DEVELOPMENT OF WATER & SEWER UTILITIES
IN
HARNETT COUNTY WATER AND SEWER DISTRICTS

HARNETT REGIONAL WATER
(Revised January 2019)

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***Chapter to be added at a later date.**

CHAPTER 1

DEFINITIONS AND TERMS

Chapter 1 DEFINITIONS AND TERMS

Section 1.1 Interpretation of Certain Terms or Words

Except as specifically defined herein, all words used in this Regulation have their customary dictionary definitions. For the purposes of this Policy, certain words or terms used herein are defined as follows:

1.1.1 Words used in the present tense include the future tense. Words used in the singular include the plural and words used in the plural include the singular.

1.1.2 The word "shall" is always mandatory.

1.1.3 The word "may" is permissive.

1.1.4 The word "lot" includes the word "plat" or parcel.

1.1.5 The word "person" includes a firm, association, organization, partnership, trust company, or corporation as well as an individual.

Section 1.2 Definitions

1.2.1 Density

Unless otherwise stated, density requirements in this regulation are to be expressed in gallons per residential equivalent per day. Table No. 1 in the Appendix shall be used to calculate gallons per residential equivalent per day. Refer to Table No. 1 in the Appendix. Other values for the determination of gallons per residential equivalent will be considered, if justified, on the basis of extensive documentation.

1.2.2 Developer

Any person, firm, corporation, or other legal entity improving property for commercial, industrial, or residential purposes.

1.2.3 Easement

A grant by the property owner to any person, firm, corporation or public entity for the use of a strip or parcel of land for a specified purpose.

1.2.4 Engineer

See: Registered Professional Engineer

1.2.5 Governing Authority

The Board-of-Commissioners of Harnett County acting through Harnett Regional Water (HRW).

1.2.6 Land Surveyor

See: Registered Professional Engineer

1.2.7 Lot

A piece, parcel, tract, or plat of land intended as a unit for the transfer of ownership for development.

1.2.8 Planning Commission

The Harnett County Planning Board and the Harnett County Development Review Board.

1.2.9 Plat

A map or drawing upon which the development plan is presented for approval.

1.2.10 Recognized Standards, Codes and Statutes

The following list of standards, codes and statutes outlined more specifically below are common principles for the design, construction, testing, inspection, operation and/or maintenance adopted by the reference for the Harnett Regional Water's Water Distribution System & Wastewater Collection System. Any extension, connection, service, tap, lateral, point of discharge or any use of the Harnett Regional Water's Water and Wastewater Systems shall agree to adopt and conform to the minimum requirements of all standard engineering design practices; construction, fabrication and installation methods; standard operating procedures and best maintenance practices for the systems in accordance with these recognized standards of the following professional societies, federal and state government agencies. Where conflicts may arise between these recognized standards, HRW shall make the determination for resolution.

A. American National Standards Institute - ANSI

The latest edition of Standards published by the American National Standards Institute.

ANSI [http://www.ansi.org/]

B. American Society of Civil Engineers - ASCE MOP

The latest edition of Manual of Practice published by the American Society of Civil Engineers.

ASCE [http://www.asce.org/]

C. American Society of Mechanical Engineers - ASME

The latest edition of the American Society of Mechanical Engineers Code

ASME [http://www.asme.org/]

D. American Society of Testing and Materials - ASTM

The latest edition of Standards published by the American Society of Testing and Materials

ASTM [http://www.astm.org/]

E. American Society of Sanitary Engineering - ASSE

The latest edition of Plumbing Standards published by the American Society of Sanitary Engineering is the voice of the ASSE Seal and Standards Programs.

ASSE [http://www.asse-plumbing.org/]

F. American Water Works Association - AWWA

The latest edition of Standards published by the American Water Works Association.

AWWA [http://www.awwa.org/]

G. HRW

Harnett Regional Water or its appointed representative over the project unless otherwise noted.

H. Institute of Electrical and Electronics Engineers, Inc. - IEEE

The IEEE name was originally an acronym for the Institute of Electrical and Electronics Engineers, Inc. Today, the organization's scope of interest has expanded into so many related fields, that it is simply referred to by the letters I-E-E-E. A non-profit organization, IEEE is the world's leading professional association for the advancement of technology.

IEEE [http://www.ieee.org/portal/site/iportals/]

I. National Electrical Code - NEC

The latest edition of the National Electrical Code.

NEC [http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=70]

J. National Electrical Manufacturers Association - NEMA

The National Electrical Manufacturers Association

NEMA [http://www.nema.org/]

K. National Rural Water Association – NRWA

The National Rural Water Association (NRWA) is a non-profit federation of State Rural Water Associations. NRWA"s mission is to provide support services to our State Associations who have more than 25,735 water and wastewater systems as members.

NRWA [http://www.nrwa.org/]

L. North Carolina Board of Examiners for Engineers and Land Surveyors

The North Carolina Board of Examiners for Engineers and Land Surveyors is responsible for the administration and regulation of the professions of engineering and land surveying in North Carolina.

NCBELS [http://www.ncbels.org/]

M. North Carolina Department of Environment and Natural Resources - NCDENR

The North Carolina Department of Environment and Natural Resources (NCDENR) is the lead stewardship agency for the preservation and protection of North Carolina's outstanding natural resources. The organization, which has offices from the mountains to the coast, administers regulatory programs designed to protect air quality, water quality, land quality, wildlife and the public's health. NCDENR also offers technical assistance to businesses, farmers, local governments, and the public and encourages responsible behavior with respect to the environment through education programs.

NCDENR [http://www.enr.state.nc.us/]

N. North Carolina Department of Transportation - NCDOT

The North Carolina Department of Transportation (NCDOT) provides and supports a safe and integrated transportation system that enhances the state. NCDOT standards must be followed by HRW, developers, utility contractors, surveyors and engineers. Developers must acquire a three party NCDOT Encroachment Agreement before scheduling work inside the established NCDOT right-of-way of each highway, street, or road maintained by NCDOT.

NCDOT [http://www.ncdot.gov/]

O. United States Army Corps of Engineers - USACE

The United States Army Corps of Engineers (USACE) provides quality, responsive engineering services to the nation relating to planning, designing, construction, operation and maintenance support for civil projects.
All development that disturbs more than one (1) acre of wetlands must follow the Nationwide 12 Permit requirements set forth by the USACE and reporting requirements of the NCDENR – Division of Water Quality

USACE [http://www.usace.army.mil/Pages/Default.aspx]

P. United States Department of Labor (USDOL)
Occupational Safety and Health Administration (OSHA)

Under the Occupational Safety and Health Act of 1970, OSHA's role is to assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health.

OSHA [http://www.osha.gov/]

Q. Mine Safety & Health Administration (MSHA) of the United States Department of Labor - NEC

The latest edition of the Federal Mine Safety & Health Act of 1977.

MSHA [http://www.msha.gov/]

R. Water Environment Federation

The Water Environment Federation® is the not-for-profit association that provides technical education and training for the world's water quality professionals and also supports like-minded organizations such as Water for People and Engineers Without Borders. Formed in 1928, the Water Environment Federation® (WEF®) is a not-for-profit technical and educational organization with 35,000 individual members and 75 affiliated Member Associations representing water quality professionals around the world. WEF and its Member Associations proudly work to achieve our mission of preserving and enhancing the global water environment. Water Environment Research (WER) publishes peer-reviewed research papers, research notes, state-of-the-art and critical reviews on original, fundamental and applied research in all scientific and technical areas related to water quality, pollution control, and management.

WEF [http://www.wef.org/Home]
WER [http://www.wef.org/ScienceTechnologyResources/Publications/WER/]

The Manual of Practice (MOP) published by the Water Pollution Control Federation is a technical guide of references written for and by the water quality community.

1.2.11 Registered Professional Engineer

A person registered as a Professional Engineer by the North Carolina Board of Examiners of Engineers and Land Surveyors and competent in the field of water and waste collection, transmission and treatment design. (See the North Carolina Board of Examiners for Engineers and Land Surveyors).

1.2.12 Registered Land Surveyor

A person registered as a Land Surveyor by the North Carolina Board of Examiners of Engineers and Land Surveyors and competent in the field of land surveying. (See the North Carolina Board of Examiners for Engineers and Land Surveyors).

Section 1.3 Additional Definitions

Throughout this specification document, the following terms shall have the meanings ascribed to them respectively:

Agreement: A agreement between Harnett Regional Water, State or representatives of the Departments of the County or State with any private developer, contractor, engineer, surveyor, attorney, or designated representative of established organizations for profit and non-profit organizations to set forth terms of an understanding between said parties. As a rule, the Harnett Regional Water requires all agreements to be in writing with the signatures of the proper representatives of Harnett Regional Water and State Department(s) and witnessed along with signatures of the all involved parties private or public.

Air-gap: The vertical distance through the atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other device and the flood level rim of the receptacle. An approved air-gap vertical separation shall be at least double the diameter of the supply pipe. In no case shall the air-gap be less than two (2") inches.

Approved Equal: Certified in writing by the Engineering staff of the Harnett Regional Water (HRW) as an acceptable device, appurtenance or methodology used within the Harnett Regional Water System. The approved equal shall be consistent with the standard specified by name in design, material, service life, and cost of ownership and ease of installation or removal for normal maintenance and repairs.

Auxiliary intake: Any piping connection or other device whereby water may be secured from a source other than public water supply.

Backflow: Any flow of water into the public water supply from any other source due to a cross-connection, auxiliary intake, interconnection, backpressure, backsiphonage, any combination thereof, or other cause.

Backpressure: Any pressure on any source of water other than the public water supply which may be greater than the pressure on the public water supply and may result in a backflow.

Backflow prevention device: An approved effective device or method used to prevent backflow from occurring in the potable water supply. The type of device required shall be based on degree of hazard, existing or potential.

Backsiphonage: Any circumstance in which the pressure on the public water supply may be reduced to the point that the elevation and atmospheric pressure on a source of water other than the public water supply may result in a pressure to be greater than the pressure on the public water supply and may result in a backflow.

Certified tester: A person who has proven his/her competency to test, repair, overhaul and make reports on backflow prevention devices as evidenced by certification of successful completion of a training program approved by the Director of Harnett Regional Water.

Cleanout: An entry point to the sanitary sewer service lateral to flush or remove clogged lateral lines to the sewer mains to remove any blockages. Cleanouts should be located near the property line at the edge of the street right-of-way.

Confinement assembly or device: A backflow prevention device, as approved and required, installed within a private plumbing or distribution system to isolate a localized hazard from the remainder of said system.

Confined Space: Spaces that are considered "confined" because their configurations hinder the activities of employees who must enter, work in, and exit them. A confined space has limited or restricted means for entry or exit, it may contain hazardous fluids or gases and it is not designed for continuous employee occupancy. Confined spaces include, but are not limited to underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, and pipelines. (See Permit-required confined space)

Containment device: A backflow prevention device, as approved and required, installed at the point of separation between the public water supply and a private service or private distribution system or at the point of metering.

Cross-connection: Any physical connection whereby the public water supply is connected with any other water supply system, whether public or private, either inside or outside of any building or buildings, in such a manner that a flow of water into the public water supply is possible either through the manipulation of valves or because of ineffective check or back-pressure valves, or because of any other arrangement.

Cross-connection Control& Backflow Coordinator: The official position established and authorized by the Harnett Regional Water and designated by the Director of Harnett Regional Water to administer and interpret the cross connection section of these specifications and who shall also be a certified tester.

Customer Connections: (WATER) A water line between ¾" and 2" that connects the end user's residential dwelling or business to the Harnett Regional Water's water system generally between the building and the water meter that carries or transports potable water to the end user or customer for consumption, cleaning or irrigation.
(SEWER) A wastewater line between 4" and 6" that connects the end user's residential dwelling or business to the Harnett Regional Water's sewer collection system generally between the building and the sanitary sewer cleanout that carries or transports wastewater to Harnett Regional Water from the end user or customer' building or dwelling.

Developer/land Developer: An individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity or any other legal entity, or their legal representatives, agents or assigns that improve raw land with the installation of utilities with the purpose to subdivide the property to sell.

Distribution Line: A water line between 2" and 8" in diameter that carries or transports potable water to the end user or customer for consumption, irrigation, agriculture or other domestic purposes.

Double check valve backflow prevention device: An approved assembly composed of two (2) single, spring-loaded independently operating check valves, including tightly closing shut-off valves located at each end of the assembly, and having suitable connections for testing the water-tightness of each check valve.

Drought: An extended period of severe hot and extremely dry weather with no

significant precipitation to increase local water supplies such as rivers, streams and lakes that negatively impact output capacity of water treatment plants. Severe drought must follow requirements established by federal, state and local laws and ordinances to protect existing water supplies. Recent changes in state laws require Harnett Regional Water to ration water resources available during the drought and taking additional conservation measures to reduce water demands from irrigation while following established conservation measures to reduce system leaks, water losses and eliminate waste by consumers.

Dual check valve: An approved device containing two (2) independently acting check valves in series.

Emergency Management Plan: An established and approved emergency plan approved by the State and adopted by Harnett Regional Water to respond to emergencies involving water supplies, treatment and distribution system.

Fire hydrant: A water distribution apparatus designed to be used by authorized fire-fighting personnel to supply bulk water in an emergency for extinguishing fire or filling pump trucks to transport water for fire-fighting.

Fire line: A system of pipes and equipment used to supply water in an emergency for extinguishing fire.

Food preparation facility or establishment: Any commercial or industrial facility that prepares or serves food, including a restaurant, cafe, cafeteria, snack bar, grill, deli, catering service, bakery, grocery store, butcher shop, or similar establishment.

Grease Interceptor/Grease Trap: An underground tank with baffles and pipes designed to trap or collect grease from food preparation facilities and food serving establishments in order to keep the Harnett Regional Water's Sewer Collection System free of fat, oil and grease deposits and accumulations.

Indirect discharge or discharge: The discharge or the introduction from any non-domestic source regulated under §307(b), (c), or (d) of the Act (33 U.S.C. 1317), into the POTW (including holding tank waste discharged into the system).

Interconnection: Any system of piping or other arrangement whereby the public water supply is connected directly with a sewer, drain, conduit, pool, heat exchanger, storage reservoir, or other device which does or may contain sewage or other waste or substance which would be capable of imparting contamination to the public water supply.

Interference: The inhibition or disruption of the POTW treatment processes, operations, or its sludge process, use, or disposal, which causes or contributes to a violation of any requirement of the POTW's NPDES or Nondischarge Permit or prevents sewage sludge use or disposal in compliance with specified applicable state and Federal statutes, regulations or permits. The term includes prevention of sewage sludge use or disposal by the POTW in accordance with §405 of the Act (33 U.S.C. 1345) or any criteria, guidelines, or regulations developed pursuant to the Solid Waste Disposal Act (SWDA) (42 U.S.C. 6901, et seq.), the Clean Air Act, the Toxic Substances Control Act, the Marine Protection Research and Sanctuary Act (MPRSA) or more stringent state criteria (including those contained in any state sludge management plan prepared pursuant to Title IV of SWDA) applicable to the method of disposal or use employed by the POTW.

Meter: A device or system of devices used to accurately measure the amount of water consumed by the end user for the purpose of billing that end user for the water consumed or used by the water service line supplied by the Harnett Regional Water's water distribution system.

Permit-required Confine Space: OSHA uses the term "permit-required confined space" (permit space) to describe a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress.

Person: Any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity or any other legal entity, or their legal representatives, agents or assigns. This definition includes all Federal, state, and local government entities.

Publicly-owned treatment works (POTW) or municipal waste water system: A treatment works as defined by §212 of the Act (33 U.S.C. 1292) which is owned in this instance by Harnett Regional Water. This definition includes any devices or systems used in the collection, storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they convey waste water to the POTW treatment plant. For the purposes of this specification document, POTW shall also include any sewers that convey waste waters to the POTW from persons outside the County who are, by contract or agreement with Harnett Regional Water, or in any other way, users of the Harnett Regional Water's POTW.

Pressure vacuum breaker: An approved assembly containing an independently operating spring loaded check valve and an independently operating loaded air inlet valve located on the discharge side of the check valve. The assembly must be equipped with suitable connections for testing the proper operation of the device and tightly closing shut-off valves located at each end of the assembly.

Pretreatment or treatment: The reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in waste water prior to or in lieu of discharging or otherwise introducing such pollution into a POTW. The reduction or alteration can be obtained by physical, chemical or biological processes, or process changes or other means, except by diluting the concentration of the pollutants unless allowed by an applicable pretreatment standard.

Public water supply or system: The water and waterworks system of Harnett Regional Water its customers outside the corporate limits, for general use and which supply is recognized as the public water supply by the North Carolina Department of Environment and Natural Resources. The Cape Fear River is the primary water source for Harnett Regional Water's water system but, other water sources are available to Harnett County through interconnections with other water systems from surrounding towns and counties.

Reduced pressure zone principle backflow prevention device (RPZ): An approved device containing within its structure two (2) spring loaded, independently operating check valves, together with an automatically operating pressure differential relief valve located between the two (2) check valves. The first check valve reduces the supply pressure a predetermined amount so that during normal flow and at cessation of normal flow the pressure between the checks shall be less than the supply pressure. In case of leakage of either check valve, the differential relief valve, by discharging to the atmosphere, shall operate to maintain the pressure between the check valves less than the supply pressure. This device shall have suitable connections for testing the proper operation of the device, including tightly closing shut-off valves located at each end of the device.

Reuse water: Wastewater that has been treated to water quality standards as defined by the applicable section of the North Carolina Administrative Code and is intended to be distributed for non-potable uses such as irrigation and/or industrial processes.

Reuse water services/service lines: Those portions of the reuse water service pipes that connect to Harnett Regional Water's reuse water mains and extend to the boundaries of public easements and rights-of-way.

Sewer Collection Lines: Gravity sewer mains between eight (8") inches and twelve (12") inches in diameter. Eight (8") inches in diameter is the minimum size of wastewater collection lines allowed by HRW.

Sewer Interceptor: Gravity sewer mains larger than eighteen (18") inches in diameter.

Sewer Lift Station: Sewer Lift Stations are designed to lift the wastewater from the low point of one sub basin into another sub basin closer to the nearest wastewater treatment facility.

Sewer Outfall: Gravity sewer mains larger than twelve (12") inches and less than or equal to eighteen (18") inches in diameter.

Sewer Service Lateral: Those portions of the sewer collection system and building sewer pipes which connect to Harnett Regional Water's sewer mains and extend to the boundaries of public easements and rights-of-way. The point of demarcation is generally established by the sanitary sewer cleanout located at the edge of the street right-of-way and extending to the sewer main. (See Customer Connections and Water Service Lines)

Storm Sewer: (See Storm Water)

Storm Water: Any flow occurring during or following any form of natural precipitation and resulting there from.

Superintendent: The person designated by Harnett Regional Water to supervise the operation of the publicly-owned treatment works, water distribution or sanitary sewer collections systems; and who is charged with certain duties and responsibilities by the Harnett Regional Water's Water and Sewer Ordinances, State Laws and General Statues, Federal Codes and Regulations, or his duly authorized representative.

