shall be as indicated on the Drawings.
   2. Meter ends shall match pipe fittings.
   3. Provide magnetic drive with sealed gear housing.
   4. Main casing shall be cast iron.
   5. Totalizer shall have:
      a. 4-inch dial reading in gallons
      b. Six-digit totalizer
      c. Circular test dial
      d. Must be capable of remote readout to match Owner’s existing system.

2.20 Pressure Gauge

A. Pressure gauge shall meet the following requirements:
   1. Use: Pressure reading locally for as shown in drawings.
   2. Liquid fill: Glycerin
   3. Dial: White aluminum with black markings.
   4. Dial size: 4 ½ inch minimum.
   5. Tube material: Bronze or Stainless Steel.
   6. Case & Ring: Aluminum
   7. Accuracy: 1/2 % of full scale.
   8. Stem connection: Lower.
   9. Gauge reading: Combination reading in psi and feet of water (ft) with range of 0 – 200 (460).
   10. Equipped with a stopcock.
   11. Mounted vertically on piping.

B. Provide a ¼ inch tap at locations shown on Drawings for each pressure gauge required.

2.21 Thrust Blocking

A. Provide concrete thrust blocking in accordance with the detail on the Drawings.

B. Thrust blocking is not required where restrained joint fittings and equivalent length of restrained joint pipe are used unless shown otherwise on the Drawings.

2.22 Disinfectant

A. The following products may be used as the disinfectant:
   1. Chlorine, liquid: AWWA B301.
   2. Hypochlorite, calcium and sodium: AWWA B300.

2.23 Detectable Marking Tape

A. A three-inch wide 0.5 millimeter thickness detectable marking tape shall be installed over all PVC pipelines. The top shall be clearly marked "water main" and shall be centered over the main twelve inches below finished grade. Any breaks in the tape shall be repaired in accordance with the manufacturer's recommendations.

B. Tape shall be by Blackburn Manufacturing, Joseph G. Pollard Co., or Reef Industries Inc.

2.24 Tracer Wire

A. Tracer wire shall be #12 wire.

B. Splices in tracer wire are to be kept minimum and joined with copper split nuts of appropriate size.

PART 3 EXECUTION

3.01 Pipes and Accessories

A. GENERAL

1. Provide erosion control measures as required. Erosion control measures including seeding and mulching shall be designed, installed and maintained in accordance with the N.C. Department of Environment and Natural Resources, Land Quality Section's "Erosion and Sediment Control Planning and Design Manual". The Developer/Engineer is responsible for securing all required permits.
2. Pipe installation shall meet the following general guidelines:
    a. Lay pipe in the presence of a representative of the Town, unless specifically approved otherwise.
    b. Handle pipe and accessories in accordance with manufacturer's recommendations. Take particular care not to damage pipe coatings.
    c. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
    d. Lay pipe to grade and alignment indicated on the Drawings.
    e. Provide proper equipment for lowering pipe into trench.
    f. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
    g. Provide tight closure pipe ends when work is not in progress.
    h. Keep pipe interior free of foreign materials.
    i. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.
    j. Disinfection of pipe during installation:
        1) Soak gaskets for minimum of one hour in a 50 - 100 ppm hypochlorite solution prior to installation.
        2) Mop bells and spigots of pipe, fittings and valves with a 50 - 100 ppm hypochlorite solution immediately prior to making joints.
    k. Block fittings with concrete, or restrain as indicated on the Drawings or as required to prevent movement.

B. Trenching for underground pipe installation

1. Definitions
    a. Backfill: A specified material used in filling the excavated trench and placed at a specified degree of compaction.
        1) 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.
            i) 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.
            ii) 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 noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.

iii) 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 included in this class.
iv) 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.
v) 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.

2) Backfill Zones: Each backfill zone shall extend the full width of the trench bottom.
i) Foundation: Extending down from the bottom of bedding zone as defined below.
ii) Pipe Embedment
a. Bedding: Extending from 4 inches below the pipe bottom to the pipe bottom for 30-inch diameter and smaller and 6 inches below the pipe bottom for pipes larger than 30 inches in diameter.
b. Haunching: Extending from the bedding (bottom of the pipe) to the pipe spring line.
c. Initial Backfill: Extending from the haunching (pipe spring line) to 1 foot above the top of the pipe.
iii) Final Backfill: Extending from the initial backfill to the finish ground elevation.

b. Laying Conditions:
1) Type 1: Flat bottom trench with loose backfill.
2) Type 2: Flat bottom trench with backfill lightly consolidated to centerline of pipe.
3) Type 3: Pipe bedded in 4 inches minimum of loose soil and backfill lightly consolidated to top of pipe.
4) Type 4: Pipe bedded on Class I material to 1/8 pipe diameter (4 inch minimum) Backfill compacted to top of pipe a minimum of 80 percent of standard proctor.
5) Type 5: Pipe bedded in compacted Class I material to pipe centerline with 4-inch minimum under pipe. Backfill to top of pipe with Class I, II, or III and compact to 90 percent of standard proctor.

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 test 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 is not included in the definition of "rock" but which may require the use of heavy excavation equipment with ripper teeth. Amount must exceed 1 cubic yard in volume. Material having a standard penetration resistance as determined by ASTM D1586 between 60 and 150 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 without the systematic drilling and blasting exceeding 1 cubic yard in volume. Material

having a standard penetration resistance as determined by ASTM D1586 greater than 150 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. Pipe Springline: A line running horizontally through the center of the pipe.

i. 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.

2. Products

a. Stone

1) Class I material shall be #67 or #78M stone in accordance with NCDOT specifications Section 1005, General Requirements for Aggregate.

b. Warning and Identification Tape

1) Tape shall be a minimum 3-inch wide polyethylene plastic tape manufactured specifically for identification of buried utilities with means of enabling detection by a metal detector to a minimum depth of 3 feet. Tape shall be color coded and continuously imprinted with warning and identification markings in bold black letters to read "CAUTION - BURIED (utility) LINE BELOW." Color and printing shall be permanent, unaffected by moisture or soil and shall be as follows:

UTILITY	COLOR	MARKING
Water	Blue	Caution - Buried Water Line Below
Gravity Sewer	Green	Caution - Buried Sewer Line Below
Force Main	Green	Caution - Buried Force Main Below
Electric	Red	Caution - Buried Electric Line Below
Gas	Yellow	Caution - Buried Gas Line Below
Telephone	Orange	Caution - Buried Telephone Line Below
SCADA	Orange	Caution - Buried SCADA Line Below

2) Tape shall be by Blackburn Manufacturing, Joseph G. Pollard Co., or Reef Industries Inc.

c. Tracer Wire

1) Tracer wire shall be #12 solid copper wire. All connections shall be by wire nuts and taped.

2) Splices in tracer wire are to be kept to a minimum and joined with copper split nuts of appropriate size.

3. Project Safety

a. Contractor is responsible for Project safety.

b. Perform work in conformance with applicable State and Federal safety regulations including, but not limited, to the following:

1) North Carolina Safety and Health Standards for the Construction Industry (29CFR 1926 Subpart P).

2) NC OSHA Industry Guide No. 14, Excavations.

3) NC OSHA Industry Guide No. 20, Crane Safety.

c. Provide barriers, warning lights, and other protective devices at excavations as necessary for safety of workers and the public.

d. Provide sloping of bank, shoring, sheeting, or other means of maintaining the stability of the trench in accordance with the requirements of the Associated Contractor's Manual of Accident Prevention OSHA, Part 1926.P.

4. Protection of Underground Facilities
   a. Investigate underground facility location prior to start of construction.
   b. Installer is required to contact North Carolina 811 prior to start of construction.
   c. Repair damage to any existing facilities.
5. Water Control
   a. Prevent surface water from entering the trench.
   b. When trench bottom is below the existing ground water table, install a dewatering system to maintain water table 1 (one) foot below trench bottom. Provide a man experienced in dewatering work at the job site.
   c. Maintain dewatering until backfilling has proceeded above the existing ground water level.
   d. Dispose of water from dewatering operations in accordance with the North Carolina Sedimentation Pollution Control Act.
6. Use of Explosives
   a. Explosives may not be used on any excavation unless specifically approved by the Town.
7. Excavating
   a. Excavation shall be by open cut method. 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. Contractor shall segregate excavated material so as to maintain material suitable for backfill separate from material that is unsuitable.
   d. Trench dimensions at the pipe embedment and foundation zone unless noted otherwise shall be as follows:
      1) Minimum width: Pipe outside diameter plus 18 inches.
      2) Maximum width: Pipe outside diameter plus 24 inches.
      3) Sides shall be vertical to a minimum of one foot above the top of pipe.
   e. Shape trench bedding to provide uniform bearing for the full pipe length. Bottom shall be free of protrusions that could cause point loading on pipe. Provide bell holes as required for properly making pipe joint.
   f. Do not over excavate. Excavation below grade shall be backfilled with Class I material.
   g. Undercut soils that become unsatisfactory by construction activity or by being left exposed to the weather and backfill with Class I material.
   h. Remove shoring, bracing, and sheeting, unless otherwise noted, as the trench is backfilled.
   i. Excavation of trench shall not advance more than 200 feet ahead of the installation. In no case should the excavation extend beyond that which can be backfilled by the end of the workday.
   j. Correct unstable soil conditions encountered at trench foundation by one of the following methods:
      1) Excavate below grade as approved by Engineer and backfill with Class I material or approved substitute material.
   k. Rock and Hard Material

1) Excavate rock and hard material to a minimum depth of 4 inches below the pipe for pipes smaller than 30 inches and 6 inches for pipes 30 inches and larger.

l. Pressure Lines:
   1) Provide a minimum 3 feet of cover.
   2) Excavate trenches to provide vertical curve chords that will not exceed the pipe manufacturer's recommended joint deflection.
   3) Provide concrete thrust blocks having a compressive strength of 3,000 psi at 28 days at change in horizontal and vertical direction and reduction in the pipe size, unless other restraint systems are approved. Cut trench sides vertical and square to receive concrete. Provide bearing area against trench wall as indicated in the Standard Detail.

8. Backfilling
   a. General
      1) Temperature must be above freezing and rising.
      2) In windy, hot, or arid conditions with a high rate of evaporation add moisture to the material to maintain the optimum moisture content.
      3) Do not proceed in rain or on saturated subgrade.
      4) Do not place material on surfaces that are muddy, frozen, or contain frost.
      5) Maintain backfill operation within 200 feet from pipe laying operation.
      6) Backfill trench to existing ground surface with select excavated material at the specified compaction.
      7) If excavated material is unsuitable to obtain specified compaction, provide suitable off-site borrow material for backfill.
      8) Re-excavate trenches improperly compacted. Backfill and compact as specified.
      9) Provide appropriate tamping equipment, and water to obtain proper moisture content, to achieve specified compaction of backfill.
      10) Conduct operation of heavy equipment above pipe installation as to prevent damage to pipe.
      11) Install warning / identification tape over utilities. Bury tape one foot below finished grade above the utility.
      12) Install tracer wire for non-metallic pressure pipe. Bury tracer wire with pipe. Wire shall be looped into valve boxes to allow access for direct contact location.
   b. Backfill in pipe embedment zone (bedding, haunching, and initial backfill).
      1) General
         i) Backfill with material as specified below. Material shall be free from objects larger than 2 inches.
         ii) Where rock and hard material has been excavated below pipe bottom, backfill and compact bedding with Class I material. Class II or III material may be used for bedding with Engineer's approval.
         iii) Place backfill material to assure placement of material under pipe haunches.
         iv) Take care during placement and compacting of material to avoid movement of pipe.
      2) Place backfill in bedding and haunching zones in 6 inch maximum lifts and compact to 90 percent density. Place initial backfill in one lift do not compact. Provide backfill material in pipe embedment zone as specified below.
         i) Pressure Lines (Flexible and Rigid Pipe)

a. Excavation in Class I, Class II, and Class III soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.
b. Excavation in Class IV or Class V, 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. Backfill with Class I, II, or III material in initial backfill.
c. Ductile Iron over 16 inch
i. Depth 0 - 12 feet: Type 2 laying conditions same as for pressure pipe.
ii. Depth over 12 feet: Provide Class I material for bedding and 4 inches up from bottom of pipe.

c. Final Backfill
1) Backfill with materials free of stones and free of debris larger than 6 inches in dimension. Place backfill in lifts not exceeding the thickness and compacted to the minimum density specified below.
2) 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.
3) Lifts and density:
i) Undeveloped areas (i.e., forests, fields, and, croplands): 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.
ii) Lawns: Backfill in 12-inch lifts and compact to 90 percent. Top 12 inches shall be free of material with a dimension over 2 inches.
iii) Roads (including Rights-of-way), drives, parking areas (including areas within 20 feet), and adjacent to existing utilities: Backfill in 6 inch lifts compact to 95 percent.
iv) Within 20 feet of foundations: Backfill in 6-inch lifts compacted to 95 percent.

d. Utility Structures: Bring backfill to grade in even lifts on all sides. Lift depths and compaction densities shall be as specified according to area of installation for pipe above. Backfill against cast-in-place concrete structure only after concrete has attained the specified 28-day compressive strength.

3.02 Relation of Water Mains to Sewers

A. Lateral Separation: Lay water mains at least 10 feet laterally from existing and proposed sewers. Where existing conditions prevent a 10-foot lateral separation, the following shall be followed with approval of the Engineer:
1. Lay water main in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.
2. Lay water main in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

B. Crossing Separation: Lay bottom of water main at least 18-inches above the top of the sewer. Where existing conditions prevent an 18-inch vertical separation, construct

both the water main and sewer of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

C. Crossing a Water Main Under a Sewer: When it is necessary for a water main to cross under a sewer, construct both the water main and the sewer of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

3.03 Water Service

A. Water service lines shall extend from the main distribution line [to a meter box located at the right-of-way] or [to a point approximately 5 feet outside the building face].

B. 3/4-inch water service lines may be direct tapped to ductile iron pipe. Water service taps larger than 3/4-inch shall be made using a service saddle.

C. Long side water services shall be installed using 2-inch conduit.

D. Taps shall be located at 10 or 2 o'clock on the circumference of the pipe.

E. Service taps shall be staggered, alternating from one side of the water main to the other and at least 12 inches apart.

F. Taps on the same side of the main shall be a minimum of 24 inches apart.

G. Taps shall be minimum 18 inches from any pipe joint.

H. Service line piping shall be one continuous line with no intermediate couplings.

I. Install meter boxes and water service components so top of meter will be within 6 inches of the surface.

J. Meter box lids shall have a factory fabricated conduit for radio read.

K. Owner will provide and install water meter.

3.04 Ductile Iron Pipe

A. Install pipe in conformance with AWWA C600 and the following:
   1. For laying pipe in a vertical or horizontal curve, each full length pipe may be deflected by the following offset distance, unless otherwise directed by the pipe manufacturer:
      a. Push-on joint
         1) 3 to 12-inch pipe: 14-inch offset
         2) 14 to 36-inch pipe: 8-inch offset
      b. Mechanical joint
         1) 3 to 6-inch pipe: 20-inch offset
         2) 8 to 12-inch pipe: 15-inch offset
         3) 14 to 20-inch pipe: 8-inch offset
         4) 24 to 36-inch pipe: 6-inch offset
   2. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance, unless otherwise directed by the manufacturer:
      a. 6 to 12-inch pipe: 11-inch offset
      b. 16 to 20-inch pipe: 7-inch offset
      c. 24 to 30-inch pipe: 5-inch offset
      d. 36-inch pipe: 4-inch offset

e. 42 to 48-inch pipe: 1 ¼ -inch offset

3.05 PVC Pressure Pipe

A. Install PVC C900 pipe in conformance with AWWA C605.

B. Solvent Weld: Field cut ends shall be sanded to roughing the surface. Joints shall be cleaned of foreign material. Solvent shall be applied to the joint and joint made as recommended by the manufacturer. Excess solvent shall be wiped off. Joint should not be moved until sufficiently set up.