Tampering: The act to disrupt normal operation of the Harnett Regional Water's water distribution system, sewer collection system, water treatment plant(s) or wastewater treatment plants by removing parts or components, damaging system equipment, or interfering of the routine duties of Harnett Regional Water staff to create a system upset, abnormality, outage of other disruption to the processes of treatment and distribution of potable water and/or the sewer collection system and the wastewater treatment plant(s).

Tap size: The nominal diameter of the connection of a water or reuse line installed between a meter assembly and main connected to the water or reuse utility system of Harnett Regional Water, without regard to the configuration of that water or reuse assembly, or ownership of the water or reuse meter assembly, service, or water or reuse main. Water tap sizes will vary from ¾" to 1" for most residential services; from 1" to 6" for commercial property and over 6" for most industrial services. Sanitary sewer taps will be no less than 4" for residential sewer service and sized by a professional engineer to handle calculated flows from commercial and industrial accounts.

Testing: The established and industry recognized procedures of exercising or checking utility system equipment and components under simulation of real operating conditions as will lead to proof or disproof of acceptability or rejection of the new or existing system or component. For example, water lines and mains must be filled with water, purged of air and pressure tested to verify the pipe, associated appurtenances and fittings will withstand the normal operating pressures before being placed into service. Testing of systems, equipment and components is only one of many inspections requirements before a new system or component may be accepted and placed into service to prove the system or component is ready for operation. Other testing procedures may be outlined in these specifications such as gathering and submitting water samples to the certified laboratory for complete analysis to determine the presence of contaminants above allowable limits or that should not be in the water system; or vacuum testing and mandrel testing of sanitary sewer systems and components to verify the new or existing sanitary sewer line or main is installed to meet designed grades and diameters. Testing procedures shall be approved by HRW before any testing may be scheduled with HRW.

Transmission Line: A water line over 10" in diameter that carries or transports potable water from the Harnett Regional Water Treatment Facility to the clear wells, elevated storage tanks and standpipes located in various water & sewer districts (Northwest, Metro, East Central, Riverside, Southeast, South Central, Southwest, and West Central) throughout the entire Harnett Regional Water System.

Utility system, utility lines: Water pipelines, reuse water pipelines, and sewer pipelines (any or all as determined by the context), and shall include all pipes, valves, valve boxes, hydrants, and other fixtures, equipment, and apparatus connected to and forming a part of the main water, main reuse water, or sewer pipelines and systems or all, and all appliances necessary and convenient thereto. The utility lines dedicated to Harnett Regional Water shall include only main distribution lines, valves, hydrants and other apparatus, fixtures and equipment forming a part of the lines laid in public streets, roads, highways and alleys or across Harnett Regional Water utility or sanitary sewer easements on private property, and shall not include lines leading from mains to building connections on private property and shall not include the water, reuse water, or sewer lines within any residences or other privately-owned building. Utility lines built in accordance with Harnett Regional Water specifications by private developers are included as part of the Harnett Regional Water's utility system.

Vehicle maintenance facility: Any commercial or industrial facility where automobiles, trucks, or equipment are serviced or maintained, including garages,

service stations, repair shops, oil and lubrication shops, or similar establishments.

Water System Management Plan: An established and approved management plan approved by the State and adopted by Harnett Regional Water to describe the ownership, organization, management policies and established standard operating procedures (SOP"s) of the water system including training of operators and staff and system monitoring, recordkeeping and public reporting. The WSMP also includes documentation of the 20-year replacement Cost plan and the 5 year operating budget projections to maintain and protect the Harnett Regional Water's water system assets and keep them in operation to serve the public with potable water service meeting all State requirements.

Wastewater: The liquid and water-carried industrial or domestic wastes from dwellings, commercial buildings, industrial facilities, mobile sources, treatment facilities and institutions, together with any groundwater, surface water, and storm water that may be present, whether treated or untreated, which are contributed into or permitted to enter the POTW.

Water services/ Service lines and (building sewer) sewer service stubs: Those portions of the water service and building sewer pipes which connect to the City's water and sewer mains and extend to the boundaries of public easements and rights-of-way.

CHAPTER 2

PLAN SUBMISSION

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Chapter 2 Plan Submission

Section 2.1 General

The following sections outline the procedures for obtaining approval of water and/or sewer system extension within the territorial jurisdiction of Harnett County and Harnett Regional Water (HRW). It is the intent of this review process to avoid duplication and unnecessary delays in project approval. Every effort will be taken by HRW to closely coordinate this review process with those of the Harnett County Planning Board, the Harnett County Development Review Board and other towns and counties inside and outside of Harnett County as well as, other agencies having jurisdiction. The developer is cautioned to adhere to the standards and provisions of the Harnett County Planning Board. Whichever public agency ordinances, rules, resolutions, or regulations impose a higher standard shall prevail. Conflicts between the policies, rules, resolutions, and ordinances of HRW and NCDEH&NR and the Harnett County Planning Board shall be resolved by mutual agreement between the respective public agencies.

2.1.1 Projects Required to Follow These Procedures are as follows:

1. Any non-residential building larger than 1,500 square feet.

2. Any business employing more than 16 employees.

3. Any building requiring internal sprinkler system or fire protection booster pump system.

4. Any building providing medical facilities, human or animal.

5. Any facility providing food service.

6. Any facility discharging any type of waste other than domestic.

7. Any facility of an unusual nature can be required by HRW upon the Director's confirmation.

8. Any single-family lot subdivision requiring the extension of water and/sewer utilities.

9. Any multifamily development.

Section 2.2 Determination of Zoning Designation:

Before proceeding with the development of property or consideration given to the extension of water and/or sewer utilities to developing properties, the

developer or property owner is cautioned to ensure that the property in question is properly zoned for the type of development being contemplated. The Harnett County Board of Adjustment must review and approve rezoning of the subject property.

In the event that the property requires a rezoning designation to a Planned Unit Development (PUD), a "Conceptual Plan" meeting the standards and requirements of the Harnett County Planning Board and the Harnett County Development Review Board will be required. The Conceptual Quality of waste to be delivered to the District's system for treatment (domestic, industrial, commercial); and Plan should be submitted to HRW staff not less than thirty (30) days, prior to the meeting date scheduled by the Harnett County Planning Board and/or the Harnett County Development Review Board to review and consider approval of the plan. HRW must review, approve, or disapprove the "Conceptual Plan" and so advise the Harnett County Planning Board and/or and the Harnett County Development Review Board of its decision prior to final decision being reached by the Planning Board and/or and the Harnett County Development Review Board. The final approving Authority shall be the Board-of-Commissioners of Harnett County.

Section 2.3 Water/Sewer Utility Master Plan

Upon the Harnett County Planning Board and/or the Harnett County Development Review Board approving a Planned Unit Development (PUD) and the associated "Conceptual Plan" establishing development patterns, density, and phasing, the developer will be required to develop a Water and Sewer Utility Master Plan. In addition, all developments greater than twenty-five (25) acres in size, as well as all phased projects will be required to develop a Water/Sewer Utility Master Plan. The Water/Sewer Utility Master Plan shall conform to the latest requirements and standards of the NCDEH&NR. The final approving authority shall be HRW and as permitted by NCDEH&NR.

Section 2.4 Determination of Ability to Serve

2.4.1 Letter of Intent

Upon determination of zoning designation and/or approval of the Conceptual Plan and completion of the Water/Sewer Utility Master Plan (as applicable) as herein above described, the next action required of a developer is a letter of intent or application for reservation of water and/or sewer capacity. This letter should include the following minimum information:

A. Name, address and telephone number of developer or development firm;

B. Name, address and telephone number of Registered Professional Engineer or Engineering Firm;

C. Identify the name, address and telephone number of contact person;

D. Date of filing letter of intent;

E. Signature of authorized representative or agent;

F. Location of property to be developed which should include: tax map and tax lot number; Subdivision name and lot number; general plat of property; and/or highway number of adjacent streets and highways; and adjacent property owners;

G. Type of development contemplated and proposed number of residential equivalent units;

H. Nature of services requested from HRW (Water, Sewer, and Fire Protection)

I. Quality of waste to be delivered to the District's collection system for treatment (Domestic, Industrial, Commercial, etc.) and:

J. Proposed sales, construction and occupancy schedules in residential equivalent units.

2.4.2 Sketch Plan Review

For expediency of review, the developer should submit along with his letter of intent a simple "sketch plan" of the proposed development. The purpose of the "sketch plan" is to enable HRW staff to assist the developer prior to extensive site planning and engineering work, which will be necessary for the preparation of a "pre-design plan" and "construction plan" as required herein. The "sketch plan" may be a simple free hand drawing. The plan should include all information identified in Section 3.3 of this document.

2.4.3 Conference

Within ten (10) work days from the date of submission of the "letter of intent" and "sketch plan", HRW will notify the developer of the date established for a conference between the developer (or his agent) and the District's staff. This conference shall be an informal, confidential review and discussion of the proposed project and the District's policies and procedures. The developer will be advised of HRW ability to serve the proposed project.

Section 2.5 The Construction Plan

2.5.1 Development of the Construction Plan

Approval of the "sketch plan" is conditional approval and does not constitute final project approval for any project involving the extension of Harnett Regional Water's water and sewer lines. The "construction plan" should address only that phase or stage approved in the "pre-design plan" and only for the water/sewer capacity needs established or agreed upon. Documents submitted as a part of the "construction plan" for approval shall include, but not be limited to: general layout, detailed plans, specifications cost estimates, bid tabulation forms, conditions, completed highway North Carolina Department of Transportation (NCDOT) encroachment permit forms, and completed Permit Application Forms. The specifications accompanying the construction drawings shall include all construction information not shown on the drawings, which are necessary to inform the utility contractor in detail of the design requirements, to identify the quality of materials to be used and to establish workmanship and fabrication techniques for the project. All comments and design modifications identified by HRW staff during the review process should be incorporated into the "construction plan". The plan shall include all plan information identified in Section 3.4 of these specifications as documented herein.

2.5.2 Approval of the Construction Plan

No approval for construction can be issued until final, complete, and detailed plans and specifications have been submitted and found to be satisfactory. HRW staff shall act on the approval of the "Construction Plan", in a timely manner. HRW shall notify the developer in writing if the "construction plans" are satisfactory or shall so notify the developer of the conditions under which approval will be granted.

Once the project and plans are found to be satisfactory by HRW, the developer or representative shall submit the required documents to NCDEH&NR for state permitting. The applications will be signed by the Director of HRW upon plan approval. When the appropriate state permits for construction water line extension(s), sanitary sewer collections system(s) and related appurtenances are received by HRW from NCDEH&NR, then the utility contractor and professional engineer must schedule and attend a pre-construction meeting with HRW Utility Construction Inspector. HRW Utility Construction Inspector must be provided with no less than 48 hours' notice for scheduling of the pre-construction meeting. The utility contractor must provide material submittals for review and approval by the Engineer of Record prior to acceptance by HRW Utility Construction Inspector during the pre-construction meeting. Following the pre-construction meeting, HRW will notify developer and/or the utility contractor that he may proceed upon review of all applicable shop drawings and specifications of the materials used in the proposed utility project. Upon review and acceptance of all shop drawings and material specifications, HRW will authorize Notice to Proceed.

Section 2.6 Fees and Charges

2.6.1 Plan Review and Processing

To defray the cost of reviewing and processing the "Conceptual Plan" "Water/Sewer Utility Master Plan", "Letter of Intent" and "Construction Plan," the developer shall pay review fees in accordance with the Harnett Regional Water's Water and Sewer Use Ordinance to HRW at the time such documents are submitted to HRW for review:

2.6.2 Connection Fees and Charges

See current Water and Sewer Use Ordinance for current fees.

Section 2.7 Water and Sewer System Development Fees

System development fees are a charge or assessment for service imposed with respect to new development to fund costs of capital improvements necessitated by and attributable to such new development, to recoup costs of existing facilities which serve such new development, or a combination of those costs. The term includes amortized charges, lump-sum charges, and any other fee that functions as described by this definition regardless of terminology.

These charges are reasonable and necessary and result in a more equitable and economically efficient method of recovery of such costs to handle new growth and to serve new customers without placing an additional financial burden on existing customers solely through inordinate enhancement of water and sewer rates. A Water System Development Fee and a Sewer System Development Fee per connection, lot and/or unit will be charged for all new water and/or sewer services connecting to any water supply or distribution system and/or sewer collection system owned and/or operated by HRW. Determination of water and sewer system fees were accomplished per a system development fee analysis that met the requirements of N.C.G.S 162A-205 and is posted on HRW's website for review. New commercial/industrial system development fees will be accomplished through the method of equivalent residential unit using the estimated water and sewer usage needed for the development. These system development fees shall be paid in the manner set forth below: The full balance of the fees for new land subdivision development shall be payable upon plat recordation or a commitment by HRW to provide water and/or sewer service to the new land subdivision development, whichever occurs later. In instances of any other new development to include commercial/industrial developments, the full balance of these fees shall be due prior to HRW's commitment to provide water and/or sewer service to the development. HRW reserves the right to impose a minimum lot count for each proposed phase within a new subdivision to prohibit excessive review and administrative overhead. This minimum lot count for phases will be determined on a case by case basis. See current Water and Sewer Use Ordinance for current fees.

CHAPTER 3

PLAN REQUIREMENTS

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CHAPTER 3 PLAN REQUIREMENTS

Section 3.1 General

3.1.1 Conceptual Plan or the Preliminary Plat Plan

The Conceptual Plan or the Preliminary Plat Plan shall conform to the latest requirements and standards established by the Harnett County Planning Board, the Harnett County Development Review Board and Harnett Regional Water.

The Harnett County Development Review Board (HCDRB) is an administrative board that reviews development applications. All major subdivisions and multifamily developments, as well as commercial site plans in the Highway Corridor Overlay District are reviewed by this board. The DRB is made up of five (5) member departments: Fire Marshal, E911/Addressing, Planning, Public Utilities, and Environmental Health.

The Harnett County Development Review Board (DRB) strives to streamline the approval processes by bringing all appropriate county departments together in one location at regular intervals for the convenience of land developers, land surveyors, engineers and architects to seek and gain approval of their developments and projects. Advisory members of the HCDRB include the North Carolina Department of Environment and Natural Resources (NCDENR) and the North Carolina Department of Transportation (NCDOT). Advisory members are not required to be present at the regularly scheduled HCDRB Meetings.

Section 3.2 Water/Sewer Utility Master Plan

The Water and Sewer Utility Master Development Plan shall conform to the latest requirements and standards of NCDENR and shall at a minimum, include a hydraulic analysis of the water distribution system. The Master Development Plan should include a proposed street and lot layout with a total lot count at complete build out. The Master Development Plan should identify all existing wetlands, streams, and rivers. The Master Development Plan should provide the name, address and contact telephone number for the Owner/Developer, the Professional Engineer (P.E.) and the Registered Land Surveyor (R.L.S.). The Master Development Plan should provide the proposed phases lines between multiple phases and shows all planned improvements such as: streets, parks, natural features (rivers, stream, ponds, lakes, etc.), buffers or areas that shall remain undisturbed, sporting amenities (swimming pools, tennis courts, basketball courts, etc.), restaurants, and public areas to be maintained by the homeowner's associations or other organizations. If the proposed development will include sanitary sewer improvements that will be connected the Harnett Regional Water's existing sanitary sewer system then the master development Plan must conform to the Harnett Regional Water's Master Sewer Plan., latest edition.

Section 3.3 Sketch Plan

The sketch plan of a proposed development shall contain or be accompanied by the following information:

A. All maps or drawings should show north arrow and estimated written or graphic scales;

B. Provide a vicinity or location map for the purpose of locating the property being developed;

C. Identify tract boundaries and provide total acreages; and

D. Identify by-name and/or number all abutting NC Department of Transportation and/or municipal road rights-of-way.

E. Closest available existing water & sewer utilities.

F. Distance to the nearest existing manhole of the Harnett Regional Water sewer system.

Section 3.4 Construction Plan

3.4.1 General

The construction plan of the water and sanitary sewer improvements to serve a proposed subdivision or any other project shall be clearly and legibly drawn to a minimum scale of one (1) inch equal to one hundred (100) feet and on a sheet measuring twenty-four inches by thirty-six inches (24 x 36). If the construction plan requires more than one sheet, a key diagram showing relative location of the several sections shall be drawn on each sheet with appropriate match lines between each sheet.

3.4.2 Content

The construction plan shall contain or be accompanied by the following information as well as all information as-required herein for the preliminary plan:

A. General Information

1. Name, mailing address, email address (if applicable) and telephone number and of owner of record and the name of the developer of record.

2. Name of subdivision, date, north arrow, vicinity map and graphic scale.

3. The North Carolina One Call Center (NCOCC) telephone number 811 or (800) 632-4949 along with a note to the utility contractor to call the NCOCC at least 48 hours before digging or excavating begins on any project in order to identify the location of all existing underground utilities near the project site.

4. Name, registration number, signature and seal of the registered land surveyor and the professional engineer.

5. Sufficient data to determine readily and reproduce accurately on the ground the location, bearing and length of every street, alley line, lot line, easement and boundary line whether curved or straight. This shall include the radius, point of tangent, and other data for curved property lines and curved streets, to an appropriate accuracy and in conformance with surveying practice.

6. Names of owners of record of all adjoining land and all property boundaries, water courses, streets, easements, utilities and other such improvements, which cross or form any boundary line of tile tract being developed.

7. Exact boundaries of the tract of land being developed shown with bearing, distances and current adjacent property owners.

8. Streets and alleys, rights-of-way, percent of grades and street names.

9. Rights-of-way or easement; location, widths, and purposes.

10. All dimensions shall be to the nearest one hundredth of a foot and angles to

the nearest minute.

11. Accurate description of the location of all monuments and markers.

12. Proposed utility easements, showing the accurate dimension in feet and hundredths including notation of any limitations on such easements.

13. Calculated Water and Sewer Daily usages.

utside the planned right-of-way must be recorded:

Easements for the following utilities:

(a) Water;
(b) Gas;
(c) Sanitary sewer;
(d) Storm drainage;
(e) Electrical lines;
(f) Telephone lines; and
(g) Existing and proposed irrigation lines.

14. Sewer profile sheets shall indicate manhole number, the top or rim elevation, the manhole inlet/outlet invert elevations, all pipe crossings, manhole casting elevation, grade, length and type of pipe and material. Plan views shall number lines and manhole. Station numbers shall be noted and profiled to a minimum interval of 100 feet.

B. Platting information

The subdivision plat shall be submitted to HRW prior to recording to verify that all previously negotiated well sites, tank sites, pump station sites, or utility right-of-ways have been properly represented. The professional engineer must submit 24" x 36" copies of the As-Built Record Drawings with all required information in bond (paper), Mylar and digital formats along with the final plat from the Registered Land Surveyor so that HRW can compare them for accuracy prior to the final plat or project approval. Digital copies shall be submitted to HRW in AutoCAD (dwg) or (dxf) files. The As-Built Record Drawings shall match the final plat and may be submitted after the project has been completed, if the developer provides Harnett Regional Water with an adequate bond to cover the utility improvements that will serve the proposed development to be subdivided and recorded with the Harnett County Register of Deeds.

C. Additional information for Construction

Additional Information may be requested by HRW such as: Detailed report identifying necessary construction specifications and procedures along with the required construction documents, contractors bid tabulation sheets, performance payment bonds, general and special conditions, etc.

1. Tentative profiles along the center line of pavement of each proposed sheet shown on the construction plan. Such profiles shall show natural and finished pavement grade with typical road right-of-way section shown. Profiles of water line(s) over culvert crossings and through pass around.

2. Three (3) complete copies of the NC Department of Environment and Natural Resources, Division of Environmental Health – Public Water Supply Section (NCDENR, DEH-PWSS) completed permit application forms ready for submittal to obtain a permit for the construction and operation of the water system improvements. No permit applications shall be submitted without the concurrence and signature of the appropriate reviewing official.

3. Three (3) complete copies of the NC Department of Environment and Natural Resources, Division of Water Quality (NCDENR, DWQ) completed permit application forms ready for submittal to obtain a permit for the construction and operation of the sanitary sewer system improvements. No permit applications shall be submitted without the concurrence and signature of the appropriate reviewing official.

4. An Engineer's Report shall accompany all water applications that cover all requirements

established by NCDENR, DEH-PWSS under North Carolina Administrative Code Title 15A Department of Environment and Natural Resources, Subchapter 18C Water Supplies, Section .0307 to accurately describe the current existing system conditions and future projections on system demands.

5. Any other information considered by either the developer or HRW to be pertinent to the review of the plan.

6. Five copies of completed NCDOT Encroachment Permit Application Form if applicable. 27
The NCDENR permit applications and NCDOT encroachments agreements will be signed and returned to the developer's engineer of record for submittal to the State review agencies. When the erosion control permit is obtained, the developer shall submit a copy to HRW prior to beginning construction.

Section 3.5 Construction and Inspections

3.5.1 Pre-Construction Conference

Once all permits have been issued by the State, the utility contractor may schedule a pre-construction conference with HRW. The Utility Contractor shall notify Harnett Regional water (HRW) and the Professional Engineer (PE) at least two days prior to construction commencing. The Utility Contractor must schedule and attend a pre-construction conference with HRW prior to the start of construction clearing and grubbing on site.

At that time, HRW will release the approved plan drawings stamped "Released for Construction," signed and dated by HRW Engineering staff. The utility contractor is required to provide HRW the material submittal package with all shop drawings at the pre-construction conference. The developer's Engineer of Record will review all shop drawings for conformance with HRW specifications prior to submittal to HRW. The shop drawing submittal to HRW shall include a cover letter by the developer's Engineer of Record certifying conformance with HRW specifications and summarizing any exceptions or concerns relative to approved drawings and/or HRW standards. The submittal and approval of all shop drawings for materials used in project must be approved prior to HRW necessary to proceed. Any materials not approved for use in Harnett Regional Water's water and sewer system shall be removed from the submittal package and suitable materials approved by the developer's Engineer of Record and HRW shall be submitted to replace the materials not approved by the developer's Engineer of Record and HRW. Once the material submittal package and shop drawings have been approved then the materials may be ordered and delivered to the project site.

3.5.2 Construction of Utility Improvements

A. The utility contractor must notify HRW Utility Construction Inspector at least two (2) days before any construction will begin and the utility contractor must coordinate with HRW for regular inspection visitations and acceptance of the water and sewer system(s). Construction work shall be performed only during the normal working hours of HRW which is 8:00 am – 5:00 pm Monday through Friday. Holiday and weekend work is not permitted by HRW. All State permits must be maintained on site throughout the entire construction process of the proposed water and sewer lines that will serve this project. The Utility Contractor will coordinate with HRW Utility Construction Inspector for regular inspection visitations and acceptance of the system.

B. The Harnett County Fire Marshal shall approve all hydrant types and locations in new subdivisions. The Contractor shall contact the Harnett County Fire Marshal at (910) 893-7580 to schedule a final inspection for each fire hydrant installation in Harnett County. The fire hydrants are installed at certain elevations. Any grade change in the vicinity of any fire hydrant which impedes its operation shall become the responsibility of the Utility Contractor for correction. Corrections will be monitored by HRW Utility Construction Inspector and the Harnett County Fire Marshal. If the project is located

outside of Harnett County, then the Contractor shall contact the Fire Marshal having jurisdiction over the project.

C. Prior to the commencement of any digging or excavation work within established utility easements or NCDOT right-of-ways, the utility contractor is required to have a signed NCDOT encroachment agreement posted on site and notify all concerned utility companies in accordance with North Carolina General Statute 87-102. The utility contractor must call the North Carolina One Call Center at 811 or (800) 632-4949 to verify the location of existing utilities prior to the beginning of construction. Existing utilities shown in the plans are taken from maps furnished by various utility companies and have not been physically located or verified by the Professional Engineer (P.E.) (i.e. TELEPHONE, CABLE, WATER, SEWER, ELECTRICAL POWER, FIBER OPTIC, NATURAL GAS, ETC.). The utility contractor will be responsible to repair any and all damages to the satisfaction of the related utility company. The utility contractor shall spot dig to expose each existing utility pipe or line which may conflict with the construction of any proposed water or sanitary sewer line extensions well in advance to verify locations of the existing utilities. The Utility Contractor shall provide both horizontal and vertical clearances to the Professional Engineer (P.E.) to allow the P.E. to adjust the water or sanitary sewer line design in order to avoid conflicts with existing underground utilities. The Utility Contractor shall coordinate with the utility owner and be responsible for temporary relocation and/or securing existing utility poles, pipes, wires, cables, signs and/or utilities including services in accordance with the utility owner requirements during water line installation, grading and street construction.

D. Construction Observation shall be performed by the Professional Engineer (P.E.) and surveying shall be performed by the Registered Land Surveyor (R.L.S). The Professional Engineer (PE) shall make regular site visits during the construction process to observe the quantities and quality of the construction to verify the utility contractor follows the State approved plans and permit requirements. Before the construction of the water and sanitary sewer improvements shall begin, the Professional Engineer (P.E.), the Registered Land Surveyor (R.L.S.) or their designees shall make a site visit at the beginning of construction to set grade stakes to establish the proposed finish grade of the streets and underground water and sanitary sewer utilities for the utility contractor to follow. The Registered Land Surveyor (RLS) should stake out all lot corners and utility easements or right-of-ways. The Registered Land Surveyor (R.L.S.) or their designees shall make a final survey of all utility improvements by recording all above ground locations for the valve boxes, meter boxes, blow off assemblies, concrete valve markers, manholes, sanitary sewer clean outs, sanitary sewer valve boxes, sewer lift stations, sanitary sewer force main(s) and associated air release valves. The above ground utility improvements shall be placed into a map with real time coordinates tied to the state coordinate plane using the 1983 North American Datum (NAD) and provided to the Professional Engineer (PE) for the As-Built Record Drawings.

E. Improvements shall be installed in accordance with the established specifications, and other applicable policies of HRW. Contractor shall conform to all applicable local, state and federal regulations. No field changes to the plans are allowed without prior written approval from HRW. The Developer shall, at his expense, retain the services of the Engineer of Record for the purposes of providing necessary inspections and supervision of the construction work, record drawings and Engineer certifications. The engineer is responsible to insure that construction is, at all times, in compliance with accepted sanitary engineering practices and the approved plans and specifications. A copy of each Engineer's field report is to be submitted to HRW as each such inspection is made. Water and sewer infrastructure must pass all tests as required by HRW specifications and those of all applicable regulatory agencies. These tests include, but are not limited to, air test, vacuum test, mandrel test, visual test, pressure test, bacteriological test, etc. A HRW inspector must be present during testing. All test results must be submitted to HRW. All tests must be satisfied prior to Final Inspection. Following completion of construction of all water and sewer infrastructure delineated in the approved water and sewer plans a Final Inspection must be requested in writing by the Developer or Developer's engineer. The Developer's engineer and HRW inspector shall prepare a written punch list of any defects or deficiencies noted during this inspection, should any exist. Upon completion of

the punch list, the Developer's engineer will schedule another inspection. In the event the number of inspections performed by HRW exceeds two, additional fees may be assessed to the Developer.

3.5.3 Documentation of Utility Improvements

A. Red Line Field Drawings by Contractor

The Utility Contractor shall provide the Professional Engineer (PE) and HRW Utility Construction Inspector with a set of red line drawings identifying the complete water and sanitary sewer system installed for each project. The red line drawings should identify the materials, pipe sizes and approximate depths of the water lines as well as the location of all gate valves, fire hydrants, meter setters, blow-off assemblies and all associated appurtenances for all water line(s) constructed in Harnett County. The red line drawings should clearly identify any deviations from the NCDENR approved plans. All change orders must be approved by HRW and the Professional Engineer (PE) in writing and properly documented in the red line field drawings by the Contractor.

B. As-Built Record Drawings and P.E. Certification.

Upon completion of the utility construction, inspections testing and acceptance of the system, the
Professional Engineer (P.E.) shall submit asbuilt drawings to HRW to conduct a final inspection and walkthrough. The P.E. will file a letter of certification that the project has been built in accordance with plans and specifications as approved by the North Carolina Department of Environment and Natural Resources, Division of Environmental Health - Public Water Supply Section for all water system improvements with a copy to HRW. The Professional Engineer (P.E.) will file a DWQ permit certification that the project has been built in accordance with plans and specifications as approved by the North Carolina Department of Environment and Natural Resources, Division of Water Quality for all sanitary sewer system improvements with a copy to HRW. In addition, a Cost Statement shall be submitted to HRW for all utility improvements added to Harnett Regional Water's existing water and sewer systems.

These Engineering Certifications shall be provided as indicated above along with the Project As-Built Record Drawings as indicated below in substantially the same form where applicable and as stipulated by HRW staff. One (1) complete set of Mylar sepia drawings that accurately depict the "as-built" locations and condition of the project shall be submitted after HRW has approved the As-Built Record Drawings. The plans shall be noted "As-built Record Drawings" or similar, dated and signed by the design engineer. All major system components such as: valves, manholes (including final depth), water service connections, meter boxes, meter setters, sanitary sewer service laterals, sanitary sewer cleanouts and other system appurtenances shall be located by either distance along the line or by distance from at least two permanent above ground structures that are readily visible near the appurtenance.

The Professional Engineer (P.E.) must file with HRW, two (2) 24" x 36" blue prints or bond copies of the "As-Built Record" drawings for all utility construction in place. These drawings must be sealed by the Registered Professional Engineer with his signature and marked "Record Drawings." Any and all field change orders that were made during construction shall be properly documented in the "As-Built Record" drawings. The "As-Built Record" drawings" shall include all lot numbers, water valves, valve markers, water meter setters, fire hydrants, blow off assemblies, manholes, sewer clean outs, air release valves, profiles and sewer lift stations as installed by the contractor. A

digital copy (CD) of the "Record" drawings must be submitted to HRW. Preferably, the digital copy of the "Record" drawings" should be produced in AutoCAD (.dwg) or (.dxf) format and one copy in PDF.

The As-Built Record Drawings shall be labeled that the coordinates have been tied to the state coordinate plane using the 1983 North American Datum (NAD) and the As-Built Record Drawings shall be provided to HRW Engineer upon completion of the utility improvement project. The As-Built Record Drawings that include gravity sewer line extensions, sewer lift station(s) and/or sewer

force mains as well as new water mains and service lines shall contain the following detailed information:

1. Lot numbers that will be served by the sewer system will be clearly identified on each page of the As-Built Record Drawings and match the final plat.

2. The distance for each sewer service lateral shall be measured from the down grade manhole along the sewer main to the connecting wye and along each sanitary sewer service lateral to the associated sewer cleanout for each lot. These dimensions should be included on the applicable sheets with each sanitary sewer main in a chart format showing these two dimensions as measured from each associated downstream manhole.

3. The direction for each sanitary sewer service lateral shall be marked as left or right facing up-grade from the nearest down grade manhole.

4. Directional arrows shall be placed on each sewer line (gravity and force main) on the overall layout sheet for each phase or section of the sewer system.

5. The location and size of all newly established utility easements which shall be provided with water or sewer improvements not installed within the established NCDOT right-of-way.

6. All pipe sizes and material shall be noted on the Record Drawings.

7. All manhole inverts must be labeled on the Record Drawings.

C. Developer's Cost Statement and P.E. Certification.

Upon completion of the utility construction, inspections testing and acceptance of the system improvements, the developer shall provide a statement of all costs associated with the construction, inspection, testing and approval of water and sanitary sewer system improvements to the Professional Engineer (P.E.). The P.E. will file a letter of certification to HRW verifying the cost statement for the utility improvements that the developer will convey to the County.

3.5.4 Approval of Utility Improvements

A. Certification of the Approval of Water and/or Sewer Systems

A letter of approval from the NCDENR, DEH-PWSS will satisfy this certification requirement for water improvements. A letter of approval from the NCDENR, DWQ will satisfy this certification requirement for sanitary sewer improvements.

B One-year warranty letter shall be provided to HRW from the developer or the developer's utility contractor.

3.5.5 Certification by HRW and the Harnett County Development Review Board

A. Final Plat Approval

The signature, seal and date of the developer's Registered Land Surveyor (R.L.S.) shall be affixed to the final plat submitted to the Harnett Country Development Review Board (HCDRB) for review and approval to be recorded

with the Harnett County Register of Deeds Office. Once the final plat has been approved then the HCDRB Officer shall sign and date the final plat to be recorded. If all utility improvements have been satisfactorily designed and installed in accordance with the State requirements and HRW Standard Specifications and Details, then HRW representative on the HCDRB will vote to approve the final plat. Otherwise, the final plat will be held until all conditions for

approval have been satisfied by the developer, the contractor and the P.E.

B. Transfer of Title.

The Developer shall transfer to HRW, title to all water distribution and sewage collection systems installed by Developer's contractor. Such conveyance is to take effect without further action upon the acceptance of HRW of said installation. As further evidence of said transfer of title, upon completion of the said installation and prior to the rendering of service by HRW, the Developer shall, without cost to HRW:

1. Convey at no cost to HRW, its successors or assigns by good and sufficient easement deed or dedication in right-of-way in a form satisfactory to HRW a perpetual right, easement and privilege to operate, maintain and repair or replace all water and wastewater mains, pipes, connections, pumps and meters within granted easements upon Developer's property in connection with supplying water and wastewater service to the inhabitants, occupants and customers in Developer's property and secure from each mortgagee and lien or a release of mortgages' and lienors' interest in the easement and fixtures thereon for so long as the easement is used for the operation, maintenance, repair replacement of water and wastewater mains, pipes, connections, pumps and meters within the easements.

2. Transfer at no cost to HRW all Developer's right, title and interest in and to all of the water and wastewater supply lines, mains, connections pipes, valves, meters and equipment installed up to and within granted easements and right-of-way for the purpose of supplying water service and wastewater collection for the inhabitants, occupants and customers in Developer's property.

3. Furnish HRW with an AFFIDAVIT that all persons, firms or corporations who furnished labor or materials used directly or indirectly in the prosecution of the work required to be performed by the Agreement have been paid. Said AFFIDAVIT shall be written in such a form as approved and accepted by HRW.

4. Furnish HRW with a RELEASE OF LIEN from all contractors and suppliers of materials and/or labor who might have acquired interest into the installations by the supply of materials and/or labor otherwise.

5. Furnish HRW with all Manufacturers' warranties which Developer might have received or is due to receive on any part of the installations.

6. Pay to HRW any and all applicable charges which shall be due and payable prior to connection to HRW water and/or wastewater system.

7. Furnish HRW with a satisfactory warranty on guaranteeing all equipment and infrastructure installed pursuant to this Agreement against defect in materials, equipment of construction for a period of not less than one (1) year from date of acceptance of same by HRW. Said warranty shall be in such a form as approved and accepted by HRW.

C. Recording Notations and Fees

Appropriate notations for transfer and recording by the County Clerk of Court, indicating the date and time of recording, the plat book and location thereof, and instrument number. All applicable recording fees shall be paid by the developer or the developer's Registered Land Surveyor (R.L.S.). All utility easements required by HRW to access the new improvements shall be accurately documented in the final plat and conveyed to the District/County as deemed necessary by HRW staff and outlined herein.

3.5.6 County Acceptance of System Improvements

HRW Engineering Representative shall invoice the developer/owner for the tap fees, system development fees, meter fees, account set up fees and account deposits as applicable once the State has issued approval of the system improvements. HRW shall approve the new system improvements and thereby release meters to the developer/owner or builder once all applicable fees have been paid by the developer/owner and the State approval letter(s) is/are on file with HRW.

CHAPTER 4

GENERAL CONSTRUCTION REQUIREMENTS

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CHAPTER 4 GENERAL CONSTRUCTION REQUIREMENTS

Section 4.1 General

4.1.1 Phase Development

Subdivisions may be developed by sections or phases in accordance with an approved time table. Each section shall be submitted as separate, independent projects in accordance with the regulations and procedures herein.

4.1.2 Conformance

Improvements shall be installed in accordance with the requirements and standards, set forth in this document and other specifications, and policies adopted from time to time by HRW. The source supply and/or manufacturer of the materials shall be approved by the Engineer of Record and HRW before delivery is started. Representative preliminary samples and certifications of independent testing laboratories relevant to the character and quality herein described shall be submitted by the contractor/developer for all materials furnished prior to obtaining any materials from the respective sources of supply if required. Only approved materials conforming to the requirements of approved specifications shall be used in the work. All materials proposed may be inspected, at any time during the progress of their preparation and they shall be stored so as to insure the preservation of their quality and fitness for incorporation into the work.

4.1.3 Commencement

No construction or installation of improvements shall begin in a proposed subdivision until the construction plan has been approved by the appropriate authorities and unless applicable permits have been issued and filed with HRW. Upon receipt of all regulatory approvals, shop drawings approvals, and any required bonds, HRW shall notify developer to begin work.

A. Commencing Work

The developer/contractor shall notify HRW in writing, at least 48 hours prior to beginning any work. Failure to comply with this requirement shall affect the acceptance of any work performed prior to notification. If the work does not commence on the date specified in the written notice, then a new notice will be required of sufficient lead time to allow the rescheduling of inspection forces.

B. Prosecution of Work

The work shall be prosecuted from as many different points in such part or parts as may be requested by the

developer/contractor. All construction activities shall be carried out during HRW normal working hours and days. Certain construction activities may be authorized such as site clean-up, etc.; however, such activities shall not be initiated without prior approval of HRW. Normal working hours and days for Harnett Regional Water shall be defined as 8:00 a.m. - 5:00 p.m., Monday - Friday.