C. Bell and Spigot Joints: Clean bell and spigot ends prior to jointing. Ends of field cut pipe shall be beveled with file. Gasket shall be clean and lightly lubricated. Joint shall be made as recommended by the manufacturer.

3.06 Valves and Fittings

A. Maximum spacing between line valves shall be as follows:

B. Install buried valves on top of an 18-inch square, 3-inch thick, solid concrete pad (minimum dimensions). The concrete pad may be provided by a pre-cast manufacturer or cast-in-place in the field above grade. Concrete used for the pads shall be a minimum 3,000 psi mix. The pads may not be cast-in-place in the pipe trench. Connection to pipe shall be such that there shall be no stress at the joint caused by misalignment or inadequate support of pipe or valve.

C. Valve Box: Set a valve box over each buried valve. Support box so that no stress shall be transmitted to the valve or pipe line. Install box plumb and set top flush with finished grade. Operating nut shall be centered in box. Provide a 24-inch x 24-inch wide by 6-inch thick concrete pad at top of valve boxes outside paved areas.

D. Valve operation nut shall be within 24 inches of the top of box. Provide stem extension if necessary to bring operating nut to within 24 inches of the top of box.

E. Install fittings as recommended by the manufacturer. Fittings shall be blocked or otherwise restrained from movement.

F. Install valves, gates, and accessories indicated on the Drawings and in complete accordance with the manufacturer's recommendations.

G. Install air / vacuum valve inside a manhole as per Standard Detail.

3.07 Air Valves

A. Installation shall be in accordance with the manufacturer’s recommendations and the Standard Detail.

3.08 Post Indicator Valve

A. Post indicator shall be installed plumb and such that the top of the post is 36” above finished grade.

B. The “OPEN” and “SHUT” targets shall be set for the appropriate valve size.

C. Coordinate installation of tamper switch with electrical contractor. Mount switches so not to interfere with the normal operation of the valve and shall be adjusted to operate

within two revolutions of the valve control or when the stem has moved no more than one-fifth of the distance from its normal position.

3.09 Encasement and Carrier Pipe

A. Verify the subsurface conditions at each boring site.

B. Stabilize and maintain bore pit bottom to provide proper equipment support and maintain pipe alignment. Dewater as necessary for site. Excavate bore pit in accordance with OSHA regulations. Provide adequate barricades, railings, and warning lights throughout the boring operation. Conduct operation in such a manner so as not to create a hazard to, nor impede the flow of traffic.

C. Install encasement pipe by dry boring and jacking.

D. Boring auger diameter shall not be greater than the outside diameter of the encasement pipe and shall not extend more than 6-inches ahead of the cutting edge of the encasement pipe. Fill voids that are formed during the operation with a 1:3 portland cement grout pumped at 50 psi to ensure that there will be no settlement of the roadway.

E. As the boring operation progresses, butt weld each new section of the encasement pipe to the section previously jacked into place. Maintain proper alignment. Confirm the grade of the encasement pipe as the Work progresses.

F. If an obstruction is encountered during the boring operation, efforts should be made to remove the obstruction. If obstruction cannot be removed, withdraw the encasement pipe and fill the void with 1:3 portland cement grout at 50 psi. If the encasement pipe cannot be withdrawn, seal ends before moving to another bore site. Town shall approve location of new bore site.

G. Provide seals at each end of encasement pipe.

H. Install carrier pipe in the encasement pipe using manufactured pipe supports. Supports shall prevent movement of the carrier pipe within the encasement. Space supports as specified.

3.10 Manholes

A. Provide 12 inches of No. 67 stone base to extend a minimum of 6 inches beyond the manhole base.

B. Set base plumb and level. Align manhole invert with pipe invert.

C. Secure pipe connectors to pipe in accordance with manufacturer's recommendation.

D. Clean bells and spigots of foreign material that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Do not stretch. Follow manufacturer's instructions when using O-ring seals.

E. Set precast components so that steps align.

F. Plug lift holes using a non-shrink grout. Cover with a butyl sealant sheet on the outside and seal on the inside with an application of an epoxy gel 1/8-inch thick extending 2 inches beyond the opening.

G. Set manhole frames to grade with grade rings. Seal joints between cone, adjusting rings, and manhole frame with butyl sealant rope and sheet.

H. Encase manhole rings in a concrete collar 18-inches wide by 6-inches thick of 3,000 psi concrete beneath paved surfaces.

I. Finish the interior by filling fractures greater than 1/2 inch in length, width or depth with a sand cement mortar. Do not fill the joints between the precast components.

J. Clean the interior of the manhole of foreign matter.

3.11 Meters

A. Install meter boxes and water service components so top of meter will be within 6 inches of the surface.

B. The Owner will install water meter.

3.12 Hydrant

A. Set hydrant in accordance with manufacturer's recommendations and Standard Detail.

B. All hydrants to be installed on 6-inch or larger mains.

C. Coordinate the location of fire hydrants with the Town. Generally hydrants will be located as follows:

1. At least one hydrant at each street intersection.
2. In residential areas the maximum spacing of hydrants, as measured along street centerlines, shall be 500 feet.
3. In business, commercial and industrial areas, the maximum spacing between hydrants, as measured along street centerline, shall be 300 feet.

3.13 Painting

A. Equipment shall receive the manufacturer's standard coating for the intended application. Coatings shall be suitable for the intended application.

B. Repaint damaged paint surfaces.

C. Above ground piping and piping within vaults shall be painted in accordance with Section, Painting.

3.14 Pavement Patching

A. Repair damaged pavement structure.

B. Cut existing pavement for utility installation in straight lines generally parallel to the utility. Properly dispose of removed pavement structure.

C. Extend pavement patch 1 foot beyond each side of trench on firm subgrade. Slope new surface to drain.

D. Asphalt Pavements: Replace asphalt pavement with a pavement structure no less than as shown on the Standard Details. For roadways under NC Division of Highways jurisdiction, pavement shall be replaced in accordance with their requirements.

E. Concrete Pavements: Replace concrete pavement with pavement structure equal to existing but no less than 6 inches. Concrete shall be minimum 3,000 psi. When existing concrete joint is within 5 feet of trench remove existing concrete to joint.

Provide expansion joint at edge of existing concrete. Surface treatment shall match existing.

F. Curbs, Gutters, and Sidewalks: Replace curbs and gutters, and sidewalks removed or damaged with similar sections to match the existing. Remove to nearest existing joint.

G. Approval of Other Authorities: Pavements under the jurisdiction of the NC Division of Highways shall be subject to the approval of a representative of that Division.

3.15 Grading and Clean-Up

A. Provide for testing and clean-up as soon as practical, so these operations do not lag far behind the pipe installation. Perform preliminary clean-up and grading as soon as backfill is complete.

B. Provide positive drainage of finished grade and drain away from structures. Finished grade shall be reasonably smooth, compacted, free from irregular surface changes and comparable to the adjacent existing ground surface.

C. Seed and mulch disturbed areas.

D. Upon completion of backfilling, remove and properly dispose of excess material and waste.

3.16 Backflow Prevention Testing

A. Install and test Backflow prevention devices in accordance with the requirements of the local authority having jurisdiction.

3.17 Pressure Testing

A. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe and as specified herein

B. General:
   1. The Engineer shall approve the source, quality, and method of disposal of water to be used in test procedures.
   2. Obtain Owner's permission 48 hours prior to filling or flushing of pipe system with water from Owner's water system. Owner shall operate valves connected to the existing water system. Where large quantities of water may be required for flushing, Owner reserves the right to require that flushing be done at periods of low demand.
   3. Clean and flush pipe system of foreign matter prior to testing.
   4. Provide air vents at the high points in the line section to be tested for releasing of air during filling. Service corporation stops may be used for air vent when located at a high point. Include cost of air vents in price of testing. Leave corporation stops in place after testing and note locations on As-Built Drawings.
   5. Allow concrete blocking to reach design strength prior to pressure testing.
   6. Test main prior to installation of service taps.
   7. Repair defects in the pipe system. Make repairs to the same standard as specified for the pipe system.
   8. Retest repaired sections until acceptance.
   9. Repair visible leaks regardless of the test results.
   10. Pipe sections shall not be accepted and placed into service until specified test limits have been met.

C. Testing
   1. Notify Engineer a minimum of 48 hours prior to testing.
   2. Perform tests in the presence of Engineer.
   3. Make pressure tests between valves. Provide suitable test plugs where line ends in "free flow."
   4. Upon completing a section of pipe between valves, test pipe by maintaining for a two-hour period a hydrostatic pressure of 150 psig.
   5. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
   6. No length of line shall be accepted if the leakage is greater than that determined by the following formula based on the appropriate test pressure:
      Q = Allowable leakage per 1,000 feet of pipe in gallons per hour.
      D = Nominal diameter of the pipe in inches.
      100 psi: Q = D x 0.07
      150 psi: Q = D x 0.08
      200 psi: Q = D x 0.09
      250 psi: Q = D x 0.10

3.18 Disinfection

A. After satisfactory completion of the pressure test, disinfect new potable water mains and existing mains that have required repair in accordance with AWWA C651 and as specified herein.

B. General:
   1. Provide a superintendent experienced in the required procedures for disinfecting with chlorine.
   2. Obtain Owner's permission 48 hours prior to filling, flushing, and chlorinating of the water mains. Owner shall operate valves connected to the existing water system.
   3. Do not allow highly chlorinated water into the existing distribution system.
   4. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize the residual chlorine. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water.
   5. Perform disinfection and testing in presence of Engineer.

C. Connection to Existing System: Notify Owner 48 hours prior to making connections to the existing system. Thoroughly clean the existing water main exterior prior to the installation of tapping sleeves and corporation stops. Lightly dust with calcium hypochlorite powder the water main exterior and the interior surface of the tapping sleeve, and corporation stops.

D. After satisfactory flushing of the main, disinfect by the injection of a chlorine solution. Induce chlorine in sufficient quantity to maintain a chlorine residual of at least 50 ppm throughout the system to be tested. Maintain the chlorine solution in the system for at least 24 hours.

E. Valves and Fire Hydrants:
   1. Open and close valves on the mains being disinfected a minimum of three times during the chlorine contact period and a minimum of three times during flushing. Fire hydrants and other appurtenances should receive special attention to insure proper disinfection.

F. For Cut-In Construction: Use the following procedures for disinfecting of the new installation and the existing main at the cut-in point in accordance with AWWA C651, Section 9:
    1. Use the following procedures for disinfecting of the new installation and the existing main at the cut-in point in accordance with AWWA C651, Section 9:
        a. Apply liberal quantities of hypochlorite, in the form of tablets, to the open trench.
        b. Interior of new pipe and fittings and the ends of the existing mains shall be swabbed or sprayed with a one percent hypochlorite solution before installation.
        c. Install a 2-inch tap downstream of the work area. Tap shall be used for blowing off the main or use the next fire hydrant downstream of the work area for blowing off the main.
        d. Install a 2-inch tap just upstream of the new installation. Control Water from the existing system so as to flow slowly into the work area during the application of chlorine. After the line is thoroughly flushed, add chlorine solution at a concentration of 100 ppm by the continuous feed method and hold in the main for one (1) hour.
        e. Coordinate all cut-in work with the Town.

G. Prior to flushing, the free chlorine residual shall be a minimum of 10 ppm. Flushing of the lines shall proceed until the lines contain the normal chlorine residual of the system.

H. Test in the field for free chlorine residual:
    1. Sample location shall be the same as required for the bacteriological test samples.
    2. Immediately after injection of the chlorine solution. Sample shall have a chlorine residual as specified.
    3. Prior to flushing of the highly chlorinated water from the potable water system and a minimum of 24-hours after the initial injection of the chlorine. Sample shall have a minimum chlorine residual as specified.

3.19 Bacteriological Testing

A. Required location for obtaining water samples:
    1. Every 2,000 lf
    2. End of each main.
    3. A minimum of one from each branch.
    4. Mains at cut-in locations: Each side of work area. Time between samples to be determined by Engineer in field.

B. A laboratory, certified for the required testing by the State of North Carolina, shall collect the sample and perform the testing. The laboratory shall be the same for both sampling and testing.

C. Obtain two water samples at each specified location for bacteriological testing. Take the first sample immediately after flushing of the chlorinated water and again in 24 hours.

D. Recommended additional samples. During the required sampling of water from the new system, it is recommended that samples be taken from the existing potable water source to determine if coliforms are present.

E. Take care in sampling. No hose or fire hydrant shall be used for the collection of samples. Take samples from an approved sample tap consisting of a corporation stop installed in the main with a copper tube gooseneck assembly. Operation shall be such as to ensure that the sample collected is actually from water that has been in the new system. The copper tube gooseneck assembly shall be removed and sample tap corporation stop shut off upon completion of testing bacteriological testing is requirements.

F. Test samples for the presence of coliform organisms in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. Testing method used shall be the multiple-tube fermentation technique, the membrane-filter technique, or presence/absence.

G. Test for odor. The water in the new system should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.

H. If samples show the presence of coliform, procedure 1 or 2 described below shall be followed, with the approval of the Owner, before placing the unit or facility in service.
   1. Take repeat samples at least 24 hours apart until consecutive samples do not show the presence of coliform.
   2. Again, subject the system to chlorination and sampling as described in this section.

I. If samples are free of coliform, and with the approval of the Owner, the potable water system may be placed in service.

J. Contamination of the existing system:

   If, in the opinion of the Town, possible contaminants have entered the existing water system, or water samples show the water in the existing system to be unsafe on completion of the work, the existing water system shall be disinfected as specified herein and shall include all contaminated components. Disinfection of the existing system shall be coordinated with the Town.

3.20 Valve Operation

A. Prior to final acceptance provide competent personnel to operate each valve in presence of Engineer. Verify that valves are left in the open position.

3.21 "As-Constructed" Drawings

A. General
   1. Maintain on-site a full set of project drawings for the purpose of recording as-constructed conditions.
   2. Information should be legibly recorded as construction progresses.
   3. Clearly and completely identify any field that changes from the original drawings.
   4. The depth of the installed waterline shall be recorded at all roadways, waterway crossings, utilities crossings, connections to new or existing waterlines, and all other areas as needed to accurately define the vertical location of the waterline. A minimum of one depth shall be recorded on each 100 feet of pipe installed. Depth shall be referenced to finished surface grades.
   5. Show horizontal and vertical location of any existing underground utilities encountered during construction.