4.1.4 Access

All public agencies shall have access to the premises and structures of a development from this document during reasonable hours to make those inspections as deemed necessary by them to ensure compliance with the provisions of this regulation.

4.1.5 Selection of Contractor

Upon approval of the construction plan by HRW and issuance of the appropriate approvals and permits by the various local, state and federal agencies, a contractor should be selected to perform the necessary improvements. In certain instances, HRW may, at its discretion, offer to the developer the option of either securing a contractor or utilizing HRW's labor and equipment to install the necessary improvements. In the event HRW elects to perform such service, the developer will be charged at or below prevailing construction prices inclusive of equipment costs, parts, materials, labor and overhead. In certain instances, involving minor extensions, HRW may reserve the right to install all improvements in accordance with this Policy.

4.1.6 Licensed Contractors

All contractors must be licensed by the Contractor's Licensing Board of the State of North Carolina. HRW reserves the right to accept or reject, based upon past performances and experiences, contractors selected to perform work on systems to be conveyed to HRW. The developer shall submit the name and license number of the contractor to perform the work to HRW for approval prior to commencing work.
All federal, state, and local laws, regulations, rules, general statutes and ordinances including but not limited to those established by: Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), the North Carolina Department of Environment and Natural Resources (NCDENR), The North Carolina Department of Labor (NCDOL) and the North Carolina Department of Transportation (NCDOT) must be followed by each utility contractor and sub-contractor working within the NCDOT right-of-way. All requirements of approved NCDOT encroachment agreements must be strictly adhered to by all personnel on site during the course of utility construction within the NCDOT right-of-way including the strict adherence to all required NCDOT traffic control and erosion control measures. The utility contractor is responsible to assure that

all staff, sub-contractors and temporary labor working on the project site meet all work zone safety requirements established by OSHA and/or the NCDOT. All personnel working on the construction site must be certified by a NCDOT approved training program with respect to the NCDOT work zone safety training certification requirements for the Flagger, Crew and Supervisory positions as deem necessary by the NCDOT. The utility contractor as well as any and all sub-contractors and temporary labor or staff working on a project for the utility contractor must adhere to the latest and most current OSHA requirements and NCDOT standards for work zone safety when working within and near the NCDOT right-of-way.

4.1.7 Projects Offered to Bid

All contract work administered by HRW must be either offered for bid or negotiated among a minimum of three (3) qualified contractors. Harnett Regional Water prefers that local utility contractors be provided the opportunity to bid on all projects that Harnett County funds. Performance and payment bonds will be required. Projects administered by HRW are those which, by delegation of the developer, HRW assumes responsibility for securing a contractor and construction management.

4.1.8 Preconstruction Conference

Upon the selection of a contractor a preconstruction conference shall be conducted. The developer shall make arrangements with those public agencies charged with the enforcement of the provisions of this document to conduct the preconstruction conference. Those in attendance must include representatives of the following: contractor, developer, engineer, and HRW. This requirement may be waived in writing by HRW depending upon the project complexity. Others that may wish to attend include NC Department of Environment and Natural Resources (NCDNR), Harnett County Planning Board, and North Carolina Department of Transportation (NCDOT). The purpose of this meeting is to outline construction, inspection, payment (to HRW) and acceptance procedures. Adequate prior notice not less than five (5) working days shall be required.

4.1.9 Fees and Charges

All prevailing applicable Harnett Regional Water fees and charges must be paid to Harnett Regional Water prior to the initiation of construction. Harnett Regional Water will accept payment of the associated fees prior to commencement of the project. Payment before all approvals are obtained will not be accepted. The fees and charges in effect on the date of the preconstruction conference shall be the prevailing rates charged. Upon payment to Harnett Regional Water and concurrence by HRW staff, construction authorization will be issued. The construction authorization should be submitted to Harnett Regional Water for the issuance of any applicable

building structure such as booster pump station permits. The County does not authorize the issuance of a building permit without official construction authorization from Harnett Regional Water.

A 10% forfeiture of fees shall be levied upon the un-built portion of the project should the developer choose not to build all portions as specified under the Water/Sewer Agreement within the time frame specified.

4.1.10 Developer's Guarantee of Work

The developer shall guarantee all facilities installed for a period of one (1) year after completion and the completion and inspection of sections of the facilities does not constitute acceptance of those sections. The guarantee by the developer shall begin on the date of formal dedication and acceptance by HRW

4.1.11 Interpretation of Plans

The approved plans will show the locations, details, and dimensions of the work contemplated, which shall be performed in strict accordance therewith and in accordance with the approved specifications. Any deviations from the plans, specifications, etc., as may be required by exigencies of construction, in all cases will be determined by HRW. Only plans marked "APPROVED FOR CONSTRUCTION" by the regulatory agencies or conformed copies may be used and a copy of same (exhibiting said approved stamp) along with project specifications shall be kept at the job site as long as construction is in progress.

In all cases, the figured dimensions shall govern in the case of a discrepancy between the scales and the figures. The contractor shall take no advantage of any error or omission in the plans, or the discrepancy between the plans and the specifications, and Harnett Regional Water's representative shall make small corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the specifications and the plans as construed by him and his decision shall be final.

Contractors shall install all water system improvements and all sanitary sewer improvements per the engineer's design as approved by HRW and permitted by the North Carolina Department of Environment and Natural Resources unless the existing site conditions preclude such installation or significantly impact the project or environment. The contractor shall inform HRW Utility Construction Inspector of such impeding conditions or adverse site concerns and request HRW Engineering Representative to review these contractor's concerns with the design engineer. The construction on the project may be halted until HRW staff consults with the design engineer to provide a satisfactory change order to adjust the plans around the adverse site conditions or other concerns of the contractor. If a satisfactory resolution cannot be made by an engineering design change order, then the project will be cancelled and completely re-designed by the design engineer. The re-designed plans shall be submitted to

HRW Engineer for review and approval before resuming any construction activity on site to determine if significant design revisions warrant the need for a new NCDENR permit. HRW reserves the right to halt the construction of any project that involves an extension of the Harnett Regional Water's water distribution system or sanitary sewer collection system at the discretion of HRW Utility Construction Inspector or HRW Engineering Representative where site conditions may be considered to be unsafe, unstable, hazardous or life threatening to HRW staff or the general public. Should new permit (s) be required then all construction shall be stopped until the appropriate NCDENR permit(s) have been applied for and received by HRW. Construction shall resume as directed by HRW Utility Construction Inspector or HRW Engineering Representative.

4.1.12 Construction Layout

The developer/contractor shall furnish all line and grade (staking and cut sheets) necessary to construct the project. The work, as completed, shall conform to the APPROVED FOR CONSTRUCTION PLANS stamped by HRW Engineering Representative as "Released For Construction" except where grade and/or alignment are changed to avoid obstructions and such changes have been previously approved by the Professional Engineer and HRW Engineering Representative Changes shall be made only as directed by the Professional Engineer and HRW Engineering Representative.

4.1.13 General Inspection

Improvements shall be installed in accordance with the established specifications, and other applicable policies of HRW. Contractor shall conform to all applicable local, state and federal regulations. No field changes to the plans are allowed without prior written approval from HRW. The Developer shall, at his expense, retain the services of the Engineer of Record for the purposes of providing necessary inspections and supervision of the construction work, record drawings and Engineer certifications. The engineer is responsible to insure that construction is, at all times, in compliance with accepted sanitary engineering practices and the approved plans and specifications. A copy of each Engineer's field report is to be submitted to HRW as each such inspection is made. Water and sewer infrastructure must pass all tests as required by HRW specifications and those of all applicable regulatory agencies. These tests include, but are not limited to, air test, vacuum test, mandrel test, visual test, pressure test, bacteriological test, etc. A HRW inspector must be present during testing. All test results must be submitted to HRW. All tests must be satisfied prior to Final Inspection.

Following completion of construction of all water and sewer infrastructure delineated in the approved water and sewer plans a Final Inspection must be requested in writing by the Developer or Developer's engineer. The Developer's engineer and HRW inspector shall prepare a written punch list of any defects or deficiencies noted during this inspection, should any exist. Upon completion of the punch list, the Developer's engineer will schedule another inspection. In the event the number of inspections performed by HRW exceeds two, additional fees may be assessed to the Developer.

HRW inspectors shall make periodic checks; during all phases of construction to ensure that the contractor is complying fully with project design and specifications, as well as the policies and procedures herein established. Any deviation or revision to the approved engineering plans shall be accomplished in writing by contract change order. No deviations or revisions will be initiated by the Contractor until the Contractor, HRW Engineering Representative and the Professional Engineer have each approved the change in writing. Harnett Regional Water requires an onsite resident inspector during all critical phases of construction. The onsite resident inspector shall be provided at the developer's expense and shall first be approved by Harnett Regional Water's management. The inspector's resume shall be submitted for review and approval prior to the Preconstruction Conference.

4.1.14 Preliminary Inspection

A preliminary inspection may be requested by the contractor for the purpose of preparing a "punch list" of items to be completed prior to final inspection. This inspection does not

authorize the developer or contractor to discharge raw wastewater into the sewer system or to distribute potable water by means of the Harnett Regional Water's water system. It should be noted that it shall be the responsibility of the developer or contractor to pump dry and dispose of all effluent in an acceptable manner prior to requesting a final inspection. Not until finally accepted by Harnett Regional Water and dedicated will Harnett Regional Water be obligated to accept waste from or distribute potable water to the proposed development.

4.1.15 Final Inspection

Upon completion of the proposed improvements, the developer or contractor shall request a final inspection. Prior to the discharging of any wastewater into Harnett Regional Water systems and distribution of potable water, the improvements shall comply with all the criteria specified by the policies herein stated and the associated plans and specifications.
In the event that the construction is acceptable, HRW will assume operational responsibility upon the completion of the following: presentation of As-built Record Drawings, the certification of non-litigation, and certification of no outstanding liens, and recording of acceptable easements and deeds to property, Engineers certification that construction is in accordance with plans and specifications, engineer's certification of final cost, letter of official warranty and anniversary inspection date.

☐ Release of NCDOT bond and/or acceptance.
☐ Erosion Control.

4.1.16 Warranty Inspection
Upon completion of the construction and upon acceptance by HRW, the one (1) year warranty period will begin. During the eleventh (11th) month following acceptance by HRW of any and all water/sewer utilities so constructed, HRW, in conjunction with the developer's engineer, shall conduct a warranty inspection. It shall be the responsibility of the developer to ensure that the water/sewer utilities are in first class condition and shall remain in said condition, less normal wear, for a period of one (1) year from the date of acceptance. All remedial items noted in the inspection shall be the responsibility of the developer.

4.1.17 Authority of Inspectors, Inspection of Work

Inspectors employed by HRW are authorized to inspect all work done and all materials furnished by the contractor and such inspection may extend to all or part of the work and to the preparation or manufacture of the materials to be used. An inspector shall be assigned to the work to report the progress of the work and the manner in which it is being performed. He shall report to the appropriate Harnett Regional Water official

whenever it appears that the materials and/or work performed by the contractor/developer fail to fulfill the requirements of the specifications and the developer's contract for this extension, and to call to the attention of the Contractor/Developer such failure or other default. Such inspection, or any failure to provide such inspection, however, shall not relieve the contractor/developer from his obligations to perform all work strictly in accordance with the requirements of the "Approved for Construction" plans and specifications nor, shall it release the developer from any of the terms of the contract for the work. The inspector is not authorized to revoke, alter or waive any of the requirements of the developer's contract; to approve or accept any portion of the completed project; nor to give any instructions to the contractor/developer which are contrary to the "Approved for Construction" plans and specifications. He shall have the authority to reject materials and to suspend the work until any questions at issue can be referred to and decided by the Harnett Regional Water's Utility Manager or Engineering Supervisor. The inspector shall, in no case, act as foreman or perform any other duties for the contractor/developer, nor shall he interfere with the management of the work by either the contractor or the developer, except in the case of the work done in the road rights-of-way where it is apparent that the County may be liable for unsafe or defective action of the contractor. Any advice or instructions which the inspector may give the contractor shall not be construed as binding upon the County in any way, or as releasing the contractor/developer from fulfilling the terms of these specifications or the developer fulfilling all of the terms of his contract for the work.

Where there is disagreement between the contractor/developer or his representative and the inspector, such as; refusal by the contractor/developer to use properly approved materials; performing work not in compliance with the "Approved for Construction" plans and specifications; or refusing to suspend work until problems at issue can be referred to and decided upon by Harnett Regional Water's Utility Manager. The inspector will immediately direct the Developer's Engineer to all issues at hand and the Developer's Engineer will prepare and deliver to the contractor/developer, by mail or otherwise, a written order suspending the work and explaining the reason for such shutdown. Subsequent inspections will not be made until such time as the issues at hand are resolved. Any work performed during the inspector's absence will not be accepted and may be required to be removed and disposed of at the contractor's/developer's expense. The contractor/developer shall remove, at his own expense, any work or materials condemned as unsatisfactory by Harnett Regional Water's Utility Manager, and shall rebuild/replace same to the standard required by the specifications.

Failure of the contractor to comply with these specifications and determinations of Harnett Regional Water and to remove condemned materials or work will jeopardize the acceptability

on future work under the jurisdiction of Harnett Regional Water. Failure of the developer to insure the required compliance by his contractor or to faithfully comply with all of the terms of his contract with Harnett Regional Water for the work will prevent the issuance of service connections until the issues at hand are satisfactorily resolved and will be considered prior to the issuance of future extension contracts. If deemed necessary by the Director of HRW, the Director may instruct his construction forces to physically disconnect the substandard construction from Harnett Regional Water's system.

4.1.18 All Work Subject to the Control of Harnett Regional Water

In the performance of the work, the developer/contractor shall abide by all orders, directions and requirements of HRW, and at such times and places, by such methods and in such manner and sequences as he may require. HRW shall determine the quality, acceptability, and fitness of all parts of the work, and shall interpret the

specifications and decide all other requests in connection with the work.

A. Upon request, HRW shall confirm in writing any oral order, direction, requirement or determination.

B. The enumeration herein or elsewhere in the specifications of particular instances in which the opinion, judgment, discretion, or determination of HRW Manager shall control, or in his approval or inspection, shall not imply that only matters similar to those enumerated shall be so governed and performed, but without exception all work shall be so governed and so performed.

4.1.19 Construction Approval, Conveyance and Dedication Requirements

Approval of the As-Built Plan shall not be given by HRW unless the developer has installed all improvements as herein specified and required or has provided a financial guarantee therefore as specified herein.

The following procedures address the requirements of the Harnett Regional Water (HRW), the North Carolina Department of Environment & Natural Resources (NCDENR) and the North Carolina Department of Transportation (NCDOT) necessary to convey water/sewer improvements and to place into service the water/sewer utilities constructed.

A. The Project Engineer will make an inspection of the project to determine what items require attention and to determine that such items are subsequently completed by the contractor prior to notifying HRW and NCDENR.

B. A pre-final inspection will be conducted by HRW at the Project Engineer's request in order to list all items that in the opinion of HRW representative, still need attention.

C. A final inspection will be coordinated by the Engineer & NCDENR where applicable with HRW and any additional agency that may have interest in the project. A preliminary "As-Built" will be supplied by the Project Engineer at this time to field verify the accuracy of same and to make the necessary changes prior to final submittal.

D. Only upon receipt of written approval of the system by HRW, will water and/or sewer service connections be permitted to the dwelling units. Service is also conditioned upon satisfaction of all HRW requirements related to the proper operation of the utilities.

E. HRW may, at times, issue a conditional temporary approval. This is not to be misinterpreted as final approval, but only an interim measure of limited operational obligation by HRW to aid the developer in completing his construction commitments. The developer still must maintain ownership

and is obligated to any excessive operational expenses associated with his project.

F. The NCDOT will be notified by the Engineer to inspect all work completed by the contractor under the Encroachment Agreement between NCDOT, the Developer and HRW. Final acceptance will be withheld until written approval by the North Carolina Department of Transportation (NCDOT) District Engineer is received for the project.

G. Final approval by HRW will be withheld until all construction is completed within each phase of a project or that portion which is approved by the regulatory agencies document. The construction, as mentioned, is limited to grading, pavement placement, landscaping, and any additional placement of any and all materials that would cause additional hardship to HRW in servicing the utilities. This does not, however, include the construction of any structures or facilities that would utilize the system.

H. Upon final approval by HRW, the Director will sign the Applicant Certification" document, and then forward the executed copies to the NCDENR for recording. The date of operation,

maintenance, and acceptance of the project by HRW, as well as the one-year warranty by the developer, will coincide with the date of the Director's signature on the above document.

I. The Engineer will supply to HRW the following documents, prior to acceptance, with ample time for inspection and corrections:

1. All Items Covered under Section 3.5 and associated documents deemed necessary by Harnett County or HRW.

2. Four (4) copies of any deed along with four copies of any plat, if applicable, prepared by the developer's attorney for conveyance of property associated with a pump station site, well site, elevated storage tank site or facility site to be deeded to the County.

3. One (1) copy of the "Cost Certification" document supplied and certified by the Project Engineer.

J. After final acceptance and verification of the accuracy of the "As-Built" plans, one (1) record set of mylars, two sets of blue prints or bond copies, and one digital copy [AutoCAD .dwg file] of the As-Built Record Drawings all having the Professional Engineer's certification and seal will be supplied to HRW, along with any original equipment manufacturers" (OEM) maintenance manuals or operational literature as may be required to operate and maintain the utilities being conveyed.

4.1.20 Acceptance of Construction and Connection to the Existing Public System

Preliminary acceptance and permission for lateral connections, as hereinafter outlined, may be granted by HRW when all testing has been successfully completed and all deficiencies corrected. Final acceptance shall not be granted until such time as:

A. All work is completed and a surface course is placed up to the finished grade (riding surface).

B. If proposed storm drainage is not in place at the time of the construction, a determination shall be made by HRW Engineering Representative that Ductile Iron Pipe has been placed in those areas to be crossed with storm drainage.

C. A final inspection has been conducted by authorized representatives of HRW and all deficiencies corrected.

D. Work within State maintained road right-of-way has been approved by the North Carolina Department of Transportation (NCDOT) District Maintenance Engineer.

E. As-Built construction plans have been submitted and approved and all right-of-way and easements in which water

and sewer lines lie have been properly recorded. 38

F. North Carolina Department of Environment & Natural Resources (NCDENR) approvals have been issued by the State and copies are on file in HRW office.

G. All Items outlined in Chapter 3 Section 3.5 have been completed.

4.1.21 Maintenance of Improvements

Completion of construction of any improvements shall not obligate HRW or any public agency to maintain said improvements. HRW will assume responsibility only when construction is accepted by HRW and all dedication instruments duly recorded.

4.1.22 Observance of Laws

The developer/contractor shall at all times observe and comply with all Federal, State, and local laws, ordinances, regulations, and all such decrees as exist at present or as may be enacted during the period of construction, by bodies or tribunals having any jurisdiction or authority over the work, in any manner affecting the conduct of the work or those employed on the work. No plea of misunderstanding will be considered on account of their ignorance thereof.