6. Submit document to the Town prior to final acceptance.

END OF SECTION

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SECTION 2: SANITARY SEWER SYSTEM

SECTION 02

SANITARY SEWER SYSTEM

Part 1: GENERAL

1.01 Section Includes

A. Work under this section includes, but is not limited to, piping, valves, pumps, generators and appurtenances for a complete sanitary sewer collection system.

B. The Engineer and Developer shall become familiar with the sewer extension policies of the Town of Spring Hope prior to making conceptual plans for developments which will require sewer service by the Town, and to the policy in regard to sewer extensions.

C. It shall be the responsibility of the Engineer or Developer to obtain the approval of the Town of Spring Hope Council for any proposed projects under their respective jurisdiction prior to submission of Contract Documents for Town approval.

1.02 Design Criteria and Permitting

A. The design of all public sanitary sewer systems that are to become a part of the Town of Spring Hope's wastewater collection system, shall be in accordance with the N.C. Department of Environment and Natural Resources' publications "Minimum Design Criteria for the Permitting of Gravity Sewers" and "Minimum Design Criteria for the Permitting of Pump Stations and Force Mains" and the requirements contained herein.

B. Engineer/Developer shall prepare and submit all applicable permit applications required by federal, state and local authority. All fees are the responsibility of the Developer.

C. As required by the Town of Spring Hope, all sewers will be installed at the maximum depth in order to allow for maximum service area.

D. Sanitary sewers shall be installed in street rights-of-way or permanent easements. Minimum easement widths shall be as follows:

1. Force Main (All Depths) ..... 10 feet
2. Gravity
    a. ..... Depth of Sewer $\leq$ 8'; 20 feet
    b. ..... 8' < Depth of Sewer $\leq$ 12'; 30 feet
    c. ..... 12' < Depth of Sewer $\leq$ 14'; 40 feet
    d. ..... Depth of Sewer > 14'; Determined by Town

1.03 References

A. Publications are referred to in the text by basic designation only.
1. American Society for Testing and Materials (ASTM)
    a. A126 Gray iron Castings and Valves, Flanges and Pipe Fittings.
    b. C361 Reinforced Concrete Low-Head Pressure Pipe.
    c. C443 Flexible Watertight Joints for Precast Manhole Sections
    d. C478 Precast Reinforced Concrete Manhole Sections

e. C828 Low-Pressure Air Test of Vitrified Clay Pipe Lines (4 to 12 inch)
f. C890 Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

B. C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
   a. C1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure
   b. D1248 Polyethylene Plastics Molding and Extrusion Materials
   c. D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
   d. D2241 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
   e. D 2321 Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
   f. D2680 Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Pipe
   g. D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
   h. D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
   i. D3350 Polyethylene Plastics Pipe and Fittings Materials
   j. F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
   k. F794 Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
   l. F949 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
   m. F894 Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
   n. F1483 Specification for Oriented Poly(Vinyl Chloride) PVCO, Pressure Pipe
2. American Water Works Association (AWWA)
   a. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
   b. C105 Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
   c. C110 Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids
   d. C115 Flanged Ductile-Iron Pipe with Threaded Flanges
   e. C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
   f. C153 Ductile-Iron Compact Fittings, 3 inch through 16 inch, for Water and Other Liquids
   g. C504 Rubber-Seated Butterfly Valves
   h. C507 Ball Valves, 6 inch through 48 inch
   i. C508 Swing-Check Valves for Waterworks Service, 2 inch Through 24 inch NPS
   j. C509 Resilient-Seated Gate Valves for Water Supply Service
   k. C512 Air-Release, Air / Vacuum, and Combination Air Valves for Waterworks Service
   l. C550 Protective Epoxy Interior Coatings for Valves and Hydrants
   m. C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances
   n. C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

o. C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch, for Water Distribution
p. C906 Polyethylene (PE) Pressure Pipe and Fittings 4 inch through 63 inch for Water Distribution
q. C909
r. M23 PVC Pipe - Design Installation

3. National Sanitation Foundation (NSF) Standards
   a. 14 Plastic Piping Components and Related Materials
4. UNI-BELL Plastic Pipe Association (UNI)
   a. B-5 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Sewer Pipe
   b. B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.04 Submittals

A. Submit the following in accordance with the Town's Public Works Department prior to beginning work:
   1. All related Design Calculations, sealed as required by a Professional Engineer licensed to practice in North Carolina.
   2. Affidavit of Compliance: Affidavit shall attest that supplied products conform to the referenced standard and this specification and that tests set forth in each applicable referenced publication have been performed and that test requirements have been met. Affidavits shall be provided for all pipe, ductile iron pipe liner, valves, pre-cast structures, pumps, generators, switch gears and other items as requested by the Town. Submit for each of the following materials:
      a. Pump Stations
      b. Pipe
         1) Ductile iron
         2) Polyvinyl Chloride (PVC) pressure pipe
            i) AWWA C900
            ii) Pressure rated
            iii) Schedule 40 & 80
         3) Polyvinyl Chloride (PVC) gravity sewer pipe
            i) SDR 35
            ii) Schedule 40, drain, waste, and vent (DWV) pipe
      c. Pre-cast concrete manholes
      d. Valves
         1) Plug
         2) Check
         3) Air Release
   3. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for all pipe, ductile iron pipe liner, valves, pre-cast structures, (including steps, pipe connectors, joint materials, castings) service saddles, pumps, access hatches, lifting hoists, float switches, pressure gauges, generators, switch gears, and other items as requested by the Town.
      a. Pump Stations
         1) Submersible non-clog centrifugal sewage pumps and motors with mounting plates and guide rails.

2) Control panel
3) Precast concrete valve vault and meter vault
4) Lifting Hoist.
5) Pressure guages
6) Magnetic flow meter
7) Hatches with emergency fall grating
8) Emergency by-pass connection
9) Fencing and gate.
10) SCADA

b. Pipe
1) Ductile iron
2) Ductile Iron with restrained joints
3) Polyvinyl Chloride (PVC) pressure pipe
i) AWWA C900
ii) Pressure rated
iii) Schedule 40 & 80
4) Polyvinyl Chloride (PVC) gravity sewer pipe
i) SDR 35
ii) Schedule 40, drain, waste, and vent (DWV) pipe

c. Pre-cast Concrete Manholes and the following appurtenances:
1) Manhole steps
2) Pipe connectors
3) Joint material
4) Castings

d. Service saddles

e. Valves
1) Plug
2) Check
3) Air Release

4. Reports:
a. Field test report for each section of pipe for the following:
1) Pressure test for force mains.
2) Low-pressure air test for gravity mains.
3) Vacuum test for manholes.

5. Operation and Maintenance Instructions: Submit complete operation and maintenance manual for the following:
a. Valves.

6. Prior to final acceptance, submit test reports, in booklet format, including but not necessarily limited to the following:

a. Field Test report for each section of pipe installed including:
1) Pressure tests for force mains.
2) Low pressure air test for gravity mains.
3) Vacuum test for manholes or other pre-cast structure

b. Pump drawdown tests.

c. Air/vacuum relief valves, surge relief valves, check valves.

d. Start-up report and load test results, including operation of automatic switch gear.

7. Prior to final acceptance, submit manufacturer's complete operation and maintenance manuals for all valves and all components of the pump station including the generator and automatic transfer switch.
8. Prior to final acceptance, provide a parts list for each piece of equipment including type and quantity of part recommended for stock.

1.05 Delivery, Storage, and Handling

A. Provide a suitable pipe hook or rope sling when handling the pipe with a crane. Lifting of the pipe shall be done in a vertical plane. Under no conditions shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to both tongue and groove ends.

B. Deliver pipe in the field as near as practicable to the place where it is to be installed. Distribute pipe along the side of the trench opposite to the spoil bank. Where necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe or coating.

C. Shield PVC pipe and fittings stored on site from the sun's ultraviolet rays by suitable cover, or indoor storage.

1.06 Quality Assurance

A. All parts and materials incorporated into a project shall be new and unused.

B. Contractors must be licensed by the N.C. Licensing Board for General Contractors and have a classification and a cost limitation appropriate for the work to be performed.

1.07 Warranty/Service Agreement

A. Line Work

1. All materials and workmanship shall have a one-year warranty from the date of final acceptance by the Town. A warranty inspection will be made jointly by the Town and Contractor/Developer approximately eleven (11) months after acceptance to identify needed repairs. All labor, equipment and materials needed to make these repairs shall be the responsibility of the Contractor.

B. Pump Station

1. Pumps shall be provided with the manufacturer's standard warranty or a minimum of one (1) year, whichever is greater. Warranty shall cover all costs including, but not limited to, parts, labor, equipment and travel. Warranty will begin on the date of Substantial Completion.
2. Engine generator system and transfer switch shall be provided with a five (5) year warranty. Warranty shall cover all costs including, but not limited to, parts, labor, equipment and travel. Warranty will begin on the date of Substantial Completion.
3. A two-year service plan for the engine generator set to become effective on the date of Substantial Completion shall be provided. The plan shall include semi-annual inspections. Provide a detailed report of each service visit. Each of the following checks and services shall be performed at least annually:
    a. Oil change; check for leaks.

b. Oil filter replacement.

c. Engine check; inspect, run and test.

d. Fuel tank test for water and leaks.

e. Check for hose leaks.

f. Top off of fluids.

g. Automatic transfer switch test.

h. Inspection of housing for corrosion, unusual noises, and excessive vibration.

i. Inspection and cleaning of batteries. Seal terminals and check voltage.

j. Analysis of oil for contaminates.

k. Fuel filter replacement.

l. Replace air filter.

4. All other components of the pump station, including the control panel shall be provided with a minimum of a one (1) year warranty. Warranty shall cover all costs including, but not limited to, parts, labor, equipment and travel. Warranty will begin on the date of Substantial Completion. A warranty inspection will be made jointly by the Town and Contractor/Developer prior to the expiration of the various warranties.

PART 2: ALLOWABLE PRODUCTS AND MATERIALS

2.01 Pump Stations

A. General

1. The requirements for individual pump stations shall be reviewed by the Town on a case by case basis. In general, pump stations shall be of the duplex, submersible non-clog centrifugal pump type. Other types of pumps may be approved by the Town. Developer/Engineer must provide supporting documentation as to why the alternate pumps should be used.
2. Electrical requirements including the control panel will also be reviewed on a case by case basis. Adjustments to the requirements listed below will be made as deemed appropriate by the Town.
3. Pumping stations shall be of the submersible pump type, unless specifically approved otherwise by the Town of Spring Hope. The stations shall be equipped with a minimum of two (2) pumps, each capable of pumping at a rate equal to the peak design flow. The pumps installed in duplex pumping stations shall be of equal capacity.
4. Sewage pumping stations, structures, controls, and appurtenances shall withstand the 100-year flood without physical damage. Pumping stations shall not be located in areas subject to frequent flooding (areas inundated by the 10-year or greater frequency flood).
5. All sewage pump stations which are adjacent to streams classified as A-I, A-II or B waters shall be equipped with an alternate power source. Alternate power sources include on site standby power, dual power feed from separate electric substations, or portable generator. A generator receptacle shall always be present.
6. All pump stations shall include a separate concrete valve vault suitable for an H-20 highway loading which shall house a lever and spring type check valve and pressure gauge for each pump discharge line. These valves shall be of the same size as the discharge pipes.
7. Wet wells shall be constructed of precast reinforced concrete manhole sections unless otherwise directed by the Town of Spring Hope. The sections shall conform to ASTM Specification C 478. The inside diameter of the wet well shall be no less than that required for installation and removal of the pump equipment and in no case less than 6.0 feet inside diameter. Wet wells shall be provided with base slabs meeting all applicable requirements of the ACI Code and of sufficient dimensions to protect the wet well from settlement and from flotation. Top slab shall be suitable for H-20 highway loading. The interior of the wet well shall receive two (2) coats of Koppers "Super Service Black", or a suitable coal tar epoxy of at least 24-mil thickness. Wet wells shall be properly vented. Pipe and fittings used on vents shall be Ductile Iron.
8. Reinforced concrete used in the construction of slabs and other structures related to wet wells shall conform to applicable sections of the NCDOT Standard Specifications for Roads and Structures. Concrete used in structures shall be Class A, 4,000 psi compressive strength, in accordance with Section 900. Reinforcing steel shall conform to ASTM A615 (Grade 60. Steel-mesh reinforcement shall conform to A185. Cover slabs for wet wells and valve vaults shall be specially reinforced at hatch openings.

9. Mortar shall meet the requirements of ASTM C144 for aggregate and strength. No mortar shall be used which has been mixed longer than forty-five (45) minutes.

B. Pump
   1. General: Provide submersible, nonclog, centrifugal pumps specifically designed for the specified use. Openings and passages of pump shall permit passage of the specified sphere diameter and typical trash and stringy material associated with sanitary sewage. Pump with appurtenances shall be capable of continuous operation at specified submergence depth. Pump shall be designed for remote connection to a base elbow using one or two guide bars.
   2. Casing: Pump casing shall be constructed of cast iron ASTM A-48, Class 30. The casing shall be of uniform quality, surface, and free from defects. The casing shall be capable of withstanding operating pressures 50 percent greater than the maximum operating pressure. Volute shall have smooth passages, which provide unobstructed flow through the pump.
      a. Mating Surfaces: Mating surfaces 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.
      b. Exterior Surfaces: A factory applied sewage resistant coating shall protect exterior surfaces of the casing in contact with sewage. Exposed nuts and bolts shall be stainless steel.
   3. Impeller: Impeller shall be of cast iron and shall be of the single or double shrouded nonclogging design. Impeller shall be statically, dynamically, and hydraulically balanced. 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.
   4. Wearing Rings: 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 or stainless steel. Wearing rings shall be designed for ease of maintenance and shall be adequately secured to prevent rotation.
   5. Shaft: Provide one piece 416 Stainless steel shaft of adequate strength to transmit full motor horsepower to the impeller.
   6. Seals: 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.
   7. Bearings: Pump shall rotate on a minimum of two (2) permanently lubricated bearings with a L-10 bearing life of 40,000 hours.
   8. Approved manufacturers of the pumps set are as follows:
      a. Wilo
      b. Fairbanks Morse
      c. Hydromatic

C. Motor
   1. Provide sealed squirrel cage induction motor for submersible operation in conformance with NEMA standards for type motor specified and shall meet the following requirements:

a. UL listed for Class I, Division 1, Group C and D explosion proof hazardous locations.
b. Service factor of 1.15.
c. Horsepower, RPM, voltage and phase shall be as specified in the paragraph, System Description. Nameplate horsepower rating shall not be exceeded by the brake horsepower requirements of the specified head and capacity conditions.
d. Continuous duty submerged and 15 minutes in air at nameplate horsepower and a minimum of 15 evenly spaced starts per hour.
e. Exterior hardware shall be stainless steel.
f. Class F insulation.
g. Lifting lugs of adequate strength to lift the pump and motor assembly shall be cast into the motor housing.
h. Two moisture detector probes to detect seal failure shall be wired internally to control cable.
i. Two normally closed automatic reset thermostats shall be imbedded in the motor windings to open on excessive heat stopping the motor.
j. Provide waterproof power and control cable sized to conform to NEC and ICEA standards and adequate length to connect to the control panel. Seal cables at motor entry point to prevent moisture from entering motor housing and cable wicking.
k. Motor shall not overload throughout the pump-operating curve.