4.1.23 Permits and Licenses

The developer/contractor shall procure all permits and licenses, shall pay all charges and fees, and shall give all notices necessary and incidental to the due and lawful prosecution of the work.

4.1.24 Indemnification of the County

The contractor/developer will indemnify, hold harmless the County and its agent and including attorney's fees arising out of or remitting from the loss or expense that is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting there from; and is caused in whole or in part any negligent or willful act or omission of the developer, contractor, and subcontractor(s), or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

In any and all claims against the County or any of its agents or employees, by any employee of the developer, contractor, and subcontractor(s), anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by, or for the developer, contractor, and subcontractor(s) under Workman's Compensation Acts, Disability Benefit Acts or other employee benefit acts.

4.1.25 Public Convenience and Safety

The contractor shall, at all times, conduct the work in such a manner as to ensure the least obstruction to vehicular and pedestrian traffic. The convenience of the general public and of the residents along and adjacent to the work shall be satisfactorily provided for, including provisions for and maintenance of access to passageways and entrances into public and private property. Fire hydrants on or adjacent to street shall be kept accessible to fire apparatus at all times, and no material or equipment shall be placed within fifteen (15) feet of any such hydrant. The contractor/developer shall provide, erect, and maintain all necessary barricades, suitable and sufficient warning lights and danger signals, provide watchmen, and take all precautions necessary for the protection of the work and safety of the public. Any necessary signs shall be mounted on suitable and approved standards and

shall be conspicuously placed adjacent to the work where traffic will be alerted.

The contractor/developer shall, at his own risk and expenses shore up and otherwise protect buildings, bridges, fences, walls, property monuments, pipes, and other structures and objects legally existing along the line or adjacent to the work; and in the event of any injury to such public or private property by reason of, or consequent upon any act, omission, neglect or misconduct in the execution of the work provided for herein, the developer/contractor shall, at his own cost and expense, make all such repairs as may be necessary to restore such property to its former condition. Failure on the part of the developer/contractor to make all necessary repairs, or to satisfy any legal demand or liability, shall confer upon HRW the right to disallow the connection of the project to the Harnett Regional Water's system.

It is clearly understood that it is the responsibility of the developer/contractor to maintain reasonable cleanliness of all streets which are used in the construction of the project. When, in the opinion of HRW representative, any street inside or outside of the project becomes excessively dusty or unclean due to its use by the contractor's equipment, the contractor shall, at his own expense, furnish men and equipment and clean (flush, etc.) said street to a degree acceptable. At the completion of the project, the contractor shall thoroughly clean the above mentioned streets to a degree acceptable to HRW representative. The inspection of these streets will be a part of the inspection.

Section 4.2 Financial Guarantees

4.2.1 General

Financial guarantees covering all improvements required herein shall be a prerequisite to HRW action on the application for the construction plan. Such Guarantees must follow the latest Unified Development Ordinance.

4.2.2 Performance Bond

Contractors performing work on State rights-of-way requiring an encroachment agreement signed by the County, will and the NCDENR permit will be required to post a bond to HRW for the total dollar amount of improvements and possible damage in that rights-of-way prior to initiating construction. Since Harnett Regional Water is ultimately held responsible for the actions of the contractor in the road rights-of-way, he will be required to sign an "Encroachment Agreement" which gives the County authority over this portion of construction. In addition, the developer or contractor must post a performance bond with the County guaranteeing the completion of all offsite improvements as determined by the Harnett Regional Water or Planning Department staff.

4.2.3 Warranty Bond

Upon completion of construction and upon acceptance by HRW, the developer/contractor shall post a warranty bond guaranteeing that the facilities, appurtenances, and lines are in first class condition and shall remain in said condition, less normal wear, for a period of one (1) year from the date of agreement by HRW to accept said facilities. An extension of the performance bond for the warranty period in lieu of a separate warranty bond is acceptable.

Section 4.3 County/District Installed Water/Sewer Extensions

Where extensions are to be made to existing Harnett Regional Water owned utility lines which may serve abutting undeveloped properties, HRW will consider providing the necessary equipment and labor to install the extension in accordance with the following conditions and latest Water and Sewer Use Ordinance:

□ The extension to be made must be within existing public road right-of-ways.

□ The extension to be made is in accordance with the Harnett Regional Water's overall Master Plan.

□ The developer or property owner makes advance payment for all materials required to complete the project, as well as, all contracted work beyond the ability of HRW to perform.

□ HRW has the proper equipment and labor available to

conduct the work contemplated.

□ The extensions to be made will be mutually beneficial to abutting properties and are not deemed by HRW to be necessary for the exclusive future development use or needs of the developer or property owner.

□ The developer understands that no portion of the funds given to Harnett Regional Water for the extensions can be rebated in the event additional properties utilize this extension.

□ The developer understands that the extension will be made by HRW staff as time is available and the County will bear no development expense due to the delays in completion of said extensions.

In no event will HRW provide equipment or labor to construct improvements within subdivisions or developing properties unless the conditions established in Sections 4.1.5, 4.1.6; 4.1.7, and 4.3.1. 40

4.3.1 Prepayment

In lieu of immediate construction by the developer of any or all required utility improvements, the developer may make payment to the County at the discretion of the County of the full amount of said improvements in compliance

with the requirements herein below.

A. Harnett Regional Water shall have the right to refuse prepayment for any and/or all required improvements and require construction and installation thereof by the developer.

B. Where prepayment is accepted by Harnett Regional Water, the construction and installation of all improvements covered thereby shall be performed by HRW. After completion of said improvements, any unexpended amounts shall be refunded by the developer.

C. In the event more than one property owner is involved in payment for a line extension, it will be the responsibility of the initiating property owner to negotiate payment by the additional property owners. Harnett Regional Water will provide an estimate of materials cost. 41

Please see Chapter 12, General and Special Conditions, Special Construction Technical Specifications for additional information and requirements for construction.

CHAPTER 5

WASTEWATER GRAVITY SYSTEM

STANDARDS AND SPECIFICATIONS

Chapter 5 DESIGN OF SANITARY SEWER IMRPOVEMENTS- REQUIREMENTS

Section 5.1 Sanitary Sewer Design Standards

All engineering plans and profiles of public sanitary sewer systems, private sanitary sewer systems and any associated or proposed system improvements to Harnett Regional Water's sanitary sewer collection systems shall be designed by a Professional Engineer (P.E.) in accordance with industry recognized standards to conform with all applicable rules and regulations established by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR –DWQ) under the Administrative Code Section 15A NCAC 2T - Waste Not Discharged to Surface Waters (EFFECTIVE September 1, 2006) , the standard specifications and details of the HRW as outlined herein this section. All engineering plans and profiles of proposed public and/or private projects, that involve improvements to Harnett Regional Water's sanitary sewer system, shall be permitted by the NCDENR – DWQ prior to any construction of the proposed improvements. The Professional Engineer (P.E.) shall submit the design plans and profiles of the sanitary sewer system improvements to the HRW Engineer for review and approval prior to the submission of any permit application to the NCDENR – DWQ. The design plans and profiles shall include the following information:

- an overall utility plan layout on a single plan sheet (24" x 36") with a scale no smaller than one (1") inch equals two hundred (200") feet,
- vicinity map with north arrow and the latest edition of the HRW Required Utility Notes for Sewer,
- the key sheet to illustrate the match lines between plan sheets and to depict any proposed phase lines,
- the size and material of each sanitary sewer main and all associated manholes,
- the crossing of any existing or proposed utilities, especially potable water lines,
- the topographic lines, existing grade and the proposed finished grade upon project completion.
- the HRW sanitary sewer details in accordance with these specifications,
- the erosion control plans and associated details.

Section 5.2 Design Capacity

In general, a Professional Engineer (P.E.) shall design any and all sanitary sewer system improvements in accordance with industry recognized standards and conform to the state minimum design rules indicated above and these specifications. The sanitary sewer system capacities shall be designed for the estimated ultimate tributary population, except in considering parts of the systems that can be readily increased in capacity. Similarly, consideration shall be given to the maximum anticipated capacity of institutions, industrial parks, etc.

- In determining the required capacities of sanitary sewers, the following factors should be considered:
- Maximum hourly domestic sewage flow;
- Pump station capacities and interceptor sewers from point of discharge to the treatment works;
- Inflow and groundwater infiltration;
- Topography of area;
- Location of sewage treatment plant; 43
- Depth of excavation; and

- Pumping requirements.

The basis of design for all sewer projects shall accompany the planning documents. More detailed computations may be required by the HRW for critical projects. The HRW Master Sewer Plan shall be the guiding document for all sanitary sewer improvements and the developer/owner shall abide by the pipe sizes, grades, locations and capacities as determined by the HRW and outlined in the HRW Master Sewer Plan.

Section 5.3 Design Flow

5.3.1 Per Capita Flow

New sanitary sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day (.38 m3 / day) or 120 gpd/bedroom. This figure is assumed to cover normal infiltration; but an additional allowance should be made where conditions are unfavorable. The NCDEHNR currently requires flow projections to assume 240 gpd per two bedroom dwelling unit, and 360 gpd per three bedroom dwelling unit. The design flow rate for any extension of the Harnett Regional Water's existing sanitary sewer collection system must follow the flow rates outlined in the North Carolina Administrative Code Title 15A North Carolina Department of Environment and Natural Resources, Division of Water Quality (NCDENR-DWQ) Subchapter 2T Sections .0100 through .1600 "Waste Not Discharged to Surface Waters, more specifically under Section .0114 Wastewater Design Flow Rates.

5.3.2 Peak Design Flow

Sanitary sewers shall be designed on a peak design flow basis using one of the following methods:

A. The ratio of peak to average daily flow shall be 2.5 as required by the North Carolina Department of Environment & Natural Resources, Division of Water Quality (NCDENR-DWQ).

B. Values established from an infiltration/inflow study acceptable to the approving agency.

C. Use of other values for peak design flow will be considered, if justified, on the basis of extensive documentation and approved by the NCDENR.

5.3.3 Combined Sewer Interceptors

Combined sewers will not be allowed. Storm water sewers shall be designed in accordance with all requirements established by the North Carolina Department of Environment and Natural Resources – Division of Land Quality (NCDNR-DLQ) and the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDNR-DWQ) and the North Carolina Department of Transportation (NCDOT).

Section 5.4 Design Details for Sanitary Sewer Mains

5.4.1 Minimum Size

No sanitary sewer gravity main conveying raw sewage shall be constructed with pipe less than eight (8") inches (20 cm) in diameter. No sanitary sewer force main shall be constructed with pipe less than four (4") inches (10 cm) in diameter unless approved by the HRW Engineer or the HRW Director.

5.4.2 Depth

Gravity extensions off existing manholes will be required to enter the manholes at the bottom and extend outward at a minimum grade to facilitate full utilization of the system. Outside drops may be allowed in areas determined as meeting full coverage. In general, sewers should be sufficiently deep to receive sewage below the floor elevation of all structures receiving service and maintain a minimum of thirty-six (36") inches of cover. The HRW Master Sewer Plan shall be deemed the governing document when the engineer is designing the sanitary sewer improvements for

one project and the question of depth is not a concern for the single project. Sewer mains exceeding depths of eighteen feet shall be Ductile Iron Pipe with protective interior coating. HRW shall review the project plans with respect to the associated basins as identified on the HRW Master Sewer Plan. 44

5.4.3 Slope

A. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second (0.61 m/s), based on Manning's formula using an "n" value of 0.013 nor mean velocities greater than 15 feet per second. The maximum slope of any sanitary sewer lines shall be twenty (20%) percent.

B. All sewers shall be designed and constructed to meet or exceed following minimum slopes: Minimum Slope Sewer Size [Rise / Run] x 100 8 inch (20cm) 0.40 10 inch (25cm) 0.25 12 inch (30cm) 0.19 14 inch (36cm) 0.16 15 inch (38cm) 0.14 16 inch (41cm) 0.13 18 inch (46 cm) 0.11 21 inch (53 cm) 0.09 24 inch (61 cm) 0.07 27 inch (69 cm) 0.06 36 inch (91 cm) 0.05

C. Slopes slightly less than those required for the 2.0 feet per second (0.61 M/s) velocity, when flowing full may be permitted at the HRW discretion. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or, greater for design average flow. Whenever such decreased slopes are selected, the design engineer must furnish with his report his computations of the anticipated flow velocities of average and daily or weekly peak flow rates. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems.

D. Sewers shall be laid on a uniform slope between manholes. Any sanitary sewer gravity mains that shall cross the NCDOT right-of-way by must be designed with an open cut with the ductile iron or PVC sanitary sewer main (carrier pipe) shall be installed inside an appropriately sized steel casing to allow for future removal and re-installation of said sanitary sewer main. The open cut shall be requested by the professional design engineer in the NCDOT Encroachment Agreement as designed in the utility plans. The carrier pipe and steel casing shall be installed by the open cut method to assure the proper grade is maintained and avoid a directional bore and jack of a wastewater line where possible. All joints of pipe installed inside an open cut shall be sealed and wrapped to be water tight so as to prevent inflow. If the NCDOT District Engineer will not approve the open cut method of installation then the sanitary sewer gravity main (carrier pipe) shall be installed inside the steel casing by the bore and jack method across one or more traffic lanes to a point where the NCDOT District Engineer will approve an open cut to begin or across the entire right-of-way as approved by the NCDOT District Engineer and the HRW Engineer.

E. Where velocities greater than 15 feet per second (4.6 m/s) are attained, special provisions shall be made to protect against displacement by erosion and shock.

5.4.4 Alignment

All sewers shall be laid with straight alignment between manholes. The alignment shall be checked by using a laser beam or other acceptable means approved by Harnett Regional Water. The angle between lines carrying wastewater into and out of a manhole will not be less than 90 degrees (except under extreme circumstances). Where new lines are connected to existing manholes, the invert channel must be reworked and shaped to fit the new pipes being installed into the existing manhole(s) so the incoming sewers will flow smoothly with an angle equal to or less than 180° degrees between the incoming sewer lines. This arrangement will assure the sewer lines do not directly oppose one another and the flow remains laminar through the invert channel. If the proper alignment cannot be maintained for any reason then the entire manhole interior shall be coated with either coal tar epoxy, Flex-Seal Utility Sealant ™, Spectrashield Liner ™ or approved equal in accordance with Section 5.5.8 below.

5.4.5 Changes in Size and Material

When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both 45 sewers at the same elevation. Sewer extensions should be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension. The HRW may require a schedule for future

downstream sewer relief. Sewer main material changes must be made between manholes. Sewer main material must remain constant between manholes.

5.4.6 Vertical Separations

The following minimum vertical separations shall be provided for any line extension of the Harnett Regional Water's existing sanitary sewer system:

Utilities or Structures		Vertical Separation Distance
A.	Storm sewers and other utilities not listed below;	2 feet
B.	Water mains (water over sewer including in benched trenches)	2 feet
C.	Reclaimed water lines (reclaimed water over sewer)	2 feet
D.	Final earth grade (finished grade)	3 feet
E.	Top of a manhole above the 100 year Flood Plain	2 feet

Ductile iron pipe shall be used for any line extension of Harnett Regional Water's existing sanitary sewer collection system where the above minimum vertical separations cannot be maintained. The design shall maintain vertical separations to satisfy state minimum requirements where the ductile iron pipe is used to satisfy the HRW.

5.4.7 Horizontal Separations

The following minimum horizontal separations shall be provided for any sanitary sewer line extension of the Harnett Regional Water's existing sanitary sewer system:

Utilities or Structures		Horizontal Separation Distance
A.	Storm sewers and other utilities not listed below	5 feet
B.	Water transmission and distribution mains conveying treated potable water;	10 feet
C.	Reclaimed water mains and associated lines;	5 feet
D.	Any private or public water supply source, including any wells, WS-I waters or Class I or Class II impounded reservoirs used as a source of drinking water;	100 feet
E.	Wetlands and waters classified WS (except WS-I or WS-V), B, SA, ORW, HQW, or SB from normal high water (or tide elevation);	50 feet
F.	Any other stream, lake, impoundment, or ground water lowering and surface drainage ditches;	10 feet
G.	Any building foundation;	20 feet
H.	Any basement or subsurface structure;	20 feet
I.	Top slope of embankment or cuts of 2 feet or more vertical height;	10 feet
J.	Any drainage systems and interceptor drains;	10 feet
K.	Any swimming pool	30 feet

Ductile iron pipe shall be used for any line extension of Harnett Regional Water's existing sanitary sewer collection

system where the above minimum horizontal separations cannot be maintained. The design shall maintain horizontal separations to satisfy state minimum requirements where the ductile iron pipe is used to satisfy the HRW.

All NCDENR DWQ and UCACOE setbacks and wetland requirements must be followed for new sewer system improvments.

Section 5.5 Materials

The following materials for sewer mains shall be utilized, but the material selected should be adapted to local conditions, such as: character of industrial wastes, possibility of septic conditions, soil characteristics, exceptionally heavy external loadings, abrasion and similar problems.

5.5.1 Pipe Materials

A. PVC Plastic Pipe (Standard Dimension Ratio) SDR 35 ASTM D3034

PVC Plastic Pipe (Standard Dimension Ratio) SDR 26 ASTM D3034

All pipe in this class shall conform to ASTM Standard D3034 for "Type PSM polyvinyl chloride (PVC) Sewer Pipe and Fittings." The pipe shall be made of PVC plastic with integral wall bell and spigot joints for the conveyance of domestic sewer. The pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13364-B (with minimum tensile modulus of 3,450 MPa (500,000 psi) as defined in ASTM Standard D1784. The pipe fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13343-C as defined in ASTM Standard D1784. Compounds with superior properties are also acceptable.

1. Joints
Jointing system shall be elastomeric gasket type joints or push-on joints providing a watertight seal. Assembly of the joints shall be in accordance with the pipe manufacturer's recommendations. The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

2. Gaskets
Gaskets for the flanged joints shall conform to ASTM Standard C1330, Grade I rubber, full face type at least 1/8" thick. The mechanical joint gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable for the gaskets.

3. Markings
Pipe in compliance with this standard shall be clearly marked at intervals of 5 feet as follows:
a. Manufacturer's name or trademark.
b. Nominal pipe size.
c. The PVC cell classification (for example 12454-B)
d. The legend "Type PSM SDR 35" and the designation ASTM 3034

Fittings in compliance with this standard shall be clearly marked as follows:
a. Manufacturer's name or trademark.
b. Nominal pipe size.
c. The PVC cell classification (for example 12454-B)
d. The legend "Type PSM SDR 35" and the designation ASTM 3034

4. Service Taps
All service taps shall be designed to be made on the PVC pipe using a Romac CB saddle or Fowler Inserta Tee hubbed with a schedule 40 or SDR 23.5 gasketed bell, rubber boot per ASTM Standard C443 and a stainless steel band. All taps must be designed to withstand low pressure air test required for the sewer main. Service taps installed with the newly constructed sewer mains shall be designed using an in-line wye fitting of the same material of the

sanitary sewer main.