D. Painting
1. Exterior surface of pump and motor shall receive as a minimum the following paint system at the factory:
a. SSPC-SP6, Commercial Blast Cleaning
b. One coat of Modified Alkyd Enamel to a minimum 2 mils dry film thickness.

E. Installation System
1. Provide a rail mounted installation system consisting of stainless steel guide rails, upper rail guide bracket, sliding bracket, intermediate rail guide bracket(s) (for rails over 20 ft), and a discharge connection elbow. System shall be of the size and type standard with the pump manufacturer for pump type to be supplied and shall not be used to support the weight of the pump. Stainless steel sliding guide bracket shall be an integral part of the pump unit. Discharge connection elbow and piping shall be permanently installed in the wet well. 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.
2. Lifting cable: Provide a stainless steel cable capable of supporting the pump and to raise and lower the pump through one continuous motion with the hoist.
3. All bolts to be stainless steel.

F. Control System
1. Provide a duplex pump control panel with the required contacts and relays for the following pump operation and controls.
a. “Lead” pump shall start when liquid level rises to “lead pump” elevation.
b. 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.

c. If liquid level continues to rise to “high water” elevation, the high water alarm shall be activated.
d. Pumps shall alternate between starting cycles. In the event either pump fails to function, the other shall automatically start.
e. Adjustable float switches shall control liquid level elevations.
f. Motors shall automatically shut down upon loss of phase, under voltage, or phase reversal.
g. Provide time delay start (15 sec) for lag pump motor to prevent both motors from attempting to start simultaneously while on standby generator power.

2. Control panel shall be a NEMA 4X stainless steel enclosure with a dead front with a hinged inner door. Panel shall be UL labeled, as a complete unit, following assembly. Panel shall include, but not be limited to, the following items:
   a. Enclosure door shall be provided with stainless steel clamps and provisions for padlocking or shall be equipped with a three-point latching mechanism operated by an oil-tight key-locking handle.
   b. Main circuit breaker. OR “main terminal block” depending on project location.
   c. Provide separate terminal blocks for each motor to allow for two separate feeds from the phase converter.
   d. Surge arrester.
   e. Surge capacitor.
   f. Phase monitor relay.
   g. Entry alarm to detect unauthorized attempt to gain entry into control panel. Provide override for use of authorized personnel.
   h. A thermal / magnetic circuit breaker and magnetic starter with 3-leg overload protection for each pump. Provide one normally open and one normally closed set of auxiliary contacts on each starter. Contacts shall be in addition to those required for specified control functions.
   i. Reduced voltage solid state soft starters:
      1) The solid state reduced voltage starter shall be coordinated with the starting and running characteristics of the motor driven load to ensure a complete and operable system. Coordination between the motor control manufacturer and the mechanical equipment supplier is essential and required to ensure that speed-torque requirements are met. Specifically, the motor controller shall provide enough voltage at the time of start and produce enough torque to start the load while maintaining the desired results of a reduced voltage start.
      2) Starter shall be installed in control panel.
      3) The motor shall be protected from solid state component failure by an isolation contactor that opens when the motor is stopped or when the controller detects a fault condition including a shorted SCR.
      4) The soft start shall provide torque control for linear acceleration independent of motor load in a manner to ensure a stable and linear acceleration ramp.
      5) A shorting contactor shall be provided. The shorting contactor shall close, shorting the SCRs after the acceleration ramp is complete and open on a stop command to allow a deceleration ramp.
      6) The soft start shall be capable of supplying 400% of rated full load current for 23 seconds at maximum ambient temperature.
      7) A digital keypad shall be provided to enter operating parameters.

8) A full voltage bypass starter with overload protection shall be included to provide motor operation in the case of soft starter failure. A NORMAL/BYPASS selector switch h shall be provided.
9) Should pump/motor require a 460 V installation, provide a transformer sized for control circuit loads and additional 120 V circuits as required. Transformer size shall be adequate to provide 150 percent of the control circuit requirements, a minimum of 3.5 amperes for the receptacle and 100 percent of other auxiliary 120-volt loads. Provide fused primary and secondary and bond unfused leg of secondary to enclosure.

j. Transformer sized for control circuit loads and additional 120 V circuits as specified. Transformer size shall be adequate to provide 150 percent of the control circuit requirements, a minimum of 3.5 amperes for the receptacle and 100 percent of other auxiliary 120-volt loads. Provide fused primary and secondary and bond unfused leg of secondary to enclosure.
k. Obtain control circuit voltage between one of the phase conductors and neutral. On high leg systems, the selected phase must be one of the non-high leg phases.
l. Separate circuit breaker with handle to project through inner door for the following:
    1) Each pump motor
    2) Control circuit.
    3) Cabinet heater.
    4) Door mounted duplex receptacle.
    5) Battery charger receptacle.
m. Cabinet condensate heater with thermostat.
n. Alternator relay to alternate pumps between successive starts.
o. Mount the following devices on inner door:
    1) Hand-off-automatic (H-O-A) control switch for each pump.
    2) Non-resettable elapsed time meter for each pump. Meter shall read in tenth of hours through 99,999 hours total time.
    3) GFCI type duplex receptacle.
p. Mount operating and warning lights on inner door for the following. Color indicates required lens color.
    1) Power on (white).
    2) High water level (red).
    3) For each pump.
        i) Running (green).
        ii) Seal failure (red).
        iii) Thermal overload (red).
    4) Phase monitor (red).
q. Alarm horn and light (red) mounted on top of protective shield. Horn sound level shall be a minimum of 100 decibels at 10 feet. Provide horn silence switch on inside panel.
    1) In the event of a power loss at the pump station or a failure of the automatically activated stand-by generator, the alarm system shall be operated from a battery back-up power source. Battery back-up power source shall be provided with continuous charge. No alarm relays or indicator lights (except the alarm silence relay and alarm light) shall be part of the battery charging circuit.

2) At a minimum, the following conditions shall be monitored by the system, and each shall cause activation of the audible and visual alarms:
   i) Loss of power supply.
   ii) Pump failure for each pump for seal failure or thermal overload.
   iii) High water level.
   iv) Loss of telemetry transmission line. Provide contacts for signal from telemetry system.
   v) Standby generator failure.

r. Auxiliary contacts for remote signal for the following:
   1) Pump run status for each pump.
   2) High water alarm.
   3) Pump failure alarm for both pumps on thermal overload or seal failure.
   4) Loss of power.
   5) Loss of phase to indicate over / under voltage, phase loss, or phase reversal.
   6) Standby generator failure.

s. Provide laminated plastic labels to identify all control components.

t. Provide a plastic laminated electric diagram with wire / terminal numbers and color codes permanently fastened to inside of enclosure door.

3. Switches, push buttons, and indicator lights shall be oil tight / watertight units. Lights shall be push-to-test type.
4. Wire shall be sized as required for load and application according to NEC. Wiring shall be neatly bundled and continuous from point to point. Wiring shall be totally accessible with permanent marking on each end to match the schematic drawing. Control and signal wire shall be a minimum of #14 AWG, stranded, 90 degree insulated and color-coded. Color coding shall be as follows:
   a. Red AC control
   b. Blue DC control
   c. Yellow External source control
   d. White AC neutral
   e. Green Ground
5. 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.
6. Conduits running into wet well shall have a positive seal in accordance with NFPA 70.

G. Scada

1. SCADA will be provided for all new and replaced pump stations by Developer.
2. Be responsible for satisfactory installation, programming, testing, and operation of the installed system.
3. Conduct path study, design and coordinate the SCADA system for proper operation with related equipment and materials furnished under other contracts and with related existing equipment.
4. Provide necessary contacts, relays, antennas, mounting equipment, wiring, power supplies, grounding, and signal computers required for a complete operating system.

5. Type of system and monitored conditions shall be consistent with the existing system in use by the Town at the time the pump station is constructed.
6. Design of the system shall be closely coordinated with the Town.

H. Portable Hoist
1. Provide one galvanized or stainless steel portable hoist at each pump station with reach as required for the safe removal of each pump and trash basket.
2. Hoist shall have a capacity of 150 percent of equipment weight and capable of 360-degree rotation.
3. Hoist shall have winch with quick disconnect cable anchor for receiving stainless cable with swagged ball end.
4. Provide lifting cable for each pump and trash basket. Lifting cable shall be stainless steel with snap hook on pump / trash basket end and swagged ball on winch end. Cable shall have sufficient length to reach from installed equipment to lifting winch.
5. Provide number of floor mounted stainless steel sockets at each pump station as required for the removal of the equipment.
6. Portable hoist shall be as manufactured by Halliday Products, Thern Inc., or Wallace B E Products.

I. Removable Trash Basket
1. Provide one aluminum trash basket with guide rails with the following requirements:
   a. Basket shall have bar screen on the front and bottom with a minimum 1-1/4 inch to maximum 2 inch clear opening between 1/4-inch thick bars. The sides of the basket may be solid.
   b. Basket shall have a minimum of four solid aluminum wheels with stainless steel axles for easy removal from wetwell on aluminum guide rail system. Guide rail system shall not be provided with ladder rungs. Provide basket stop bar for installation in field to insure proper location of basket.
   c. Minimum dimensions: 2 inches wider than OD of influent pipe, 18 inches deep, and 18 inches high. Influent pipe must be able to pass through guide rails to influent face of basket.

J. Pressure Gauges
1. Pressure gauges shall meet the following requirements:
   a. Use: Pressure reading for sanitary sewer force main.
   b. Liquid fill: Glycern
   c. Dial: White aluminum with black markings.
   d. Dial size: 4 inch minimum.
   e. Case & Ring: Aluminum
   f. Accuracy: 1/2 % of full scale (Grade 2A).
   g. Stem connection: Back.
   h. Gauge reading: Combination reading in psi and feet of water (ft) with range as follows:
      1) Name of location: Required gauge range
   i. Equipped with a stopcock and a diaphragm isolator for use with sewage.
   j. Mounted on piping in the valve box. Provide accessories as necessary so gauge shall face up with numbers reading towards access hatch.
2. Provide a 1/4-inch tap on each effluent pipe for pressure gauge.

K. Pre-Cast Concrete Wet Well and Valve Vault

1. Pre-cast concrete wet wells and valve vaults shall be in conformance with the requirement for pre-cast concrete manholes with the following exceptions:
    a. Tops shall be flat.
    b. Tops of wet wells and valve vaults shall be a minimum of 2 feet above the 100 year flood elevation.
    c. Steps are not required.
    d. Ring and covers shall be replaced with access hatches as described herein.

L. Access Hatch
    a. Provide access hatches in conformance to the following requirements:
    b. Size as indicated on the Drawings. The size on the Drawings is for the required minimum clear opening. Unless specifically indicated on the Drawings the doors can be single or double door as required for opening size.
    c. Frame shall be aluminum extrusion and aluminum checkered tread plate for the door(s). Frame shall be equipped with necessary anchors for setting in concrete. Hinges, nuts, bolts, and washers shall be stainless steel and tamper proof from outside.
    d. Design and construct hatches for a minimum 300 lb. live load unless an H20 load is indicated on the Drawings.
    e. Provide the following:
        1) Bituminous coating at locations, which will have contact with concrete.
        2) Waterproof hatch where indicated on the Drawings.
        3) Positive open door latch.
        4) Retractable lifting handle.
        5) Double doors shall be interlocked.
        6) Padlocking provision. Provide lock for each hatch and keyed alike for multiple hatches.
        7) Provide a stainless steel interior automatic slam lock with an interior operating handle. The lock shall be operated from the outside by a removable handle key.
        8) Provide doors requiring greater then a 50 lb lift with a stainless steel spring assist.
    f. Hatches shall be of one manufacturer.

M. Yard Hydrant
1. Provide a non-freeze, self draining, post type yard hydrant with wheel handle operator. Interior parts and casing shall be bronze with cast aluminum casing guard. Seat washer shall be replaceable. Drain port shall be a minimum of 1/8-inch diameter. Hydrants shall have a 3/4-inch hose bib and a 3/4-inch inlet.

N. Sign
1. Provide a metal sign mounted on the fence at the gate to the pump station. Sign shall be a minimum of 18 inches square and white with blue lettering. Sign shall read “Town of Spring Hope Pump Station, Name of Station Pump Station, Emergency Contact Phone number.”

2.02 Engine Generator System with Automatic Transfer Switch

A. General

1. Each new sewer pump station shall be provided with an on-site generator including an automatic transfer switch to provide emergency back-up power. The generator shall be rated to continuously provide power for both pumps and all associated equipment simultaneously for the duration of any normal power failure as determined by the Town. In no case shall the fuel storage be less than that needed to operate the generating unit for 12 continuous hours.
2. Each generator will be evaluated on a case by case basis with adjustments to the requirements as stated herein as deemed appropriate by the Town.
3. Approved manufacturers of the generator set are as follows:
    d. MTU-On Site Energy
    e. Onan
    f. Catepillar
    g. Olympian
    h. General
    i. Kohler
4. Approved manufacturers of the automatic transfer switch are:
    a. Russelectric
    b. GE/Zenith
    c. Asco
    d. Lake Shore
    e. Standard product of the generator set manufacturer.

B. Engine

1. Engine requirements include the following:
    a. Water-cooled inline or V-type, four stroke cycle, compression ignition Diesel internal combustion engine.
    b. Rating: 100 percent of rated Kw for duration of an emergency outage.
    c. Isochronous type governor to maintain engine speed within 0.5 percent, steady state, and 0.5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.
    d. Automatic engine shutdown on high coolant temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
    e. DC engine starting system with positive engagement, number and voltage of starter motors as required by manufacturer. Include remote starting control circuit, with Run-Off-Auto selector switch on engine / generator control panel.
    f. Include a thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F.

g. Unit mounted radiator using glycol coolant, with blower type fan. Size fan to maintain safe engine temperature in ambient temperature of 110 degrees F with a maximum of 0.5 inches of water static pressure on the fan.

h. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear driven water pump, and gear type lube pump. A bypass valve shall be provided to allow lube oil circulation in the event of a failure of the filtering system.

i. Provide vibration isolators between engine/alternator and base frame.

C. Generator

1. Generator requirements include the following:

a. NEMA MG1 three phase, four pole, re-connectable brushless synchronous generator with brushless exciter, twelve lead, 2/3 pitch, random wound, permanent magnet generator.

b. Alternator Insulation Class: H.

c. Temperature Rise: Class F. 130 degrees C rise @ 40 degrees C ambient (Standby duty).

d. Enclosure: NEMA MG1, open drip proof.

e. Include generator-mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Include manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain.

f. Frequency Regulation: 3 hertz maximum from no load to rated load.

g. Anti-Condensation space heater.

h. Diesel engine generator systems shall meet or exceed the emission requirements of the current Environmental Protection Agency regulations for emergency generators.

2. Accessories

a. Critical type silencer with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions. The silencer shall be mounted within the generator enclosure. The silencer shall be industrial standard construction, all welded, for stationary engine application. The entire exhaust system shall be supported independently of the generator set to prevent transmission of vibration and allow for thermal expansion. Long radius, low restriction fittings shall be used throughout, and pipe size shall be sufficiently large to handle the engine exhaust flow at full load without causing back pressure in excess of that allowed by the engine manufacturer. A stainless steel rain cap shall be provided.

b. Batteries: Heavy duty, diesel starting type lead-acid storage batteries of sufficient capacity to provide a minimum of five full cycle starts for ten seconds crank with ten second rest periods between cranks. Match battery voltage to starting system. Include necessary cables and clamps.

c. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

d. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide enclosure to meet NEMA 250, Type 1 requirements and NFPA 110 requirements.

e. Line Circuit Breaker: NEMA AB 1, molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole. Unit-mount in enclosure to meet NEMA 250, Type 1 requirements.

f. Control Panel: NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators conforming to NFPA 110 Level 2. Panel shall be mounted with vibration isolators. Unit shall include the following devices and features:

    1) Panel lighting.
    2) Fused DC circuit to protect controls.
    3) 3-position Run - Off – Auto selector switch.
    4) Frequency Meter: 45-65 Hz. range, 3.5-inch dial (or digital display).
    5) AC Output Voltmeter: 3.5-inch dial, 2 percent accuracy, with phase selector switch (or digital display).
    6) AC Output Ammeter: 3.5-inch dial, 2 percent accuracy, with phase selector switch (or digital display).
    7) Output voltage adjustment.
    8) Provide indicator lights to show the following:
        i) Generator Off (Red)
        ii) Generator Auto (Green)
        iii) Generator Run (Yellow)
        iv) Generator Warning (Yellow)
        v) Generator Shutdown (Red)
    9) Provide a scrolling digital display or indicator light to show the following critical data:
        i) Overcrank. (Shutdown)
        ii) Low water temperature. (Shutdown)
        iii) High engine temperature.(Shutdown)
        iv) Low lube oil pressure.(Shutdown)
        v) Overspeed.(Shutdown)
        vi) Low coolant level warning.
    10) Audible alarm for any of the above conditions. Provide silence switch; however, activation shall not inhibit any subsequent alarms from sounding.
    11) Engine running time meter.
    12) Oil pressure gauge.
    13) Coolant temperature gauge.

14) Emergency stop switch.

15) Auxiliary Relay for indicating that generator set is running or shut down, with contact terminals prewired to terminal strip.

16) Common Failure Relay: Remotely signals auxiliary fault, emergency stop, high engine temperature, low oil pressure, overcrank and overspeed.

17) Provide terminal strip for remote signaling of alarm and status to SCADA. Coordinate with Town as to which conditions are to be monitored.

18) Signal to fuel shut-off solenoid valve on fuel supply line to open when required by the generator.

3. Weather Protective Enclosure

   a. Sound attenuated Level 1 reinforced aluminum housing allowing access to control panel and service points, with lockable doors and panels. Sound pressure level shall be limited to 76 dBA at 7 meters. Include fixed louvers, battery rack, battery charger rack, and silencer. Doors shall be equipped with stainless steel locks and hinges. Provide oil and coolant drain extensions. Color shall be manufacturer's standard.

4. Sub-Base Fuel Tank

   a. Fuel system shall include a double walled, UL approved, welded construction, base mounted fuel tank with integral stub-up area. It shall have the structural integrity to support the engine generator set. The tank must be supplied and warranted by the engine generator set manufacturer and be factory installed. Minimum features shall include:

      1) Lockable fuel filler cap. Shall be installed in a 5 gallon spill containment reservoir with drain and lockable cover.

      2) Fuel gauge.

      3) Low fuel level alarm.

      4) Tank rupture alarm.

      5) Fuel line check valve.

      6) Fittings for fuel supply, return, fill and vent.

5. Access Platform

   a. If height of fuel tank exceeds 30 inches above top of generator pad, the contractor shall provide an all welded steel structural platform with walkway floor even with bottom of generator skids. Steps shall meet OSHA requirements. A 42 inch wide walkway with aluminum pressure locked grating shall extend all around the generator set. Grating shall be flush top SGF Series by Ohio Gratings Inc., or equal. Bearing bar spacing shall be on 1-3/16 inch centers. Cross bars shall be locked at right angles to, and in the same plane as the top surface of bearing bars. Spacing shall be 4 inches on center. Grating shall be supported on minimum 4 foot centers. Grates shall have an anti-skid surface and shall be designed to support a live load of not less than 200 pounds per square foot with a maximum deflection of $1/180^{th}$ of the span. A double pipe 42 inch handrail system consisting of 1-1/2 inch diameter aluminum pipe for the rails and vertical posts, and toe plate, shall be provided on the outside

perimeter and rails shall be provided on each side of the steps. The platform location shall not interfere with tank fill operations. Color to be selected by owner. Aluminum components shall not be painted. Access platform fabricator shall submit shop drawings with detailed connections and structural calculation sealed by registered North Carolina Structural Engineer.

6. Duplex Receptacle
    a. Provide a GFCI type duplex convenience receptacle inside the weatherproof enclose. Receptacle shall be connected to an external circuit.
7. Emergency Stop Switch
    a. Heavy duty, red mushroom push bottom, push-to-stop/pull-to-activate maintained contacts, mounted in NEMA Type 12 enclosure. Provide phenolic label attached to enclosure stating, “GENERATOR EMERGENCY STOP”.

D. Automatic Transfer Switch

1. Transfer switch requirements include the following:
    a. NEMA ICS 10 closed transition automatic transfer switch, service entrance rated with integral overcurrent protection for both sources.
    b. Electrically operated, mechanically held transfer switch.
    c. Time delay neutral transfer method.
    d. Ground fault protection shall be provided on overcurrent protective device.
    e. Provide lights mounted in cover of enclosure to indicate Normal Source Available, Alternate Source Available and Switch Position.
    f. Mount test switch in cover of enclosure to simulate failure of normal source.
    g. Provide Transfer Switch Auxiliary contacts as follows:
        1) One set of relay contacts to open on loss of normal power supply.
        2) One set of relay contacts to close when switch in “NORMAL” position.
        3) One set of relay contacts to close when switch in “EMERGENCY” position.
        4) One set of relay contacts for generator “RUN”.
        5) One set of relay contacts for generator “FAIL”.
        6) One set of relay contacts interlocked with the pump control panel to open when the switch is in the emergency position to lock out the lag pump.
    h. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 80 percent or frequency varies more than 5 percent from rated nominal value.
    i. Thermostatically controlled electric heater sized to prevent condensation under expected weather conditions at the project site. Provide terminals for separate connection of 120 volt power.
2. Automatic Sequence of Operation

a. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

b. Time Delay To Start Alternate Source Engine Generator: 0 to 3 seconds, adjustable.

c. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

d. Time Delay Before Transfer to Alternate Power Source: 0 to 3 seconds, adjustable.

e. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

f. Time Delay Before Transfer to Normal Power: 0 to 25 minutes, adjustable; bypass time delay in event of alternate source failure.

g. Time Delay Before Engine Shut Down: 0 to 25 minutes, adjustable, of unloaded operation.

h. Engine Exerciser: Start engine every 7 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.

i. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

3. Enclosure

a. Enclosure: ICS 6, Type 1.

b. Finish: Manufacturer's standard gray enamel.

2.03 Pipes and Accessories

A. Ductile Iron Pipe

1. Pipe and fittings shall conform to the following requirements:
   a. Size shall be as indicated on the Drawings.
   b. Suitable for a system working pressure of 350 psi.
   c. Cement-mortar lined with seal coat in accordance with AWWA.
   d. Interior of pipes and fittings shall be lined with virgin polyethylene complying with ASTM D1248, compounded with an inert filler and with sufficient carbon black to resist ultraviolet rays during above ground storage of the pipe and fittings. The polyethylene shall be bonded to the interior of the pipe or fitting by heat. The lining shall be 40 mils nominal thickness and a minimum of 30 mils. The lining shall be American Polybond, U.S. Polylined or equal.
   e. Interior of pipes and fitting shall be Protecto 401 lined per Section, Sanitary Sewer Pipe Liner.
   f. Interior of pipes and fittings shall be coal tar epoxy lined.
2. Ductile-iron pipe for below ground service shall have push-on or mechanical joints, unless noted otherwise on the Drawings, conform to AWWA C151, and to the following requirements:
   a. Pipe thickness class shall be suitable for a laying condition as specified in Section, Trenching for Utilities, at the depth indicated on the Drawings, and at the system working pressure specified above.

b. Provide mechanical joint fittings, unless noted otherwise on the Drawings.
c. Encase pipe in polyethylene conforming to AWWA C105.

3. Ductile-iron pipe for above ground service shall have flanged joints, unless noted otherwise on the Drawings, and conform to AWWA C115.
   a. Pipes to be painted shall have only a shop primer on the outside by the manufacturer. Verify that proposed manufacturer's primer is compatible with the proposed paint system.
4. Fittings for ductile-iron pipe shall conform to AWWA C110, or C153 and to the following requirements:
   a. Joint type shall be as specified above for the supplied ductile-iron pipe.
   b. Fittings shall be made of gray-iron or ductile-iron.
5. Ductile iron pipe on piers shall have Mech-Lok™ rigid restrained joint by Griffin Pipe Products Co. or approved substitute. Provide necessary expansion couplings as recommended by Pipe Manufacturer and approved by Engineer.
6. Special Pipe Joints
   a. Restrained
      1) Provide restrained joint pipe at fittings and valves where indicated on the Drawings. Length of restrained pipe shall be as shown. Restrained joints shall be Snap-Lok (Griffin Pipe), Flex Ring and Lok-Ring (American), TR Flex (U.S. Pipe) or approved equal.
      2) Restrained joint pipe and fittings shall meet all AWWA standards and other requirements as specified above for standard ductile iron pipe and fittings unless addressed herein.
      3) Field made joints are allowable but should be avoided where possible. Careful planning to locate field cuts in standard pipe sections is preferred. For field made joints in restrained piping, use field weldments or an insert equal to TR Flex Gripper Rings or approved equal. Gasket type field made joints will not be allowed.
      4) Restrained joint fittings shall be provided by the restrained joint pipe supplier where located within restrained joint pipe sections. Fittings shall be of the same model / type as the pipe supplied from the pipe manufacturer.
      5) Restrained joint fittings may be push-on joint type.
      6) Megalugs, Series 1100, as manufactured by EBAA Iron Sales or approved equal shall be allowable for restraint where fittings or valves are not available with restrained joints from the pipe manufacturer.
      7) Where additional fittings/valves are required and not shown on Drawings, consult with Engineer for length of restrained joint pipe necessary each side of fittings/valve prior to installation of pipe/fitting.
      8) Contractor shall develop a field layout schedule and drawing for restrained joint pipe installations.

B. Polyvinyl Chloride (PVC) Pressure Pipe
   1. General
      a. Pipe and fitting size shall be as indicated on the Drawings.
      b. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
      c. Pipe used for wastewater system use shall be green in color.
      d. Pipe used for reclaimed water system shall be colored purple (Pantone 522) and embossed on opposite sides every three feet with the words "Caution – Reclaimed Water – Do Not Drink."

2. AWWA C900: C900 PVC pipe 4-inch to 60-inch shall conform to AWWA C900 and the following requirements:
    a. Outside diameter shall conform to ductile-iron pipe.
    b. Pipe shall be pressure class 235 with a standard dimension ratio of DR 18.
    c. Pipe shall have plain end and elastomeric-gasket bell ends.
    d. Fittings shall conform to AWWA C110, or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.
3. Pressure Rated: Pressure Rated (PR) PVC pipe 1-1/2-inch to 12-inch shall conform to ASTM D2241 and the following requirements:
    a. Pipe shall be pressure rated 200 with a standard dimension ratio of SDR 21.
    b. Pipe shall have an integral elastomeric-gasket bell end. The joints and gaskets shall comply with ASTM D3139 and ASTM F477.
    c. Fittings for pipe 3-inch and larger shall conform to AWWA C110, or C153 and have mechanical joints with transition gaskets as required for the pipe outside diameter. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.
4. Schedule 40 & 80: Schedule 40 & 80 PVC pipe ½-inch to 12-inch shall conform to ASTM D1785 and the following requirements:
    a. Outside diameter shall conform to iron pipe.
    b. Pipe shall be schedule 40 or 80.
    c. Pipe shall have an integral elastomeric-gasket bell end or solvent weld joints.
    d. Fittings for the pipe shall conform to ASTM D2466 or D2467 as appropriate for the pipe schedule.

C. POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

a. General
    1) Pipe and fitting size shall be as indicated on the Drawings.
    2) PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
    3) Pipe shall have an integral elastomeric-gasket bell end. Gaskets shall be in conformance with ASTM F477.
    4) See Section, Trenching for Utilities, for trench bedding and haunching requirements.
b. SDR 35: PVC SDR 35 gravity sewer pipe 4-inch to 15-inch and related fittings shall conform to ASTM D-3034 and the following requirements:
    1) Pipe shall have standard dimension ratio of SDR 35.
    2) Nominal pipe length shall be a minimum of 13 feet.
c. Gravity mains greater than 15-inch in diameter shall be presented to Spring Hope prior to approval.

D. SERVICES

a. General
    1) Unless otherwise directed by the Town, pipe for gravity sewer service laterals, including the cleanout stack, shall be PVC Schedule 40 pipe meeting the requirements of ASTM D1785, or ductile iron pipe.
    2) All service connections to new lines shall be made by installing “wyes”.
b. Joints
    a. Joints for PVC service pipe shall be solvent cement welded.

E. ENCASEMENT PIPE

1. Materials
    a. Encasement pipe installed under Town maintained and NCDOT maintained roadways shall be in accordance with NCDOT's "Policies and Procedures for Accommodating Utilities on Highway Rights-of-Way".
    b. Encasement pipe installed under railroads shall be in accordance with "Part 5.3, Specifications for Pipelines Conveying Non-Flammable Substances" as developed by the American Railway Engineering Association (AREA).
    c. Pipe materials used for the carrier pipe shall be adjusted as needed to meet the requirements of the roadway or railroad owners.
    d. Pipe supports used in the encasement pipe designed and manufactured for the support of the carrier pipe shall be as follows:
        1) Band and Riser Material: 14 gauge steel for band and riser except if the riser is over 6-inches high, the steel shall be 10 gauge for riser. Riser shall be of the channel shape. Band with risers shall have a fusion bonded PVC coating of a minimum of 10-mil thickness. Band shall be bolted together with stainless steel bolts, nuts and washers.
        2) Band Liner: Provide PVC liner a minimum of 0.09 inches.
        3) Runners: Glass Reinforced Polyester of UHMW Polymer plastic. Runner shall be a minimum of 1-inch wide and not more than 1-inch shorter than the bandwidth. Provide 2 top and 2 bottom runners for pipe sizes through 12-inches and 2 top and 4 bottom runners for pipes over 12-inches.
    e. End seals installed on the encasement pipe may be a wrap around or a pull-on type. Seal shall be made of 1/8-inch thick synthetic rubber and shall be secured with stainless steel banding straps with worm gear tightening device. Alternate means of sealing the encasement may be approved by the Town.