5. Service Pipe
All 4" and 6" sanitary sewer service laterals, service lines, cleanouts and associated fittings shall be Schedule 40 PVC conforming to ASTM Standards D2466 and D2672 respectively or SDR 23.5 conforming to ASTM Standard D2665 D3034 with glued or gasketed joints. The sanitary sewer service lateral shall include a long sweeping wye with a plug to cover the end of the cleanout until the final service line connection is completed by the plumber hired by the builder/owner.

6. Testing and Acceptance
Low pressure air tests will be performed on all newly laid sewer lines and associated service taps. The pressure holding time is based upon an average of 3 psi gage or a drop from 3.5 psi to 2.5 psi per the requirement of the ASTM Standard C828, latest revision. PVC pipe shall be capable of withstanding a two hour immersion test in a sealed container of 99.5 % Anhydrous Acetone and show no signs of flaking on interior or exterior when tested in accordance with ASTM Standard D2152. PVC pipe strength shall be capable of withstanding stiffness, flattening and impact test as scheduled or referenced in ASTM Standard D3034-73, SDR 35.

Tests shall be conducted to demonstrate joint performance at 5% maximum diametric deflection of the spigot as specified in ASTM Standard D3212. Maximum allowable pipe deflection shall be five (5%) percent of inside diameter. Deflection shall be checked by the contractor in the presence of the engineer and the HRW Utility Construction Inspector using a mandrel go/no-go device a minimum of 30 days following the installation. The mandrel device must be cylindrical in shape. The mandrel"s length and diameter (ID of proving ring) shall be sized for the sewer pipe installed on each project in accordance with Table 1 below. The mandrel shall be subject to the approval of the HRW Utility Construction Inspector and the Professional Engineer (P.E.).

Table 1

Nominal Diameter	Length	Diameter of Mandrel (Proving Ring)
6"	6"	5.65"
8"	8"	7.56"
10"	10"	9.45"
12"	10"	11.26"
15"	12"	13.78"

7. Leakage
All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

8. Infiltration
The contractor shall provide HRW a guarantee that infiltration shall not exceed 100 gallons per mile per day per inch diameter of pipe. The contractor shall provide the Professional Engineer (P.E.) a means to test infiltration after the completion of pipe installation prior to final acceptance.

B. Ductile Iron Pipe Centrifugally Cast for Water ANSI/AWWA C151/A21.51 Class 50 and ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer main shall be made because of the width and depth of trench where necessary to withstand extraordinary superimposed loading, special bedding, concrete cradle or special construction may be used. PVC plastic pipe SDR 35 ASTM D3034 or SDR 26 ASTM D3034 shall be used above 18 feet. Ductile iron ANSI A21.51 Class 50 shall be used below 18 feet. When transitioning from one pipe material to another, the pipe material must be consistent from one manhole to the next manhole unless prior approval is given by the HRW. **Revise both to 14.**

All ductile iron pipe and fittings shall be furnished with a special interior coating which shall be Protecto 401 ceramic lining as manufactured by U.S. Pipe or equal. All lining and coatings shall be per manufacturer's specifications and conform to ANSI/AWWA C151/A21.51.

All pipe in this class shall conform to either ANSI/AWWA C151/A21.51 Class 50 for "Ductile Iron Pipe, Centrifugally Cast for Water" or ASTM A746, Standard Specification for "Ductile Iron Gravity Sewer Pipe" or better.

1. Gaskets
Gaskets for the flanged joints shall conform to ASTM Standard C1330, Grade I rubber, full face type at least 1/8" thick. The mechanical joint gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable for the gaskets.

2. Markings
Pipe in compliance with this standard shall be clearly marked at intervals of 5 feet as follows:

a. Manufacturer's name or trademark.
b. Nominal pipe size.
c. NSF and UL approvals
d. The legend "DI" and the designation ANSI C151

Fittings in compliance with this standard shall be clearly marked as follows:

a. Manufacturer's name or trademark.
b. Nominal pipe size.
c. NSF and UL approvals
d. The legend "DI" and the designation ANSI C151

3. Joints
The pipe shall have push-on joints, flanged joints or mechanical joints. The push on joints shall conform to ANSI/AWWA C110/A21.11, except the gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable for the gaskets. Restrained push on joints shall be American "Lok-Fast" or "Lok-Ring"; U.S. Pipe "TR Flex" or Griffin "Snap-Lok" or "Field-Lok 350" gaskets. Flanged joints shall be ductile iron, flat faced to conform to ANSI/AWWA C115/A21.15, latest revision. Bolts shall be chamfered or rounded ends projecting ¼ to ½ inch beyond outer face of the nut to conform to ASTM Standard A307. Nuts shall conform to ASTM Standard A30, hexagonal per ANSI Standard B118.2.2, heavy semi-finished pattern.

4. Field Joints
Joints in buried locations shall be mechanical joint or push-on type unless otherwise indicated on the drawings. Bells on wall castings and wall sleeves shall be mechanical joint type with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the drawings. Grooved end couplings may be used in lieu of flanges provided rigid radius grooving is used to preclude pipe movement.

5. Mechanical Joints
Mechanical joints shall have grip rings and they shall be carefully assembled in accordance with the manufacturer's recommendations. "Megalug" fittings shall only be used for pipe sizes greater than 12 inches diameter. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Tie rods for mechanical joints shall conform to ASTM Standard A307. All bolts shall be uniformly tightened to the torque values listed in Appendix A of the ANSI/AWWA Standard C111/A21.11. Over tightening of bolts to compensate for poor installation practice will not be permitted. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

6. Push-On Joints
The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

7. Flanged Joints

Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline. When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate, so that gasket compression is uniform. Special care shall be taken when connecting to pumping equipment to ensure that pipe stresses are not transmitted to the pump flanges. All such piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of abutting pump and piping flanges are obtained before installation of any bolts in those flanges. In addition, pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened.

8. Flanged Coupling Adapters

Flanged coupling adapters shall be installed in strict accordance with the coupling manufacturer's recommendations. After the pipe is in place and bolted tight, the proper location of holes for the anchor studs shall be determined and the pipe field drilled. Anchor stud holes shall be drilled completely through the pipe wall. The hole diameter shall be not more than 1/8 inch larger than the diameter of the stud projection.

9. Mechanical Couplings

Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. A space of at least 1/4 inch and not more than one inch shall be left between the pipe ends. Pipe and coupling surfaces which contact gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of the Engineer.

10. Wall Castings

Unless otherwise indicated on the drawings, wall castings shall be provided where cast iron pipes pass through concrete walls. Where a flange and mechanical joint piece is to connect to a mechanical joint wall casting, the bolt holes in the bell of the wall casting shall straddle the top (or side for vertical piping) centerline of the casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall casting at the foundry. Wall castings shall have mechanical joints with water stop and tapped holes; single casting or fabricated ductile iron shall be "Adjustable Wall Pipe" as manufactured by Midwest Pipe Fabricators, Omaha, Nebraska or approved equal. All holes shall be sized according to project plans and provided with removable plugs.

11. Reducers

Reducers adjacent to flow meters and pumps shall be eccentric pattern. Eccentric reducers shall be installed with the straight side on top so that air traps are not formed. Unless otherwise indicated on the drawings, all other reducers shall be concentric pattern.

12. Outlets

Where a 12" or smaller branch outlet is indicated and the diameter of the line pipe is at least twice the diameter of the branch, either a tee, factory welded-on boss, or a tapping saddle will be acceptable. Gauge connections in the cast iron piping shall conform to the requirements of this section.

Connection of gauges to 6 inch and smaller cast iron-pipe shall be made using a tapping saddle or a tee complete with a blind flange drilled and tapped to accept the gauge piping specified. Connection to gauges to 8 inch and larger piping shall be made by means of a factory welded-on boss or a tapping saddle. Drilling and tapping of the pipe wall will also be acceptable provided the wall thickness, minus the foundry tolerance, at the point of connection equals or exceeds the wall thickness required for 4-thread engagement in accordance with Table A.1, Appendix A of ANSI/AWWA Standard C151/A21.51.

13. Shop Coating and Lining

The interior of all pipe and fittings for water service shall be cement mortar lined. The exterior surfaces of all pipe and fittings which will be exposed to interior locations shall be shop primed and then painted after installation. Flange faces shall be coated with rust-preventive compound. Exterior surfaces of all other pipe and fittings shall be asphaltic coated. The interior of all pipe and fittings for water service shall be coated with Protecto 401 or approved equal for protection against attach by sewer gases such as methane and hydrogen sulfide. The exterior surfaces of all pipe and fittings which will be exposed to interior locations shall be shop primed and then painted after installation. Flange faces shall be coated with rust-preventive compound. Exterior surfaces of all other pipe and fittings shall be asphaltic coated.

14. Handling

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Pipe and fittings in which the lining has been damaged shall be replaced. With the concurrence of the Engineer, small and readily accessible damaged areas may be repaired. All pipe coating which has been damaged shall be repaired by the contractor before the pipe is installed.

15. Cutting Pipe

Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file or power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitable beveled. Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be permitted. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be permitted.

16. Cleaning

The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation and shall be kept clean until the work has been accepted. Before joining pipe sections, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed. Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other materials shall not be placed in or allowed to enter the pipe. Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

17. Inspection

Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site of the work.

18. Alignment

Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated in Table 5 or Table 6 of the AWWA Standard C600, unless specially designed bells and spigots are provided. Either shorter pipe sections or fittings shall be installed where required to conform to the alignment or grade indicated on the drawings.

19. Laying Pipe

Pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions. Pipe shall be laid with the bell ends facing the direction of laying except when reverse laying is specifically authorized by the Engineer.

20. Connections with Existing Piping:

Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the HRW. The customers shall be provided at least 48 hours' notice for any planned service outages by placing a door hanger notice on each door of the customers" dwellings before the existing lines may be shut off or removed from service. Facilities shall be provided for proper

dewatering and disposal of all water removed from dewatered lines and excavations without damage to adjacent property. Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water, mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings and valves installed in such connections shall be thoroughly cleaned and then swabbed with, or dipped in, chlorine solution having a chlorine content of 200 milligrams per liter (mg/l).

21. Concrete Encasement
Concrete encasement shall be installed as indicated on the drawings. Concrete and reinforcing steel shall be as specified in the cast-in-place concrete section. All pipe to be encased shall be suitably supported and blocked in proper position, and shall be anchored to prevent flotation.

22. Reaction Anchorage and Blocking
All exposed piping with mechanical couplings, push-on or mechanical joints, or similar joints subject to internal pressure shall be blocked, anchored, or harnessed to preclude separation of joints. All push-on and mechanical joint tees, wye (Y) fittings, bends deflecting 22.5° degrees or more, and plugs which are installed in buried piping (subjected to internal hydrostatic heads in excess of 30 feet) shall be provided with suitable reaction blocking, anchors, joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure

Concrete blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by the Engineer. If adequate support against undisturbed ground cannot be obtained, metal harness anchorages shall be installed to provide the necessary support. Metal harness anchorages shall consist of steel rods extending across the joint and securely anchored to pipe and fitting, or other adequate anchorage facilities shall be installed to provide the necessary support. If the lack of suitable solid vertical excavation face is due to improper trench excavation, metal harness anchorages shall be furnished and installed by the contractor and at the expense of the contractor. Reaction blocking, anchorages, or other supports for fittings installed in fills or other unstable ground, above grade, or exposed within structures, shall be provided as required by the drawings or as directed by the Engineer.

All steel clamps, rods, bolts, and other metal accessories used in tapping saddles, reaction anchorages, or joint harness subject to submergence or contact with earth or other fill material and not encased in concrete shall be protected from corrosion by two coats of thixotropic coal tar applied in the field to clean dry metal surfaces. The first coat shall be dry and hard before the second coat is applied. Metal surfaces exposed above grade or within structures shall be painted in accordance with the painting section.

23. Service Taps All service taps made on the existing sewer mains constructed with ductile pipe shall be made with a Romac CB saddle or Fowler Inserta Tee hubbed with a schedule 40 or SDR 23.5 Gasketed bell, rubber boot per ASTM Standard C443 and a stainless steel band. All taps must be able to withstand low pressure air test required for the sewer main. Service taps installed with the newly constructed sewer mains shall be installed using a wye fitting of the same material of the sewer main.

24. Service Pipe
All 4" and 6" sanitary sewer service laterals, service lines, cleanouts and associated fittings shall be Schedule 40 PVC conforming to ASTM Standards D2665 and D2466 respectively and/or SDFR 23.5 conforming to ASTM Standard D3034 with glued or gasketed joints.

25. Testing and Acceptance
Low pressure air tests will be performed on all newly laid sewer lines and associated service taps. The pressure holding time is based upon an average of 3 psi gage or a drop from 3.5 psi to 2.5 psi per the requirement of the ASTM Standard C828, latest revision. Maximum allowable pipe deflection shall be five (5%) percent of inside diameter. Tests to demonstrate deflection of rigid pipe by using a mandrel go/no-go device are not required by the HRW.

26. Leakage

All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

27. Infiltration
The contractor shall provide HRW a guarantee that infiltration shall not exceed 100 gallons per mile per day per inch diameter of pipe. The contractor shall provide the Professional Engineer (P.E.) a means to test infiltration after the completion of pipe installation prior to final acceptance.

28. Dimensions
The thickness class for cast iron pipe shall be as indicated in the following table:

Location	Nominal Size (Inches)	Pressure Class (psi)
All push-on	3 through 12	350
All flanged	3 through 12	350

29. Drawings and Data
Complete layout drawings, details and specifications covering all cast iron piping and accessories shall be submitted to the HRW during the plan approval and the pre-construction conference as outlined in these specifications.

C. Semi-Rigid PVC Truss Pipe for Gravity Sewer ASTM D2680

All semi-rigid PVC truss pipe in this class shall be manufactured by extruding Class 12454 PVC resin per ASTM Standard D1784 into a truss shape forming an inner and outer wall supported by webs. After extrusion the voids between the trusses shall be filled with an air entrained Portland cement perlite filler or other inert filler material exhibiting the same degree of performance. The pipe shall exhibit minimum pipe stiffness of 200 psi when tested in accordance with ASTM Standard D2412 and shall be furnished in laying lengths of 12 feet 6 inches. The pipe shall meet or exceed ASTM Standard D2680 or latest revision.
The pipe fittings shall conform to ASTM Standard D2680, latest revision. The pipe joints shall be supplied with elastomeric (Gasketed) seals that meet the requirements of ASTM F477, latest revision and when these joints are assembled they shall conform to the test of ASTM 3212 showing no leakage.

1. Installation
For pipe installed to depths of 15 feet or less, semi-rigid Gasketed PVC truss pipe shall be installed per the manufacturer's recommendations and shall meet the ASTM Standard D2640, Appendix XI. Backfill material used to a point one (1) foot above the barrel of the pipe shall be select materials that are free of large stones and clods larger than 1-1/2 inches in diameter. Class I, II, III or IV materials per ASTM 2680, Appendix XI are suitable for bedding, haunching and initial backfill. The haunching and initial backfilling for Class II, III or IV soils shall be placed completely under pipe haunches and up each side in uniform layers not exceeding 6 inches in depth with each layer carefully and uniformly compressed or compacted. Where sub grade is unstable or water is present in quantities sufficient to make uniform bedding of the pipe impossible, the contractor will be required by the engineer to stabilize the trench bottom with stabilization stone, 4 inches minimum, or as directed by the HRW Engineer or the HRW Utility Construction Inspector. All trench stabilization stone shall be placed in the trench carefully to avoid damage to previously installed sections of pipe. 53

For pipe installed to depths greater than 15 feet, the contractor shall bed the pipe with granular stone (Class I) bedding no less than 6 inches thick below the pipe barrel and up to the spring line of the pipe to the full width of the trench. All bedding stone at these depths shall be included with the pipe price submitted per linear foot of pipe installed.

2. Service Taps
All service taps shall be designed to be made on the PVC pipe using a Romac CB saddle or Fowler Inserta Tee hubbed with a schedule 40 or SDR 23.5 gasketed bell, rubber boot per ASTM Standard C443 and a stainless steel band. All taps must be designed to withstand low pressure air test required for the sewer main. Service taps installed with the newly constructed sewer mains shall be designed using an in-line wye fitting of the same material of the sanitary sewer main.

3. Service Pipe
All 4" and 6" sanitary sewer service laterals, service lines, cleanouts and associated fittings shall be Schedule 40 PVC conforming to ASTM Standards D2466 and D2672 respectively or SDR 23.5 conforming to ASTM Standard D2665 D3034 with glued or gasketed joints. The sanitary sewer service lateral shall include a long sweeping wye with a plug to cover the end of the cleanout until the final service line connection is completed by the plumber hired by the builder/owner.

4. Testing and Acceptance
Low pressure air tests will be performed on all newly laid sewer lines and associated service taps. The pressure holding time is based upon an average of 3 psi gage or a drop from 3.5 psi to 2.5 psi per the requirement of the ASTM Standard C828, latest revision. PVC pipe shall be capable of withstanding a two hour immersion test in a sealed container of 99.5 % Anhydrous Acetone and show no signs of flaking on interior or exterior when tested in accordance with ASTM Standard D2152. PVC pipe strength shall be capable of withstanding stiffness, flattening and impact test as scheduled or referenced in ASTM Standard D3034-73, SDR 35.

Tests shall be conducted to demonstrate joint performance at 5% maximum diametric deflection of the spigot as specified in ASTM Standard D3212. Maximum allowable pipe deflection shall be five (5%) percent of inside diameter. Deflection shall be checked by the contractor in the presence of the engineer and the HRW Utility Construction Inspector using a mandrel go/no-go device a minimum of 30 days following the installation. Deflection tests will not be required for semi-rigid pipe with a pipe stiffness of 150 psi or greater per ASTM Standard D2412.

5. Leakage
All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

6. Infiltration
The contractor shall provide HRW a guarantee that infiltration shall not exceed 100 gallons per mile per day per inch diameter of pipe. The contractor shall provide the Professional Engineer (P.E.) a means to test infiltration after the completion of pipe installation prior to final acceptance.

D. Reinforced Concrete Pipe (RCP) for Gravity Sewer ASTM D2680

This specification covers reinforced concrete pipe (RCP) intended to be used for the conveyance of sewage, industrial wastes, and storm water, and for the construction of culverts. Pipe manufactured in accordance with this specification shall be of five classes identified as Class I, Class II, Class III, Class IV, and Class V. Pipes shall conform to the ASTM Standard C76 Class III, Class IV, and Class V of the design and strength requirements for diameter, wall thickness, and compressive strength as shown on the drawings. The approval and acceptability of the pipe shall be determined by the results of testing concrete batch samples, cores and cylinders using the three-edge bearing test, absorption test, material test, visual inspection, crushing test, and compression test methods. 54

The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform. The pipe manufacturing process shall be of the "wet cast" type or of the "dry cast" type using the BiDi manufacturing process or the counter-rotating packer head manufacturing process or the internal care and external jacket process. "Wet cast" forms shall not be removed for at least 8 hours after concrete placement or until the concrete strength has reached 2,000 psi, whichever comes first. For the BiDi and counter-rotating packer head process, plastic or fiberglass form rings shall be placed on the spigot end of the pipe immediately after removal of the forms and shall not be removed prior to the initial set of the concrete. Pipe shall be steam cured after forming. Pipe forms and equipment shall be maintained in excellent condition and shall be kept clean and free of any condition which may contribute to lower quality pipe.