2.04 Manholes

A. General
1. Provide manholes made of precast concrete sections in conformance with ASTM C478, NC Department of Transportation, and the following requirements:
    a. General
        1) Provide manholes to the depth as indicated on the Drawings. Manhole inside diameter shall be 4 feet unless noted otherwise on the Drawings.
        2) Precast concrete manholes shall be as manufactured by Adams Concrete, Carolina Precast Concrete, Inc., D & M Concrete Specialties, Inc., N. C. Products Corp., Stay Right Tank, Tindall Concrete Products, Inc. or approved substitute.
2. Precast Concrete Sections
        1) Minimum wall thickness shall be 5-inches.
        2) Base: Cast monolithically without construction joints or with an approved PVC waterstop in the cold joint between the base slab and the walls. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness.
        3) Riser: Minimum lay length of 16 inches.

4) Eccentric Cone: Top inside diameter shall be 24 inches. Width of the top ledge shall be no less than the wall thickness required for the cone section.
5) Transition Cone: Provide an eccentric transition from 60-inch and larger manholes to 48-inch diameter risers, cones, and flat slab top sections. Minimum slope angle for the cone wall shall be 45 degrees.
6) Transition Top: Provide an eccentric transition from 60-inch and larger manholes to 48-inch diameter risers, cones, and flat slab top sections. Transition Top sections shall be furnished with vents as shown on the manhole details. Tops shall not be used in areas subject to vehicle traffic.
7) Flat Slab Top: Designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops shall be sized to fit within the manhole ID and the top and bottom surfaces. Provide a float finish for exterior slab surface.
8) Precast or core holes for pipe connections. Diameter of hole shall not exceed outside diameter of pipe by more than 3-inches.
9) Grade Rings: May be used to adjust frame and cover to finished grade. Grade Rings shall be no less than 4 inches in height.
10) Lifting Devices: Devices for handling precast components shall be provided by the precast manufacturer and comply with OSHA Standard 1926.704.

3. Joints
   a. Manufacturer in accordance with tolerance requirements of ASTM C 990 for butyl type joints.
   b. Minimize number of joints. Do not use riser section for manholes up to 6 feet tall and no more than one riser for each additional 4 feet in height.
   c. Flexible Joint Sealants: Preformed butyl rubber based sealant material conforming to Federal Specification SS-S-210A, Type B and ASTM C990.
   d. External Seal: Polyethylene backed flat butyl rubber sheet no less than 1/16-inch thick and 6-inches wide.
4. Inverts
   a. Brick and mortar or precast concrete invert.
   b. Form and finish invert channel to provide a consistent slope from inlet(s) to outlet up to 4-inches.
   c. Channel walls shall be formed to 3/4 of the height of the outlet pipe diameter.
   d. Finish benches with a minimum uniform 1.5:12 slope. Provide a 1/4-inch radius at the edge of bench and trough.
5. Flexible Pipe Connectors: Provide flexible connectors for pipe to manhole that conform to ASTM C923. Location of connectors shall vary from Project Drawings no more than 1/2-inch vertically and 5 degrees horizontally. Provide stainless steel pipe clamp type band around flexible connection to sewer pipe.
6. Manhole Steps:
   a. Steps shall be in accordance with ASTM C478 and made of 1/2-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.
   b. Secure steps to the wall with compression fit in tapered holes or cast-in-place. Align steps along a vertical wall and shall not be located over a pipe opening. First step shall be a maximum of 26 inches from the bottom.
   c. Steps shall be by American Step Co., Inc., Bowco Industries, Inc., M. A. Industries, Inc. or approved substitute.

2.05 Castings

A. General

1. Made of gray iron, ASTM A-48 - class 30, or ductile iron, ASTM A536, grade 65-45-12.
2. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16-inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame.
3. Castings shall be domestic made and manufactured by Neenah Foundry Co., U.S. Foundry & Manufacturing Corp., or Vulcan Foundry.

B. Manhole Frame and Cover:

1. Minimum clear opening shall be 22 inches.
2. Minimum weight for frame and cover shall be 300 pounds and suitable for Heavy Duty Highway Traffic Loads of H-20.
3. Frame shall have four 3/8-inch anchor bolt holes equally spaced.
4. Cast “Sanitary Sewer” on the cover. Casting shall bear the name of the manufacturer and the part number.
5. Provide solid cover.
6. Provide cover with two 1-inch perforated holes unless noted as watertight on the Drawings.
7. Provide the following where indicated on the Drawings:
    a. Ring and cover shall be watertight.
    b. Bolt down cover. Bolt down covers shall be provided with four (4) 3/8-inch stainless steel hex head bolts at 90 degrees.

2.06 Transition Couplings for Gravity Sewer Pipe

A. The preferred transition connection between different sewer line materials shall be a standard manhole installation.

B. Pipe material changes between manholes may be permitted provided there is not a substantial difference in inside diameters, a smooth uniform flow line is maintained, and a watertight rubber sleeve or mechanical coupler conforming to ASTM C-425 is used to make the transition. All metal hardware shall be stainless steel. HARCO hard couplings are preferable; alternatively, transition sleeves may be manufactured by Fernco or Indiana Seal with the prior written consent from the Town of Spring Hope.

2.07 Sewer Service

A. Provide PVC service wye the same material as the main. Saddles shall be solvent welded and fastened with double stainless steel bands.

B. Inserta Tee or approved equal shall be used for connection to PVC ribbed pipe.

C. Service saddle for cast iron soil pipe services may be “ROMAC C” sewer saddles consisting of a virgin SBR gasket compounded for sewer service, a ductile iron saddle casting, a 304 stainless steel adjustable strap for fastening the gasket and the saddle casting to the sewer main, and a 304 stainless steel adjustable circle clamp for securing the service line into the SBR gasket.

2.08 Valves

A. General: Valves shall meet the following requirements:
   1. Size shall be as required for the pipe size and material as indicated on the Drawings and specified.
   2. Open by counterclockwise rotation. (Open left for sewer Applications Only)
   3. Shall be suitable for a working pressure of 150 psi.
   4. Equip valves with a suitable means of operation.
   5. For buried valves over 5 feet deep, provide extension stems of cold rolled steel to bring the operating nut to within 2 feet of the ground surface.
   6. Provide valve accessories as required for proper valve operation for valve locations as indicated on the Drawings and as recommended by valve manufacturer.
   7. Valve accessories shall be compatible to proper valve operation.
   8. Valves shall be manufactured by American Flow Control, Clow Valve Company, Kennedy Valve Company, M&H Valve Company, Mueller Company, or U.S. Pipe and Foundry Company.

B. Plug Valves: Plug valves shall conform to the following requirements:
   1. Plug valves shall be of the non-lubricated, eccentric type designed for a working pressure of 175 psi for valves 12 inch and smaller, 150 psi for vales 14 inch and larger.
   2. Valves shall provide tight shut-off at rated pressure.
   3. The plug valve body shall be cast iron ASTM A126 Class B with a welded-in overlay of not less than 90% nickel alloy content on all the surfaces contacting the face of the plug.
   4. The valve plug shall be constructed of cast iron conforming to ASTM A126 Class B, with Buna N resilient seating surface to mate with the body seat.
   5. Valve flanges shall be in accordance with ANSI B16.1 Class 125.
   6. Shaft bearings shall be sleeve-type, sintered, oil impregnated, and permanently lubricated stainless steel.
   7. Plug valve shaft seals shall be of the multiple V-ring type and shall be adjustable. Sealing system shall conform to AWWA C504 and C507 standards. All packing shall be replaceable without removing the bonnet or actuator and while valve is in service.
   8. Valves 6” and larger shall be provided with gear actuators.
   9. Provide levers or hand wheels to operate the valve as recommended by the manufacturer.
   10. Full ported (i.e,. 100% flow area) and piggable.

C. Swing Check Valves: Swing check valves from 2 to 24 inch shall conform to AWWA C508 and to the following requirements:
   1. Provide lever and weight for swing check control.
   2. Resilient material to Metal seat construction.
   3. Ends shall be flanged.
   4. All interior iron surfaces shall be coated with a minimum of a 8 mils of fusion bonded epoxy or liquid epoxy in accordance with ANSI/AWWA C550.

2.09 Air Valves

A. Provide air valves in conformance with AWWA C512 and the following:
   1. Valve type shall be a combination valve.

a. Inlet size: 2 inch
b. Large orifice minimum: 1 inch
c. Small orifice minimum: 1/8 inch

2. Valve shall be designed for the following automatic operation:
   a. Release of large quantities of air during the filling of the main.
   b. Permit air to enter the main when it is being emptied.
   c. Release accumulated air while the main is in operation and under pressure.
3. Valve shall be designed for a system pressure 150 psi. Valve shall also operate at a minimum system pressure of 20 psi.
4. For pipes between 4 and 8 inches in diameter, air release valves shall be HARCO air release valves or some equivalent
5. The air release valve assembly hall utilize HARCO's ball valve, adapters and stainless steel transition nipple.
6. Air Relief Valve construction shall consist of a one-piece injection molded C900 Tapped Service Tee and pressure class 235 psi/DR18 per AWWA C907. Fittings shall be qualified as tapped service tees.
7. Polyethylene transition nipples shall consist of 316 Stainless Steel threaded pipe adapter press fit over DR11 IPS PE 4710 HDPE pipe complying with ASTM D3035 and NSF61. The ball valve made to restrain the valve and pipe shall be 200 psi rated and have an Outside Diameter of 2.375" (IPS – OD controlled).
8. Polypropylene compression fittings shall be 230 psi rated and meet or exceed the dimensional and functional AWWA C800 and comply with NSF 61 listing. All joints are to be in accordance with ASTM D3139. All threads shall meet or exceed ANSI/ASME B1.20.1 and ASTM F1498
9. For pipes greater than 8 inches in diameter, air release valves will utilize a saddle with 2" MNPT threads.
10. Sewage force main valve shall include backwash accessories. They shall include bronze flushing ball valves and 5 feet of rubber hose with quick-connect coupling on each end.
11. For pipes between 4 and 8 inches, manual air release valves shall be provided by tapping the main and installing a C900 service tee, a corporation stop, one-inch (1") service tubing, and a Mueller P-14258 lock wing angle meter stop.
12. For pipes greater than 8 inches, installation of manual air release valves will be the similar as those for pipe diameters between 4 and 8 inches. However, installation of a standard saddle will take place instead of a C900 service tee.

2.10 Valve Box

A. Valve Box, Below Ground: Boxes shall be high strength cast iron of the screw or telescopic type. Box shall consist of a base section, center extension as required, and a top section with cover marked "SEWER."

2.11 Thrust Blocking

A. Provide concrete thrust blocking for pressure lines in accordance with the detail on the Drawings.

B. Thrust blocking is not required where restrained joint fittings and equivalent length of restrained joint pipe are used unless shown otherwise on the Drawings.

PART 3: EXECUTION/ INSTALLATION

3.01 Pipe and Accessories

A. General

1. Provide erosion control measures as required. Erosion control measures including seeding and mulching shall be designed, installed and maintained in accordance with the N.C. Department of Environment and Natural Resources, Land Quality Section's "Erosion and Sediment Control Planning and Design Manual". The Developer/Engineer is responsible for securing all required permits.
2. Pipe installation shall meet the following general guidelines:
    a. Lay pipe in the presence of a representative of the Town, unless specifically approved otherwise.
    b. Handle pipe and accessories in accordance with manufacturer's recommendations. Take particular care not to damage pipe coatings.
    c. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
    d. Lay pipe to design grade and alignment.
    e. Provide proper equipment for lowering pipe into trench.
    f. Provide tight closure pipe ends when work is not in progress.
    g. Keep pipe interior free of foreign materials.
    h. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
    i. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.
    j. Block fittings with concrete or restrained joints.
3. Gravity Pipe: Gravity pipe installation shall meet the following general guidelines:
    a. Lay pipe upgrade from the lower end and at the grades and alignment indicated on the Drawings.

B. Trenching for Underground Pipe Installation

1. Definitions
    a. Backfill: A specified material used in filling the excavated trench and placed at a specified degree of compaction.
        1) 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.
            i) 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.
            ii) 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 noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.

iii) 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 included in this class.
iv) 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.
v) 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.

2) Backfill Zones: Each backfill zone shall extend the full width of the trench bottom.
i) Foundation: Extending down from the bottom of bedding zone as defined below.
ii) Pipe Embedment
a. Bedding: Extending from 4 inches below the pipe bottom to the pipe bottom for 30-inch diameter and smaller and 6 inches below the pipe bottom for pipes larger than 30 inches in diameter.
b. Haunching: Extending from the bedding (bottom of the pipe) to the pipe spring line.
c. Initial Backfill: Extending from the haunching (pipe spring line) to 1 foot above the top of the pipe.
iii) Final Backfill: Extending from the initial backfill to the finish ground elevation.

b. Laying Conditions:
1) Type 1: Flat bottom trench with loose backfill.
2) Type 2: Flat bottom trench with backfill lightly consolidated to centerline of pipe.
3) Type 3: Pipe bedded in 4 inches minimum of loose soil and backfill lightly consolidated to top of pipe.
4) Type 4: Pipe bedded on Class I material to 1/8 pipe diameter (4 inch minimum) Backfill compacted to top of pipe a minimum of 80 percent of standard proctor.
5) Type 5: Pipe bedded in compacted Class I material to pipe centerline with 4-inch minimum under pipe. Backfill to top of pipe with Class I, II, or III and compact to 90 percent of standard proctor.

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 test 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 is not included in the definition of "rock" but which may require the use of heavy excavation equipment with ripper teeth. Amount must exceed 1 cubic yard in volume. Material having a standard penetration resistance as determined by ASTM D1586 between 60 and 150 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 without the systematic drilling and blasting exceeding 1 cubic yard in volume. Material having a standard penetration resistance as determined by ASTM D1586 greater than 150 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. Pipe Springline: A line running horizontally through the center of the pipe.
i. 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.

2. Products
   a. Stone
      1) Class I material shall be #67 or #78M stone in accordance with NCDOT specifications Section 1005, General Requirements for Aggregate.
   b. Warning and Identification Tape
      1) Tape shall be a minimum 3-inch wide polyethylene plastic tape manufactured specifically for identification of buried utilities with means of enabling detection by a metal detector to a minimum depth of 3 feet. Tape shall be color coded and continuously imprinted with warning and identification markings in bold black letters to read "CAUTION - BURIED (utility) LINE BELOW." Color and printing shall be permanent, unaffected by moisture or soil and shall be as follows:

UTILITY	COLOR	MARKING
Water	Blue	Caution - Buried Water Line Below
Gravity Sewer	Green	Caution - Buried Sewer Line Below
Force Main	Green	Caution - Buried Force Main Below
Electric	Red	Caution - Buried Electric Line Below
Gas	Yellow	Caution - Buried Gas Line Below
Telephone	Orange	Caution - Buried Telephone Line Below
SCADA	Orange	Caution - Buried SCADA Line Below

   c. Tracer Wire
      1) Install tracer wire for non-metallic pressure pipe. Bury tracer wire with pipe. Wire shall be looped into valve boxes to allow access for direct contact location. Tracer wire shall be #12 solid copper wire. All connections shall be by wire nuts and taped. Splices in tracer wire are to be kept to a minimum and joined with copper split nuts of appropriate size.
      2) Tracer wire shall be #12 solid copper wire. All connections shall be by wire nuts and taped.
      3) in tracer wire are to be kept to a minimum and joined with copper split nuts of appropriate size.

3. Project Safety
    a. Contractor is responsible for Project safety.
    b. Perform work in conformance with applicable State and Federal safety regulations including, but not limited, to the following:
        1) North Carolina Safety and Health Standards for the Construction Industry (29CFR 1926 Subpart P).
        2) NC OSHA Industry Guide No. 14, Excavations.
        3) NC OSHA Industry Guide No. 20, Crane Safety.
    c. Provide barriers, warning lights, and other protective devices at excavations as necessary for safety of workers and the public.
    d. Provide sloping of bank, shoring, sheeting, or other means of maintaining the stability of the trench in accordance with the requirements of the Associated Contractor's Manual of Accident Prevention OSHA, Part 1926.P.
4. Protection of Underground Facilities
    a. Investigate underground facility location prior to start of construction.
    b. Installer is required to contact North Carolina 811 prior to start of construction.
    c. Repair damage to any existing facilities.
5. Water Control
    a. Prevent surface water from entering the trench.
    b. When trench bottom is below the existing ground water table, install a dewatering system to maintain water table 1 foot below trench bottom. Provide a man experienced in dewatering work at the job site.
    c. Maintain dewatering until backfilling has proceeded above the existing ground water level.
    d. Dispose of water from dewatering operations in accordance with the North Carolina Sedimentation Pollution Control Act.
6. Use of Explosives
    a. Explosives may not be used on any excavation unless specifically approved by the Town.
7. Excavating
    a. Excavation shall be by open cut method. 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. Contractor shall segregate excavated material so as to maintain material suitable for backfill separate from material that is unsuitable.
    d. Trench dimensions at the pipe embedment and foundation zone unless noted otherwise shall be as follows:
        1) Minimum width: Pipe outside diameter plus 18 inches.
        2) Maximum width: Pipe outside diameter plus 24 inches.
        3) Sides shall be vertical to a minimum of one foot above the top of pipe.
    e. Shape trench bedding to provide uniform bearing for the full pipe length. Bottom shall be free of protrusions that could cause point loading on pipe. Provide bell holes as required for properly making pipe joint.
    f. Do not over excavate. Excavation below grade shall be backfilled with Class I material.
    g. Undercut soils that become unsatisfactory by construction activity or by being left exposed to the weather and backfill with Class I material.

h. Remove shoring, bracing, and sheeting, unless otherwise noted, as the trench is backfilled.
i. Excavation of trench shall not advance more than 200 feet ahead of the installation. In no case should the excavation extend beyond that which can be backfilled by the end of the workday.
j. Correct unstable soil conditions encountered at trench foundation by one of the following methods:
    1) Excavate below grade as approved by Engineer and backfill with Class I material or approved substitute material.
k. Rock and Hard Material
    1) Excavate rock and hard material to a minimum depth of 4 inches below the pipe for pipes smaller than 30 inches and 6 inches for pipes 30 inches and larger.
l. Pressure Lines:
    1) Provide a minimum 3 feet of cover.
    2) Excavate trenches to provide vertical curve chords that will not exceed the pipe manufacturer's recommended joint deflection.
    3) Provide concrete thrust blocks having a compressive strength of 3,000 psi at 28 days at change in horizontal and vertical direction and reduction in the pipe size, unless other restraint systems are approved. Cut trench sides vertical and square to receive concrete. Provide bearing area against trench wall as indicated in the Standard Detail.
m. Gravity Lines:
    1) Excavate trench to the design alignment and grade.
n. Utility Structures: Provide a minimum of 12 inches below subgrade and backfill with Class I compacted to 95 percent maximum density. If the soil conditions are found to be unsuitable for structural stability of the manhole, Town may require additional depth of Class I material.

8. Backfilling
    a. General
        1) Temperature must be above freezing and rising.
        2) In windy, hot, or arid conditions with a high rate of evaporation add moisture to the material to maintain the optimum moisture content.
        3) Do not proceed in rain or on saturated subgrade.
        4) Do not place material on surfaces that are muddy, frozen, or contain frost.
        5) Maintain backfill operation within 200 feet from pipe laying operation.
        6) Backfill trench to existing ground surface with select excavated material at the specified compaction.
        7) If excavated material is unsuitable to obtain specified compaction, provide suitable off-site borrow material for backfill.
        8) Re-excavate trenches improperly compacted. Backfill and compact as specified.
        9) Provide appropriate tamping equipment, and water to obtain proper moisture content, to achieve specified compaction of backfill.
        10) Conduct operation of heavy equipment above pipe installation as to prevent damage to pipe.

11) Install warning / identification tape over utilities. Bury tape one foot below finished grade above the utility.

12) Install tracer wire for non-metallic pressure pipe. Bury tracer wire with pipe. Wire shall be looped into valve boxes to allow access for direct contact location.

b. Backfill in pipe embedment zone (bedding, haunching, and initial backfill).

1) General

i) Backfill with material as specified below. Material shall be free from objects larger than 2 inches.

ii) Where rock and hard material has been excavated below pipe bottom, backfill and compact bedding with Class I material. Class II or III material may be used for bedding with Engineer's approval.

iii) Place backfill material to assure placement of material under pipe haunches.

iv) Take care during placement and compacting of material to avoid movement of pipe.

2) Place backfill in bedding and haunching zones in 6 inch maximum lifts and compact to 90 percent density. Place initial backfill in one lift do not compact. Provide backfill material in pipe embedment zone as specified below.

i) Pressure Lines (Flexible and Rigid Pipe)

i. Excavation in Class I, Class II, and Class III soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.

ii. Excavation in Class IV or Class V, 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. Backfill with Class I, II, or III material in initial backfill.

iii. Ductile Iron over 16 inch

a) Depth 0 - 12 feet: Type 2 laying conditions same as for pressure pipe.

b) Depth over 12 feet: Provide Class I material for bedding and 4 inches up from bottom of pipe.

ii) Gravity Sewer Lines, Rigid Pipe and Ductile Iron

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.

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. Backfill with Class I, II, or III material in initial backfill.

iii) Gravity Sewer Lines, Flexible (PVC SDR 35)

i. Depth 0 to 14 ft: Provide Class I material for bedding and haunching. Backfill with Class I, II, or III material in initial backfill.

ii. Depth over 14 ft: Provide Class I material for bedding, haunching, and initial backfill.

c. Final Backfill

1) Backfill with materials free of stones and free of debris larger than 6 inches in dimension. Place backfill in lifts not exceeding the thickness and compacted to the minimum density specified below.

2) 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.

3) Lifts and density:

i) Undeveloped areas (i.e., forests, fields, and, croplands): 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.

ii) Lawns: Backfill in 12-inch lifts and compact to 90 percent. Top 12 inches shall be free of material with a dimension over 2 inches.

iii) Roads (including rights-of-way), drives, parking areas (including areas within 20 feet), and adjacent to existing utilities: Backfill in 6 inch lifts compact to 95 percent.

iv) Within 20 feet of foundations: Backfill in 6-inch lifts compacted to 95 percent.

d. Utility Structures: Bring backfill to grade in even lifts on all sides. Lift depths and compaction densities shall be as specified according to area of installation for pipe above. Backfill against cast-in-place concrete structure only after concrete has attained the specified 28-day compressive strength.

C. Relation of Sewer to Water Main, Wells and Storm Sewer

1. Lateral Separation: Lay at least 10 feet laterally from existing and proposed water main. Where existing conditions prevent a 10-foot lateral separation, the following shall be followed with approval of the Town:

a. Lay sewer in a separate trench, with the elevation of the top of the sewer at least 18-inches below the bottom of the water line.

b. Lay sewer in the same trench as the water main with the sewer main located at one side on a bench of undisturbed earth, and with the elevation of the top of the sewer at least 18 inches below the bottom of the water line.

2. Crossing Separation: Lay top of sewer at least 18 inches below the bottom of the water. Where existing conditions prevent an 18-inch vertical separation,

construct both the water main and sewer of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. Both the water and sewer line must be pressure tested to 150 psi to insure water tightness.

3. Crossing a Sewer Over a Water Main: When it is necessary for a sewer to cross over a water main, construct both the water main and the sewer of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.
4. A 24-inch vertical separation shall be provided between sanitary sewers and storm sewers or ferrous pipe specified.
5. Lay sewer pipe to true lines and grades by use of laser beam equipment or other acceptable means.
6. Minimum Separation Distances:
    a. 100-foot horizontal separation from wells or other water supplies.
    b. 24-inch vertical separation from storm sewers or ferrous pipe shall be used.

D. Ductile Iron Pipe
1. Install pipe in conformance with AWWA C600 and the following:
    a. For laying pipe in a vertical or horizontal curve, each full length pipe may be deflected by the following offset distance:
        1) Push-on joint
            i) 3 to 12-inch pipe: 14-inch offset
            ii) 14 to 36-inch pipe: 8-inch offset
        2) Mechanical joint
            i) 3 to 6-inch pipe: 20-inch offset
            ii) 8 to 12-inch pipe: 15-inch offset
            iii) 14 to 20-inch pipe: 8-inch offset
            iv) 24 to 36-inch pipe: 6-inch offset
    b. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:
        1) 6 to 12-inch pipe: 11-inch offset
        2) 16 to 20-inch pipe: 7-inch offset
        3) 24 to 30-inch pipe: 5-inch offset
        4) 36-inch pipe: 4-inch offset
        5) 42 to 48-inch pipe: 1 ¼ -inch offset

E. PVC Pressure Pipe
1. Install PVC C900 pipe in conformance with AWWA C605.
2. Bell and Spigot Joints: Clean bell and spigot ends prior to jointing. Ends of field cut pipe shall be beveled with file. Gasket shall be clean and lightly lubricated. Joint shall be made as recommended by the manufacturer.

F. Encasement Pipe

1. General

a. Verify the subsurface conditions at each boring site.

b. Stabilize and maintain bore pit bottom to provide proper equipment support and maintain pipe alignment. Dewater as necessary for site. Excavate bore pit in accordance with OSHA regulations. Provide adequate barricades, railings, and warning lights throughout the boring operation. Conduct operation in such a manner so as not to create a hazard to, nor impede the flow of traffic.

c. Install encasement pipe by dry boring and jacking.

d. Boring auger diameter shall not be greater than the outside diameter of the encasement pipe and shall not extend more than 6-inches ahead of the cutting edge of the encasement pipe. Fill voids that are formed during the operation with a 1:3 portland cement grout pumped at 50 psi to ensure that there will be no settlement of the roadway.

e. As the boring operation progresses, butt weld each new section of the encasement pipe to the section previously jacked into place. Maintain proper alignment. Confirm the grade of the encasement pipe as the Work progresses.

f. If an obstruction is encountered during the boring operation, efforts should be made to remove the obstruction. If obstruction cannot be removed, withdraw the encasement pipe and fill the void with 1:3 portland cement grout at 50 psi. If the encasement pipe cannot be withdrawn, seal ends before moving to another bore site. Town shall approve location of new bore site.

g. Provide seals at each end of encasement pipe.

2. Carrier Pipe

a. Install carrier pipe in the encasement pipe using manufactured pipe supports. Supports shall prevent movement of the carrier pipe within the encasement. Space supports as specified.

G. Sewer Cleanouts

1. General

a. Sewer cleanouts connected to ductile iron pipe shall also be ductile iron sewer pipe conforming to these specifications.

b. Sewer cleanouts connected to PVC pipe shall also be PVC sewer pipe schedule 40 conforming to ASTM-D-3034 latest revision. Use elastomeric gaskets for pipe joints.

c. Service wyes shall be used on new PVC pipe. Service saddles shall be used on existing PVC, solvent welded to the main and fastened with double stainless steel bands.

d. Cleanouts shall be a minimum of 4-inch diameter. Provide sewer cleanouts with screw-in watertight cap. Installation shall be in accordance with the standard detail.

H. Service Connections

1. General

a. Make service connections in accordance with the standard detail.

b. Service connections to the main lines shall be perpendicular to the main line to the edge of the right-of-way or easement line.

c. Four-inch lines shall have a minimum slope of 1.0 % and have cleanouts every 75 feet at a minimum in addition to a cleanout at the right-of-way line or at the edge of the easement.

d. Six-inch lines shall have a minimum slope of 0.60 % and have cleanouts every 100 feet at a minimum in addition to a cleanout at the right-of-way line or at the edge of the easement.

e. 6-inch service lines shall tie directly into a manhole.

f. Service lines, which are connected into manholes, shall be installed less than 2.5 feet above the invert or shall be installed as a standard drop.

I. Anti-Seep Collars

1. General

a. Anti-seep Collars: Provide anti-seep collars to prevent groundwater flow along pipe in wetlands. Collars shall extend past trench walls and bear against undisturbed soils. Dimension of collars shall be as indicated on the standard details. Do not place stone in area of anti-seep collars.

b. Concrete Collar: Provide Class B concrete with minimum cement content of 5 sacks per cubic yard (5.5 sacks for angular course aggregate); 6.8 gallons of water per sack water-cement ratio; 2-4 inch slump range; and 28-day strength of 2,500 psi.

c. Clay Collar: Provide clay of medium to high plasticity with a soil classification of CL or CH and a permeability of 10-5 cm / second. Place clay in 6-inch lifts and compact by use of a mechanical hydraulic tamper to 95 percent.

J. Pavement Patching

1. General

a. Repair damaged pavement structure.

b. Cut existing pavement for utility installation in straight lines generally parallel to the utility. Properly dispose of removed pavement structure.

c. Extend pavement patch 1 foot beyond each side of trench on firm subgrade. Slope new surface to drain.

d. Asphalt Pavements: Replace asphalt pavement with a pavement structure no less than as shown on the Standard Details. For roadways under NC Division of Highways jurisdiction, pavement shall be replaced in accordance with their requirements.

e. Concrete Pavements: Replace concrete pavement with pavement structure equal to existing but no less than 6 inches. Concrete shall be minimum 3,000 psi. When existing concrete joint is within 5 feet of trench remove existing concrete to joint. Provide expansion joint at edge of existing concrete. Surface treatment shall match existing.

f. Curbs, Gutters, and Sidewalks: Replace curbs and gutters, and sidewalks removed or damaged with similar sections to match the existing. Remove to nearest existing joint.

g. Approval of Other Authorities: Pavements under the jurisdiction of the NC Division of Highways shall be subject to the approval of a representative of that Division.

K. Grading and Clean-Up

1. General

a. Provide for testing and clean-up as soon as practical, so these operations do not lag far behind the pipe installation. Perform preliminary clean-up and grading as soon as backfill is complete.

b. Provide positive drainage of finished grade and drain away from structures. Finished grade shall be reasonably smooth, compacted, free from irregular surface changes and comparable to the adjacent existing ground surface.

c. Seed disturbed areas.

d. Upon completion of backfilling, remove and properly dispose of excess material and waste.