Cement shall be non-air-entraining Portland cement conforming to ASTM C150, Type II. The use of any admixture shall be subject to the specific approval of the HRW Utility Construction Inspector and the Engineer. The aggregate

shall be so sized, proportioned, graded, and mixed with such proportions of Portland cement, blended hydraulic cement, or Portland cement and supplementary cementing materials, or admixtures, if used, or a combination thereof, and water to produce a homogeneous concrete mixture of such quality that the pipe will conform to the test and design requirements of the ASTM Standard C76 and these specifications. Fine aggregate shall consist of washed inert natural and conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed dolimitic or calcitic limestone otherwise conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. The minimum alkalinity of the finished concrete shall be 50 percent as a calcium carbonate equivalent. Documentation that the aggregates to be used in the manufacture of reinforced concrete pipe meet these requirements shall be submitted to the HRW Utility Construction Inspector and the Engineer.

Pipe reinforcement methods considered in this specification are circumferential reinforcement, longitudinal reinforcement, and joint reinforcement. Pipe shall be subjected to either steam curing, water curing, or the two methods combined, provided that the required compressive strength is attained as prescribed herein these specifications. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe and cylinder testing shall not be less than the design compressive strength for each RCP size and class. The concrete mass shall be dense and uniform. Reinforcement shall be circular for all concrete pipe(s). Quadrant steel shall not be used. Pipe reinforcement shall be as specified in the ASTM Standard C76 with the following exceptions:
The maximum variation in the radial position of the reinforcement in the pipe wall shall be + ¼" inch for the outer layer and + ½" inch and ¼" for the inner layer. Reinforcement shall be secured by steel spacers that tie the inner cage to the outer cage and brace to the outside form only. Spacers shall be located circumferentially around the pipe at not less than 90 degrees radial spacing and axially along the pipe at not less than 24-inch spacing. Reinforcement shall be installed in both the bell and the spigot. . At least three circumferential reinforcement wires shall be in the bell area, and longitudinal reinforcement shall extend to the end of the bell and shall be continuous with the wires in the barrel. At least two circumferential reinforcement wires shall be in the spigot area, and longitudinal reinforcement shall extend to within 1" inch of the end of the spigot.

Only one layer of steel mesh shall be allowed for each cage. The minimum steel area specified by ASTM C76 for each cage shall be met with one layer of steel reinforcement.

Pipe may be rejected for any of the following reasons:

- Exposure of any steel reinforcement in any surface of the pipe, except for ends of longitudinal reinforcing in the bell ends of reinforcement spacers.
- Any shattering or flaking at a crack.
- Voids exceeding ¼" inch in depth, with the exception of a few minor bug holes, on the interior and exterior surfaces of the pipe.
- Unauthorized pipe repair or application of any wash coat of cement or grout.
- A deficiency greater than ¼" inch from the specified wall thickness of pipe 30 inches or smaller in internal diameter.
- A deficiency greater than 6% percent from the specified wall thickness of pipe larger than 30 inches in internal diameter, except that the deficiency may be 8 percent adjacent to the longitudinal form joint, provided that the additional deficiency does not lie closer than 20 percent of the internal diameter of the pipe. The deficiencies in wall thickness permitted herein do not apply to gasket contact surfaces in gasketed joint pipe.
- A variation from the specified internal diameter in excess of 3 percent or interior surfaces which have been reworked after placing of concrete. The variation in internal diameter permitted herein does not apply to gasket contact surface in gasketed joint pipe.

- A hollow spot (identified by tapping the internal surface of the pipe) which is greater in any dimension than the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified herein.

- Defects that indicate imperfect molding of concrete or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension equal to the wall thickness or deeper than two times the maximum graded aggregate size, or local deficiency of cement resulting in loosely bonded concrete, the area of which exceeds in size limits of area described above when the defective concrete is removed. Repair of such defects not exceeding these limits may be made as specified herein.

- Any of the following:

a. A crack having a width of 0.01 throughout a continuous length of 36 inches or more.
b. A crack having a width of 0.01 inch to 0.03 inch or more throughout a continuous length of 1 feet or more.
c. Any crack showing two visible lines of separation for a continuous length of 2 feet or more or an interrupted length of 3 feet or more anywhere in evidence, both inside and outside.
d. Cracks anywhere greater than 0.03 inches in width.

The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the HRW Utility Construction Inspector and the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained full strength for each RCP size and class and not before 5 days after manufacture and/or repair, whichever is the longer.

Pipe shall have a minimum laying length of 12 feet, except for closure at structures. Shorter lengths of pipe for closure of structures shall be obtained by saw-cutting full lengths of pipe. The length of the incoming and outgoing concrete pipe at each structure shall be at least 4 feet beyond the outside face of the structure wall. Each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1-1/2" longer than that shown on the shop drawings shall not be used. Variations in length of the same pipe shall not exceed ASTM C76 requirements.

During manufacturing measuring devices shall be used to assure joint assembly is within the tolerance of ASTM C76 and these specifications. The Engineer shall have the right to take samples of the concrete after it has been mixed or as it is being placed in the forms or molds and to make inspection and tests thereof.

At the start of the pipe manufacture, a set of three test cylinders shall be taken, cured, and tested. One core shall be taken and tested from each of the first ten pieces of pipe produced. No additional pipe shall be manufactured until the Engineer has inspected the cores, the cylinders and cores have been tested, and the Engineer has reviewed the results of the core and cylinder testing. A relationship shall be established between the compressive strength of test cylinders stored in a standard manner compared to cores taken from the corresponding finished pipe. All cylinders, coring, and testing shall be by the pipe manufacturer. The results shall be furnished immediately to the Engineer and to the HRW Utility Construction Inspector upon request. If a satisfactory relationship between core and cylinder test strengths is demonstrated as specified herein, further core testing may be waived by the Engineer and the HRW Utility Construction Inspector except as specified herein. Should this relationship not be established, one core shall continue to be taken and tested from each piece of pipe until the manufacturer's quality control has been improved to the extent that a satisfactory relationship between core and cylinder test strengths is demonstrated between the compressive strength of test cylinders stored in a standard manner compared to cores taken from the corresponding finished pipe.

The Engineer and the HRW Utility Construction Inspector shall each have the right to direct that test cores be taken from pieces of the finished pipe as he selects for inspection and for such tests as he may wish to apply. Holes left by the removal of cores shall be filled with non-shrink grout by the manufacturer as approved by the Engineer and the HRW Utility Construction Inspector. Core drilling, testing, and filling shall be carried out by the pipe manufacturer as a subsidiary requirement of the manufacturer. A 9-inch x 9-inch waterproofing self-adhering membrane (Gator

Wrap, Mac Wrap or equal) shall be placed over the core holes on the exterior of the pipes. The number of cores shall not exceed the requirements of ASTM C76.

One test core shall be taken for every 500 linear feet of pipe manufactured but not less than once each day on which pipe is manufactured for the project. Cores may be reduced to one set of two per week but not less than one set for every 1,500 linear feet, if a continued satisfactory relationship is established between cores and cylinders made and cured in the standard manner. This relationship shall not vary by more than 10 percent more or less from the average ratio. Cores may be drilled in any manner which will provide a smooth core face. All pipe cylinders and cores shall be 4-inches in diameter. Cores shall be carefully saw-trimmed and capped in a vertical position with a sulfur cap of minimum thickness at least one day before being tested.

Cylinder and core testing shall conform to Standard ASTM Methods and may be performed by the manufacturer at his test facilities if approved by the Engineer. Otherwise, the manufacturer shall employ an independent testing laboratory for cylinder and core testing at no additional cost to the HRW. All other ASTM Standards, including but, not limited to the following, shall apply to elements and components of RCP as follows:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
C33 Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete

At the time of inspection, the pipe will be carefully examined for compliance with the specifications and the approved shop drawings. All pipes shall be inspected for general appearance, dimension, blisters, cracks, roughness, soundness, etc. The surface shall be dense, smooth, and close-textured. Cores also shall serve as a basis for rejection of pipe if lamination or poor bond of reinforcement is apparent.

Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and, if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced at the discretion of the HRW Utility Construction Inspector.

Pits, blisters, rough spots, breakage and other imperfections may be repaired, subject to the approval of the Engineer and the HRW Utility Construction Inspector, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar shall be used for repairs and shall have a minimum compressive strength of 6,000 psi at 7 days and 7,000 psi at 28 days when tested

in 3-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.
The first 6 inches of the bell and spigot ends of each piece of pipe shall be painted at the place of pipe manufacturing with a latex paint to be approved by the Engineer and the HRW Utility Construction Inspector. Coordinate type of paint (or alternative coating) with the joint testing apparatus manufacturer as specified.

1. Joints for Concrete Pipe
Joints for concrete pipe shall be the bell and spigot type joint conforming to ASTM C443/C361 and the Bureau of Reclamation Type R -4 except as modified by these specifications with provisions for using a round rubber o-ring gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1 ½ degrees and 2 degrees. The diameters of the joint surfaces which compress the gasket shall not vary from the true diameters by more than 1/16th of an inch. Longitudinal reinforcement shall be continuous from end of spigot to end of bell and shall be expanded within the bell.

The round rubber o-ring gaskets shall conform to ASTM C443 except as otherwise specified herein. Gaskets shall be furnished by the supplier. The gasket manufacturer shall have the following tests performed by a qualified independent testing laboratory on the gaskets proposed for this project. Specimens of the gaskets shall be heated in a dry oven to 150 degrees F for 6-hours duration, and five specimens shall be tested by immersion, one each as follows: 72-hour immersion in saturated hydrogen sulfide solution, 72-hour immersion in 1 percent NaOH solution, 72-hour immersion in standard soap solution (80 percent alcohol), 72-hour immersion in 10 percent NaCl solution. Specimens of the gaskets shall be subjected to tensile tests of approximately 100 psi before and after immersion and heating tests and shall show an elongation of at least 25 percent. Upon release from the tensile tests, each specimen shall return to its original length. The specimens shall show no detrimental change in color, texture, or feeling upon completion of the above tests. The manufacturer shall supply test data and affidavits showing compliance with these requirements. Tests shall have been conducted within six months of the start of manufacture of the pipe.

The pipe and pipe joints shall be designed and manufactured so that the pipe and joints will withstand an external water pressure of 15 psi without leakage through the pipe wall or by the gasket. The pipe manufacturer shall provide facilities and factory test all pipe used in the Contract Work. Such tests shall be made by an internal vacuum as specified below. The Engineer and the HRW Utility Construction Inspector shall be notified for witnessing all tests.
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Install sealed end caps/plugs fabricated with the specified joints and gaskets identical to those of the pipe. Connect a vacuum source with shut-off valve and vacuum gage.

Draw a vacuum of 7 inches of mercury (Hg) then shut off valve and disconnect vacuum source. Measure the length of time required for the vacuum to decrease from 7 to 5 inches of mercury (Hg). Times shall not be less than the following:

Minimum Time for 2 inches of mercury (Hg) pressure
decrease or drop in the pipe between manholes

Pipe Diameter (inches)	8 ft. pipe (min-sec)	12 ft. pipe (min-sec)
24	0:50	1:15
27	1:03	1:35
30	1:18	1:57
36	1:52	2:49
42	2:33	3:50
48	3:20	5:00
54	4:13	6:20
60	5:13	7:49

If the vacuum test fails, determine if the failure was a joint failure, or wall porosity failure. Mark the pipe and remove it to eliminate any possibility that the pipe will be shipped to the project site for any Contract Work. Correct product quality control to conform to all test requirements and standards. All pipe furnished shall be so tested and

shall meet the test requirements. The pipe and ends of the pipe shall be made true to form and dimension. The manufacturer shall inspect and measure all pipe ends for out-of-roundness and square and shall mark his certification on the interior of the pipe. The manufacturer shall furnish the Engineer and the HRW Utility Construction Inspector upon request affidavits showing the results of these measurements and stating pipe meets the requirements of ASTM C76 and ASTM C443/C361 and these specifications.

2. RCP/DIP Adaptors: Ductile iron pipe (DIP) shall conform to these specifications for DIP and reinforced concrete pipe (RCP) shall conform to these specifications for RCP for gravity sewer pipe. Where concrete collars are to be poured around the DIP, the pipe shall be cleaned to bear metal by grinding, wire brushing or sandblasting. One-half (1/2") inch round studs are to be welded to the DIP at quarter points of pipe in center segment with wire one (1") inch minimum cover. DIP shall then be coated with concressive liquid Bonding Agent and allowed to cure in accordance with the ASTM Technical Bulletin.

WWF shall be shaped to proper Radius and lap welded. WWF shall be sized and shape to conform to ASTM specifications for the appropriate size and class of concrete pipe. WWF shall be held in place with WWF spacers not more than 18" apart circumferentially. Concrete shall be a minimum of 5000 psi.

3. Pipe Installation: Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe. Pipe shall not be dropped. All pipe shall be examined by the Contractor before laying, and installation. The Engineer and the HRW Utility Construction Inspector shall be notified of any defect. No piece shall be installed which is defective in any way unless authorized in writing by the Engineer and the HRW Engineer.

Any pipe damaged during transport or unloading at the site or during construction operations shall be immediately set aside and stored by the Contractor for inspection by the Engineer and the HRW Utility Construction Inspector. Any pipe damaged during manufacturing or shipping operations shall be immediately set aside and stored by the manufacturer for inspection by the Engineer and the HRW Utility Construction Inspector. If any damaged pipe is approved for repair, the pipe shall be repaired with epoxy mortar by the manufacturer and re-inspected by the Engineer and the HRW Utility Construction Inspector. If not approved for repair, the pipe shall be removed from the site and replaced by the manufacturer.

Excavation, bedding and backfill and other earthwork requirements shall be as specified in Chapter 6 construction of Sanitary Sewer Improvements. As soon as the excavation is completed as shown on the drawings and confirmed by a laser to the required sub grade elevation, the Contractor shall compact the sub grade, remove excess earth from the trench by hand, and place, grade, and compact the stone bedding material in the trench to a depth called for in these specifications. There shall be no water observable in the trench bottom or bedding. Should water be present, all pipe installation shall immediately cease until dewatering of the site is improved to the extent that no water is present in the trench or the bedding material.

A depression shall be formed with hand tools in the compacted bedding material along the pipe to final bedding elevation and shall be contoured to match the curvature of the pipe for continuous support of at least the bottom 30 degrees of the pipe. The depression shall be slightly deeper at the joint to prevent bedding material from entering the bell and interfering with seating the spigot of the next pipe section and to provide space for installing the membrane collar and the grade checked by laser and adjusted as necessary, always providing full support of the bottom 30 degrees of the pipe. Blocking under the pipe will not be permitted. Before the pipe is lowered into the trench, the spigot and bell shall be clean and free from dirt. Gasket and bell shall be lubricated by a vegetable lubricant which is soluble in water and harmless to the rubber gasket. The pipe shall be properly aligned in the trench to avoid any possibility of contact with earth or bedding and fouling the bell, spigot, or gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home by an approved method. The preferred driving method shall be as follows: Pipe sections are driven home by using a section of pipe or other ramming device that will apply even pressure to a round section of forgiving material such as hard rubber or wood that covers the entire circumference of the spigot end of the pipe to avert damaging the ends of the pipe during installation. The maximum gap on the inside of the pipe shall be 0.05 foot. The maximum gap on the outside of the pipe shall be 0.10 foot.

As soon as the pipe is in place and its correct position is confirmed and bedding material is in place and compacted as indicated on the drawings for at least one-half the length of pipe. Each joint between every manhole section, catch

basin or pipe joint shall be sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal.

The assembled joint shall be tested in accordance with ASTM C 1103 with a joint tester to verify the joint seal. If test indicates an improper seal, the pipe shall be removed, cleaned, remade, and retested until a good seal is achieved between pipe sections. Bedding material shall then be place and compacted to the required depth as shown on the drawings and the pipe backfilled in compacted layers of common fill as shown on the drawings, details and these specifications. The Contractor shall protect the installed pipe against the inflow of surface water against floatation until the work is completed, inspected and accepted by the HRW.

4. Leakage
All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

RCP for sewer?

5.5.2 Manhole Material

Manholes shall be pre-engineered and designed using pre-cast base sections, extended base sections, riser sections, cone sections to simplify field installation for the concrete manholes installed in Harnett County. All manholes shall meet or exceed the ASTM standards and these specifications herein for the concrete, structural design, polypropylene reinforced steps, butyl-rubber mastic seal and wraps for water tightness. The pre-cast concrete sections that form the manhole assembly shall be designed to conform to the latest standards established by the North Carolina Department of Transportation (NCDOT) and to support the HS-25 loading for vehicular traffic.

Manholes may be formed and poured on site if the completed concrete structure meets or exceeds the structural integrity of the manholes assembled using the pre-fabricated, pre-formed concrete manhole barrel, cone and riser sections and conforming to the following applicable ASTM standards:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement **A706/A706M** Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement **C33** Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
and Section 5.4.1 d above for reinforced concrete pipe (RCP).

Any work to construct manholes by forming and pouring on site shall be directly supervised by the Professional Engineer (P.E.).

Section 5.6 Manholes

5.6.1 Location

Manholes shall be designed by the Professional Engineer (P.E.) using pre-fabricated, pre-formed concrete manhole barrel, cone and riser sections. Manholes shall be installed at the end of each line and at all intersections. Manholes shall not be installed at distances greater than 400 feet (121.92 m). Any plans that indicate the manholes are more than 400 feet apart should be identified during the pre-construction conference and these manholes will be approved by HRW in writing. Otherwise the manholes should not be installed more than 400 feet apart. Manholes designed to be installed within the streets, sidewalks, parking lots or other impervious surfaces shall be designed to be flush with the finished grade. Otherwise the manholes shall be installed two feet above finished grade or at least two (2 ft.) feet above the 100 year flood plain, whichever is higher in elevation. Cleanouts may be used only for sanitary sewer service laterals and special conditions approved by HRW. Cleanouts shall not be substituted for manholes nor installed at the end of laterals greater than 150 feet (45.72 m) in length.

5.6.2 Drop Pipe

A drop structure manhole with a drop pipe should be provided for a sewer entering a manhole at an elevation of 24 inches (61 cm) or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches (61 cm), the invert should be filled to prevent solids deposition and the contractor shall cut a small cross section of eight (8) inch PVC pipe and imbed it in the invert slope by grouting it in place to form a PVC pipe slide in the transition area. All other areas surrounding the invert should be tapered to drain toward the invert out and the interior of the manhole shall be coated and sealed with coal tar epoxy, Flex-Seal Utility Sealant ™, Spectrashield Liner ™ or HRW approved equal as outlined herein these specifications and the plan details.