3.02 Manholes

A. Set base plumb and level. Align manhole invert with pipe invert.

B. Secure pipe connectors to pipe in accordance with manufacturer's recommendation.

C. Clean bells and spigots of foreign material that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Do not stretch. Follow manufacturer's instructions when using O-ring seals.

D. Set precast components so that steps align.

E. Plug lift holes using a non-shrink grout. Cover with a butyl sealant sheet on the outside and seal on the inside with an application of an epoxy gel 1/8-inch thick extending 2 inches beyond the opening.

F. Set manhole frames to grade with grade rings. Seal joints between cone, adjusting rings, and manhole frame with butyl sealant rope and sheet.

G. Apply external seal to the outside of joint.

H. Finish the interior by filling fractures greater than 1/2-inch in length, width or depth with a sand cement mortar.

I. Clean the interior of the manhole of foreign matter.

J. Ring and Cover shall be installed in accordance with Standard Details

3.03 Valves and Fittings

A. General

1. Install buried valves on top of an 18-inch square, 3-inch thick, solid concrete pad (minimum dimensions). The concrete pad may be provided by a pre-cast manufacturer or cast-in-place in the field above grade. Concrete used for the pads shall be a minimum 3,000 psi mix. The pads may not be cast-in-place in

the pipe trench. Connection to pipe shall be such that there shall be no stress at the joint caused by misalignment or inadequate support of pipe or valve.

2. Install fittings as recommended by the manufacturer. Fittings shall be blocked or otherwise restrained from movement.
3. Valve Boxes: Set valve boxes flush with finished grade. Box shall be supported so that no stress shall be transmitted to the valve. Operating nut shall be centered in box.
4. Install valves and other accessories in complete accordance with the manufacturer's recommendations.
5. Valve boxes shall be set straight with the operating nut centered and supported on (2) 4" concrete blocks, to prevent load transfer onto valve body or pipe line. Set top of box at finished grade. Provide a 24-inch x 24-inch wide by 6-inch thick concrete pad at top of valve boxes outside paved areas. Pre-cast pads may be allowed by the Town.
6. Air Valves
    a. Main shall be drilled for the appropriate size connection.
    b. Valve shall be installed on the main line with a service saddle.
    c. Install air valve in a flat top manhole as per detail.

3.04 Pump Station

A. General

1. Install precast concrete wet well and valve vault in accordance with Paragraph 3.02 – MANHOLES of these specifications.
2. Install pumps and motors in accordance with manufacturer's installation instructions.
3. Electrical work shall be in accordance with all local, state and federal requirements. Contractor is responsible for obtaining all required permits and scheduling inspections. Coordinate electrical service to site with local power company.

3.05 Engine Generator System with Automatic Transfer Switch

A. Engine Generator

1. Install in accordance with manufacturer's instructions.
2. Provide fuel system piping as recommended by generator set manufacturer.
3. Provide wiring for fuel shutoff valve powered from generator set batteries and controlled by generator set control panel.
4. Provide interconnecting wiring between generator control panel and pump control panel.
5. Provide interconnecting wiring between generator control panel and telemetry system.
6. Provide interconnecting wiring between generator control panel and automatic transfer switch for automatic start.
7. Provide duplex receptacle, battery charger, alternator heater, and jacket heater branch circuits from an external source.

B. Automatic Transfer Switch

1. Install transfer switch in accordance with manufacturer's instructions.
2. Provide engraved plastic nameplates.
3. Provide generator start/stop signal wiring and conduit from transfer switch to generator control panel.
4. Provide interconnection wiring with duplex pump control circuit to allow only one pump to run while on generator power.
5. Provide 120 volt power source for heater.

3.06 Painting

A. Equipment shall receive the manufacturer's standard coating for the intended application. Coatings shall be suitable for the intended application.

B. Repaint damaged paint surfaces.

C. Above ground piping and piping within vaults shall be painted in accordance with Section, Painting.

PART 4: TESTING AND STARTUP

4.01 Pipes and Accessories

A. GENERAL
   1. Clean and flush pipe system of foreign matter prior to testing.
   2. Notify Owner and Engineer a minimum of 48 hours prior to testing.
   3. Perform tests in the presence of Engineer.
   4. Length of line to be tested at one time shall be subject to approval of Engineer.
   5. Pipe sections shall not be accepted and placed into service until specified test limits have been met.
   6. Repair defects in the pipe system. Make repairs to the same standard as specified for the pipe system.
   7. Retest repaired sections until acceptance.
   8. Repair visible leaks regardless of the test results.

B. Pressure Mains
   1. The Engineer shall approve the source, quality, and method of disposal of water to be used in test procedures.
   2. Obtain Owner's permission 48 hours prior to filling or flushing of pipe system with water from Owner's water system. Owner shall operate valves connected to the existing water system. Keep pipe interior clean during construction to minimize the amount of water required for flushing. Where large quantities of water may be required for flushing, Engineer reserves the right to require that flushing be done at periods of low demand.
   3. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe and the following.
   4. Make pressure tests between valves. Furnish suitable test plugs where line ends in "free flow."
   5. Provide air vents at the high points in the line section to be tested for releasing of air during filling. Service corporation stops may be used for air vent when located at a high point. Include cost of air vents in price of testing. Leave corporation stops in place after testing and note locations on As-Built Drawings.
   6. Allow concrete blocking to reach design strength prior to pressure testing.
   7. Force main shall be completely filled with water, all air expelled from the pipe, and the discharge end of the pipeline shall be plugged and adequately blocked before hydrostatic test begins.
   8. Upon completing a section of pipe between valves, test pipe by maintaining for a two hour period the following hydrostatic pressure for each main:
      a. Force main: 150 psig
   9. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
   10. No length of line shall be accepted if the leakage is greater than that determined by the following formula based on the appropriate test pressure:

       L = Allowable leakage per 1,000 feet of pipe in gallons per hour.
       D = Nominal diameter of the pipe in inches.
       100 psi: L = D x 0.07
       150 psi: L = D x 0.08
       200 psi: L = D x 0.09
       250 psi: L = D x 0.10

C. Gravity Sewer Mains
   1. Test gravity lines between manholes.
   2. Light Testing: Engineer will check for displacement of pipe as follows:
      a. A light will be flashed between the ends of the pipe section being tested.
      b. If the illuminated interior shows misalignment, or other defects as designated by Engineer, defects shall be repaired.
   3. General
      a. Infiltration shall not exceed 100 gallons per inch of diameter, per mile of pipe, per 24 hours. Engineer may require flow measurement for verification of infiltration.
      b. Verify that maximum infiltration rate shall not be surpassed by air testing as follows.
   4. Low Pressure Air Test:
      a. Air testing of sewer mains shall conform to UNI-B-6 and the following requirements:
      b. Perform initial air test when each section of main is complete including services to right of way. Test as construction proceeds.
      c. Wet interior surfaces of porous pipe material prior to testing.
      d. Safety
         1) Provide a superintendent who has experience in low pressure air testing of gravity sewer mains.
         2) Follow safety recommendations of air testing equipment manufacturer.
         3) Properly brace sewer plugs during testing. Test plugs prior to use in air testing.
         4) No one shall be allowed in manhole or trench when pipe is under pressure.
         5) 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.
      e. Equipment
         1) Sewer plugs shall be specifically designed for low pressure air testing.
         2) Use two 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.
         3) As a minimum the above ground air testing equipment shall include a shutoff 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.
         4) 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.
         5) Monitoring gauges shall be subject to calibration as deemed necessary.
         6) Air used for testing shall pass through a single above ground control panel.

f. Testing
    1) Groundwater Determination: 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.
    2) 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.
    3) When the above required pressure is reached, throttle air supply to maintain internal pressure for at least two minutes to permit stabilization.
    4) When pressure has stabilized at required pressure, shut off air supply.
    5) While observing the continuous monitoring pressure gauge, decrease pressure approximately 0.5 psi from required pressure.
    6) 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 the pressure drop does not exceed 1 psig in the time prescribed for the test in Table 1, Low Pressure Air Testing for Gravity Sewer Mains, at the end of this section.

5. Deflection Test for SDR 35 and Ribbed (ASTM F 949) PVC pipe.
    a. Measure for deflection of pipe no sooner than thirty days after installation and backfill.
    b. Deflection shall not exceed 5 percent of pipe diameter. Maximum allowable long term deflection shall be 5 percent.
    c. Measure deflection with an approved “GO-NO-GO GAUGE” method or by an approved recording deflectometer. Verify gauge on site prior to testing.
6. Hydrostatic Test for Gravity Sewers
    a. The source, quality, and method of disposal of water to be used in test procedures shall be approved by the Engineer.
    b. Obtain Owner’s permission 48 hours prior to filling or flushing of pipe system with water from Owner’s water system. Owner of water system shall operate valves connected to the existing water system.
    c. Air test line, as described above, prior to hydrostatic testing.
    d. Provide taps for filling and pressurizing the line. Service corporation stops may be used. Include cost of taps in price of testing. Leave corporation stops in place after testing and note locations on As-Built Drawings.
    e. Suitable means for thrust restraint shall be installed for testing.
    f. Test for each manhole reach.
    g. Test pipe by maintaining for a two-hour period a hydrostatic pressure of 150 psig.
    h. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
    i. Pressure test in accordance with AWWA C600 for ductile iron pipe and as described above.
    j. Hydrostatic testing for gravity sewers within 100 feet of a water supply well shall be paid for as described in Section, Basis for Payment.

4.02 Manholes

A. Vacuum test each manhole in accordance with ASTM C1244 and the following:
    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:

Manhole I.D. (inches)	**48**	**60**	**72**	**84**	**96**	**120**
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 Engineer and repeat test until manhole passes.

4.03 Pump Station

A. Wet Well and Valve Vault

1. Test wet well for water-tightness. Perform water-tightness test in the presence of the Town.
2. Water-tightness test shall be in accordance with ACI 350.IR/AWWA 400 "Testing Reinforced Concrete Structures for Water-Tightness." Plug influent line and fill wet well with water to 6-inches below the force main pipe. Allow water to sit for 24 hours to allow for absorption by the concrete. There shall be no loss of water over a 24 hour period. If the water level has dropped the test may be run again at the Contractor's option. If the test fails a second time, the interior of the wet well shall be coated with water proofing compound and the wet well retested.
3. Vacuum test may be used upon approval of the Town. Test shall meet the requirement for manhole testing as indicated in Paragraph 4.02 – MANHOLES of these requirements.
4. Submit record of test signed by the Contractor.

B. Pump Operations

1. A Certified Performance Test shall be performed on each pump at the factory before delivery to the site.
2. Provide the services of manufacturer's representative to check the pump station installation, supervise initial start up, and instruct the Town's personnel in proper operation and maintenance of the pumps and appurtenances. A minimum of two separate trips to the site will be required, each consisting of a minimum of one 8 hour working day. Regardless of the time spent at the site, services will not be considered complete until the pump station operates as intended for a minimum of one (1) week of operation.
3. Operate pump station under actual field service to demonstrate that the all equipment performs to the specified criteria flow capacity and head conditions. During the field test, make adjustments as necessary for proper operation. Adjust impeller size as necessary to meet field conditions.

4. Manufacturer's recommended start up tests shall be performed according to the installation schedule. Start up tests shall include the following as a minimum:
    a. Data for each pump under operating conditions:
        1) Amperage reading.
        2) Pressure head reading.
        3) Drawdown flow test.
    b. Pull out each pump and reinstall using guide rails and hoist.
    c. Test alarm condition for high flow.
    d. Test auxiliary contacts.
    e. Test float control system.
5. Submit copy of tests and checks performed in the field, complete with recordings, where applicable, to the Town.

4.04 Engine Generator System with Automatic Transfer Switch

A. Engine Generator System

1. Provide the services of manufacturer's representative to check the equipment installation, supervise initial start up, and instruct Town's personnel in proper operation and maintenance of the equipment. A minimum of one trip to the site will be required, consisting of a minimum of one 8-hour working day. Regardless of the time spent at the site, services will not be considered complete until the system operates as intended for a minimum of one (1) month of operation.
2. Provide a four hour full load test utilizing portable test bank. Simulate power failure including operation of transfer switch, automatic starting cycle, automatic shutdown, and return to normal. The load bank test shall be performed at the job site and shall include one hour at 50% load, one hour at 75% load, one hour at 100% load, and one hour at 50% load. Any defects that become evident during the test shall be corrected. Safety shutdown features shall be tested by simulating the primary device contact closure.
3. Record in 20 minute intervals during four hour test:
    a. Kilowatts.
    b. Amperes.
    c. Voltage.
    d. Coolant temperature.
    e. Ambient temperature.
    f. Frequency.
    g. Oil pressure.
4. Test alarm and shutdown circuits by simulating conditions.
5. Describe loads connected to standby system and restrictions for future load additions.
6. Adjust generator output voltage and engine speed.
7. Clean engine and generator surfaces. Replace oil and fuel filters at time of final acceptance by the Town.

8. Provide required fuel for testing and start up services.
9. Provide complete charges of oil and antifreeze at time of final acceptance by the Town.
10. Fuel tank shall be filled at time of final acceptance by the Town

B. Automatic Transfer Switch

1. Manufacturer's representative shall prepare and start-up system in accordance with manufacturer's recommendation.
2. Fully demonstrate, in the presence of the Town's representatives, the operation of the switch in normal and emergency modes.

4.05 Closed Circuit TV'ing of Gravity Lines

A. General

1. Following installation of gravity lines, Contractor shall visually inspect each line by means of close-circuit television (CCTV). Video shall be recorded on a DVD.
2. Television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. Camera shall be operative in 100 percent humidity conditions. Components of the video system shall be capable of producing a minimum 310 line resolution. Lighting system shall minimize reflective glare. Camera shall move through at a constant rate with a maximum speed of 30 feet per minute.
3. Deliver DVD to the Town prior to final acceptance.

4.06 "As-constructed" Drawings

A. General

1. Maintain on-site a full set of project drawings for purpose of recording as-constructed conditions.
2. Information should be legibly recorded as construction progresses.
3. Clearly and completely identify any field changes from the original drawings.
4. The depth of all force mains shall be recorded at all roadways, waterway crossings, utilities crossings and all other areas as needed to accurately define the vertical location of the force main. A minimum of one depth shall be recorded on each 100 feet of pipe installed. Depth shall be referenced to finished surface grades.
5. Show horizontal and vertical location of any existing underground utilities encountered during construction.
6. Submit document to the Town prior to final acceptance.

Table 1:
Low Pressure Air Testing
For
Gravity Sewer Mains
Minimum Time Required for a Maximum 1.0 PSIG Pressure Drop
For Size and Length of Pipe Indicated

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	5 Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:36	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.324 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

*This Table is from UNI-B-6-90. The table is based on a Q (allowable air loss rate in test section) = 0.0015 cubic feet / minute / square feet.
*To shorten required test time a maximum pressure drop of 0.5 psig may be used and time requirements reduced by half.

END OF SECTION