Drop structure manholes should be constructed with an outside drop connection using a manhole with a diameter of at least 48 inches. Inside drop connections may be allowed if less than 2 feet and shall be secured to the interior wall of the manhole and access for cleaning provided. Inside drop connections (when necessary) in excess of 2 feet may be used with a 5 foot diameter manhole. Due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection shall be encased in concrete for all outside drop structure manholes. The manhole joints shall be sealed on the exterior of the manhole with an external rubber sleeve (similar to MacWrap™, Infi-Shield Gator Wrap™ as manufactured by Sealing Systems, Inc) or approved equal prior to encasing the drop structure in concrete.

5.6.3 Diameter

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The minimum diameter of manholes shall be 48 inches (1.22m) larger diameters are preferable for large diameter sewers. A minimum access diameter of 24 inches (61 cm) shall be provided. Larger diameter manholes shall be required for all inside drop structure manholes and where sanitary sewer force mains discharge.

5.6.4 Flow Channel

The flow channel through manholes should be made to conform in shape and slope to that of the sewers. Change in direction of the channel shall not be less than 90o without prior approval of the HRW.

5.6.5 Exterior Sealing for Water-Tightness

Manholes shall be of precast concrete or poured-in-place concrete type. Manholes shall be waterproofed. The inlet and outlet pipes shall be joined to the manhole with a cast in place booted gasket and secured with stainless steel clamps. Manhole frame and covers shall be minimum 310 lbs. in weight and shall be cast from domestic foundries. Each joint between every manhole section, catch basin or pipe joint shall be sealed with an external rubber sleeve (similar to Mac Wrap™, Infi-Shield Gator Wrap™ as manufactured by Sealing Systems, Inc) or approved equal.

The seal shall be made of a stretchable, self-shrinking, intra-curing halogenated based rubber with a minimum thickness of 30 mils. The back side of each unit shall be coated with a cross-linked re-enforced butyl adhesive. The butyl adhesive shall be non-hardening sealant, with a minimum thickness of 30 mils. The seal shall be designed to stretch around the substrate then overlapped creating a cross-link and fused bond between the rubber and butyl adhesive. The application shall form a continuous rubber seal that applies inward pressure on the protected area for the life of the application. The butyl adhesive and the inward pressure exerted on the substrate will prevent the intrusion of water and soil through the joint sections of a manhole, catch basin or concrete pipe. External rubber sleeve shall be UV and Ozone resistant and it shall meet or exceed the following:
Sheer Strength shall be 20 psi minimum per ASTM test method D816
Tensile Strength shall be 50 psi minimum per ASTM test method D412
Elongation % shall be 500 % per ASTM test method D412
Penetration shall be 60/140 MM minimum per ASTM test method D217
Low temperature shall be -49° F flexibility per ASTM test method D746
Heat aging, the material shall be able to withstand 90°C for 7 days and be able to reach 300% elongation at break and have a minimum tensile strength of at least 100 psi.

5.6.6 Interior Sealing for Water-Tightness

A. No-Flow (HDPE) Manhole Inserts
A No-Flow, dish type insert shall be installed in the top of each manhole that is installed within a paved street, driveway, parking lot, concrete sidewalk or any other impervious surface when the manhole cover will be flush with the finished grade and located at the lowest point in the project where the potential for inflow is the greatest. The dish inserts shall be constructed of an ultra high density polyethylene copolymer material that meets ASTM Standard D1248, Class A, Category 5, Type III with a minimum impact brittleness temperature of less than -131°F. The thickness shall be uniform 1/8" or greater. The material shall be corrosion proof from all gases associated with waste water collection systems and the inserts will include the following:

1. Lift Strap – The lift strap shall be made of a woven polypropylene web material attached to the bowl of the dish by a wide head stainless steel rivet with a stainless steel backup washer ¾" in diameter. All cut edges shall be seared to prevent unraveling.

2. Vent – ventilation shall be provided by a 1/8" hole and/or a valve located on the side of the bowl. The hole or the valve shall allow a maximum release of 10 gallons of water per 24 hours and shall not be affected by debris that can collect at the bottom of the dish. Sewer gases shall be vented at one (1 psi) pound per square inch or less.

3. Density – The density shall be at least fifty-nine (59 lbs. /ft3) pounds per cubic foot and conforming to ASTM D1505.

4. Tensile Strength – The tensile strength shall be 3,600 psi and conforming to ASTM D638 Type IV.

5. Brittleness Temperature – The brittleness temperature shall be greater than or equal to -131°F and conforming to ASTM D1505.

B. Internal Manhole Seals
Manhole seal shall be designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. Extensions shall include but is not limited to lifting rings, brick and/or block material that may have been used to achieve grade. The seal shall remain flexible allowing for the repeated vertical or horizontal movements of the frame due to frost lift, ground movement or the thermal movement of pavements. The final liner material shall be made no less than 170 mils of corrosion resistant aromatic flexible urethane resin coating to be applied to the inside wall of the entire chimney area as described above. Mil thickness may vary depending on the local climate. The contractor should contact the manufacture for thickness recommendations. The product shall have a minimum elongation of 800% and hardness (Durometer) of 75. Final liner shall have a minimum tensile and adhesion strengths of 1150 psi and 175 lb. l/in. respectively. The manhole sealing system shall conform to the physical requirements of ASTM D- 412. The lining product shall have an aromatic urethane primer resin on the complete surface. The sealing system shall line the interior of the

adjustment area from the cone/top of the manhole and onto the inside of the casting. If the manhole has been relined prior to the seal installation the seal shall cover a minimum of 12 vertical inches or a minimum of 1 kit.

All loose and protruding mortar and brick that would interfere with the seal's performance shall be removed. Any lips for gravel pan supports shall be cut off flush with casting. Patching cement shall conform to requirements of the manufacture. Any profiling cement work will require the contractor to contact the sealant manufacture to determine in writing the proper time required for the cement to completely cure prior to installing this item. Preparation of the surface should include sandblasting (minimum of 70CFM) and an acetone wet wipe to ensure a clean surface as required by manufacture. Active leaks (infiltration) must be corrected by a method approved by the HRW Engineer prior to installing an Internal Manhole Seal. The substrate surface must be free of sand, loose debris, latencies, dust, oil, grease or chemical contamination. A blower or torch may be required to completely dry the substrate surface or as recommended by the manufacturer. Flex-Seal Utility Sealant or approved equal may require the proper mixing of agents, as recommended by the manufacturer's instructions. Ensure casting and structure surfaces are clean and dry where the primer is intended to adhere. After allowing for proper drying of primer to occur, sealant may be applied by brush as evenly as possible over the entire chimney area that includes the frame joint area and the area above the manhole cone including all extensions to the chimney area. The contractor is to furnish the HRW Utility Construction Inspector Engineer two (2) mirrors with extension handles that can be used to inspect sealant application to areas underneath frame without entry of manhole. These items will become the property of HRW upon completion and at no additional cost of this item. Cost for these items shall be included in the bid items for internal manhole sealing work.

5.6.7 Interior Coating for Manholes Receiving Wastewater Discharge from a Force Main

Where force mains are discharged to manholes, such manhole interior shall be adequately protected with a HRW approved coating to prevent hydrogen sulfide damage. The interior coating shall be either coal tar epoxy, Flex-Seal Utility Sealant ™, Spectrashield Liner ™ or HRW approved equal. The Spectrashield Liner ™ must be applied by the manufacturer's authorized representative due to the trademark rights, proprietary, legal and quality control reasons due to the special heat application equipment. The Flex-Seal Utility Sealant manufactured by Sealing Systems, Inc. may be applied by any competent contractor once certified by the manufacturer and the sealant must be applied at ambient temperatures at 45° F or higher with minimal humidity in the atmosphere for ideal application conditions. The sealant must be applied by brush to achieve a sealant layer of at least 170 mils thick. The manufacture must in writing certify that each of the contractor's representatives are approved to install Flex-Seal Utility Sealant or approved equal for this item. The training shall be included in the bid items for internal manhole seals. The appropriate certification by the manufacturer must be provided for each contractor that will apply the sealant to the manholes. The contractor shall submit shop drawings in accordance with the General Contract Conditions. The manufacturer's specifications for the materials and method for proposed installation of this item shall be submitted to the HRW Engineer for the approval before internal sealing work commences.

5.6.8 Paved and Unpaved Roads

When manholes are placed in unpaved roads, the top of the manhole shall be 4 inches below grade of the road and constructed in order that the manhole may be lowered 6 inches by including a riser section above the cone section and below the ring and cover. The riser section may be removed and replaced with a different riser section in the future to adjust the manhole rim elevation to the finished grade of the road should it be paved in the future.

5.6.9 Final Adjustment to Finished Grade with Rubber Riser Rings

For manholes located in the paved streets and parking lots subject to vehicular traffic, rubber riser ring sections shall be located between the cone section of the manhole and the cast ring and cover assembly and it shall be bolted down through the ring into the last concrete riser section. The rubber riser will reduce vibration from the vehicular traffic and will protect the structural integrity of the manhole assembly below the finished grade of the street.

When manholes are placed in paved roads, the top of the manhole shall be installed to be flush with the finished grade of the street including the rubber riser ring that can vary from ½ inch to 3 inches. During construction process the top of the cone section of the manhole shall have at least 48 square inches of concrete poured around it to keep it stable prior to paving the street or parking lot. This will keep the structure in placed should the paving contractor bump the top of the manholes ring and cover. The concrete shall be formed and poured to at least six (6") inches below finished grade of the road. The concrete poured in the form around the top of the riser section shall be rated for at least 3,000 psi or greater. Manholes shall be adjusted to finished grade using Infi-Shield Uni-Band manhole adjustment rings or approved equal. The Uni-Band seal manhole sealing system shall be installed to prevent leakage of water into the manhole through the frame joint area and through the adjustment ring area. All sealing materials required for the installation of the Uni-Band manhole sealing system shall be furnished by the contractor and shall be new, of first grade, and shall be of reputable domestic manufacturers. The frame or ring casting shall be sealed to the concrete manhole structure with a Uni-Band sealing system as manufactured by Sealing Systems, Inc. or approved equal. The seal shall be a continuous seamless band made of high quality EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils. There shall be a preformed L shaped corner molded into the top of the seal. The top section and the side section will extend from the L shaped corner at a generally 90-degree angle to each other. Wherein the seal is pre-formed in substantially the same shape as when attached to the manhole structure, the thickness of the L shaped corner extending 1" into the top section and 1" down the side section is increased and may be at least twice the thickness of the top section reinforcing the seal at this particular area. There shall be a 2" to 3" wide strip of butyl mastic attached to the underside of top section of the seal. There shall be a 2" wide strip of butyl mastic attached to the inside of the side section at the bottom of the seal. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 1/8", and shall seal to the cone/top of the manhole section and over the flange of the casting frame. An aerosol primer shall be used to enhance the bond strength of the seal to the structure. The Uni-Band seal sealing system shall be installed according to the manufacturer's recommendations. The top section of the seal shall extend up from ½" to 3" (in ½" sections) attaching to the casting base/flange with the side section covering over the entire grade adjustment ring area and onto the cone section a minimum of two (2") inches.

5.6.10 Main Line Location

In both public and private road right-of-ways, main line sewers shall be located in accordance with the HRW. A minimum permanent easement width of 20' shall be provided where it is necessary to install main line sewer outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels.

5.6.11 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the standards established by North Carolina Department of Transportation (NCDOT). Under no circumstances shall open cuts in the existing state maintained roadways remain unpaved or patched in keeping with highway standards for more than 2 days. Failure on the part of the contractor to take adequate action on patching will force Harnett Regional Water to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs as required by the NCDOT.

Section 5.7 Access

Access steps shall be provided in all manholes and shall be so located to be easily accessible for entry. Steps shall be of a non-corrosive material such as polypropylene per HRW Standard details. The manhole ring and cover shall not be less than 24" in diameter to provide adequate room for access to the manhole interior. 64

Section 5.8 Pipe Connections to Existing Manhole

Pipe connections to existing manholes shall be made in such a manner that the finished work will conform as nearly as practical to the essential requirements specified for new manholes, including all necessary concrete work, cutting and shaping. The connection shall be at a right angle target (centered) to the manhole. Holes for the new pipe shall be large enough to facilitate a Harnett Regional Water approved rubberized water stop and allow packing cement

mortar around the entire periphery of the pipe but no larger than 1-1/2 times the diameter of the pipe. No manhole may be core drilled until a representative of HRW may be present to witness the drilling operation, pipe installation and sealing of the new opening in the manhole wall.

Section 5.9 Sanitary Sewer Service Laterals

5.9.1 Mainline Lateral Connection

All service laterals will be constructed at the time the collector sewers are installed for all new construction of sanitary sewer mains. Care shall be taken to ensure that floor elevations of all existing building units are sufficiently high enough the finished grade above the sanitary sewer main to provide for a uniform slope of not less than 1/8" per foot. All service laterals will be connected to the collector main by a service wye. Service laterals shall not be greater than six (6") inches (Polyvinyl Chloride ASTM D 3034). A terminal cleanout with a sweeping wye fitting shall be provided at or near the road right-of-way. The cleanout cap at the back of the sweeping wye may be plastic since it is temporary until the plumber connects the service line to the building. The cleanout cap at the top of the stack shall be brass or bronze with an 18" x 18" x 6" concrete collar placed around the cleanout stack in accordance with the HRW standard details to protect it from damage. This cleanout establishes the point of termination for maintenance responsibility by Harnett Regional Water. In case of easements, a terminal cleanout shall be provided not greater than nine (9 ft.) feet from center line of pipe of the sanitary sewer main. In undeveloped areas, sanitary sewer service laterals shall be installed at least every two hundred (200 ft.) feet on both sides of the street or easement unless otherwise approved by the HRW Engineer. No sanitary sewer service lateral shall be connected to any manhole unless approved in writing by the HRW Engineer.

5.9.2 Residential Sewer Service Lateral Connections

A. Materials

4" Polyvinyl Chloride (PVC) - All pipe fittings shall conform to latest edition ASTM D 1785, Schedule 40.

6" Polyvinyl Chloride (PVC) - All pipe and fittings shall conform to latest edition ASTM D 3034, SDR 35.

B. Location

All sanitary sewer clean outs shall be designed to be positioned at least one (1 ft.) foot inside the right-of-way or utility easement. The cleanout stack shall be designed to be at least two (2 ft.) feet above finished grade and capped with a temporary cap until the plumber can make the connection to the building and lower the clean out to the finished grade.

5.9.3. Grease Traps

All grease traps shall be manufactured in accordance with the project plans and profiles as designed by the Professional Engineer (P.E.) and approved by the HRW. The P.E. shall notify the HRW Pretreatment Coordinator of the proposed grease trap to verify proper sizing. Grease traps shall have minimum capacity of at least 1,000 gallons or more as required by Harnett Regional Water's Sewer Use Ordinance unless approved in writing by the HRW Pretreatment Coordinator. All grease traps shall be manufactured in conformance to ASTM standards, including but, not limited to the elements and components of reinforced concrete structures as follows:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement **A706/A706M** Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
C33 Specification for Concrete Aggregates

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete

The Professional Engineer (P.E.) shall include a grease trap in the project plans as necessary to be in conformance with Harnett Regional Water's Sewer Use Ordinance. The basic requirements are as follows:

A. All boarding houses, cafes, restaurants, food preparation establishments, hotels or motels with efficiency apartments, condominiums and such other establishments deemed necessary by Harnett Regional Water constructed after adoption of this Resolution, shall install a grease trap on the kitchen waste line. The grease trap must precede the septic tank on the kitchen waste line if a septic tank is used. The grease trap must be designed in accordance with current engineering standards and shall be easily accessible for cleaning. Grease traps shall be installed on the outside of buildings and must have a minimum capacity of 1,000 gallons. Grease traps shall be cleaned periodically by the owner or operator of the facility. Failure to make periodic cleaning which results in a stoppage of Harnett Regional Water's Sewer System shall constitute cause by Harnett Regional Water and/or other aggrieved property owners to bring suit for damages incurred. If HRW employees are required to clean out the sewer lines as a result of a stoppage due to a clogged grease trap, the property owner or operator shall be further required to pay the costs of the HRW labor and materials required to clean out such sewer.
B. All existing boarding houses, cafes, restaurants, hotels, or motels with efficiency apartments, condominiums, food preparation establishments, or such other establishments deemed necessary by the HRW shall be required to construct a grease trap within sixty (60) days after notification by the HRW, at the Owner's expense, if and when the approving authority determines that a grease problem exists which is capable of causing damage or operational problems to structures or equipment in the Harnett Regional Water's sewer system. The HRW shall retain the right to inspect and approve the installation of the grease trap facility.

Section 5.10 Sewer in Relation to Streams

5.10.1 Location of Sewers on Stream and Drainage

A. Cover Depth.

The top of all sewers entering or crossing streams shall be of a sufficient depth below the natural bottom of the stream bed to protect the sewer line. Service laterals shall be two (2) feet below invert of any drainage ditch or canal. Any sanitary sewer gravity main, outfall line or wastewater interceptor installed along a creek, stream or river shall be designed to be installed deep enough such that any sanitary sewer service lateral or branch sewer line shall be at least three (3") feet below the creek bed, the stream bed and/or the river bed when installed across a natural water resource. This will eliminate or reduce the need for exposed aerial sewer crossings that will be classified as "High Priority."

B. Horizontal Location.

Sewers located along streams or drainage ways shall be located outside of the stream bed and sufficiently removed there from to provide for future possible stream widening and to prevent pollution by siltation during construction.

C. Structures

The sewer outfalls, headwalls, manholes, gate boxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.

D. Alignment

Sewers crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade. Sewer systems shall be designed to minimize the number of stream crossings.

E. Construction

Sewers entering or crossing streams shall be constructed of cast or ductile iron pipe with mechanical joints; otherwise they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not cause siltation.

F. Siltation and Erosion

Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams to provide adequate control of siltation and erosion. Specifications shall require that cleanup, grading, seeding, and planting or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days.

Section 5.11 Aerial Crossings

Aerial crossings shall be avoided where possible and the sewer line improvements shall be designed deep enough to avoid the use of an aerial crossing where practical. When an aerial crossing is deemed necessary then support shall be provided for all joints in pipes utilized for any and all aerial crossings. The supports shall be designed to prevent frost heave, overturning and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 100-year flood.

Section 5.12 Separation of Sewer Mains from Buildings and Other Structures

5.12.1 Type of Structure

A. Permanent Structures and Buildings

No permanent structures or buildings shall be constructed within 20 feet of a sewer main.

B. Non-Permanent Structures or Improvements

No non-permanent structures or improvements shall be constructed within 20 feet of a sewer main.

Section 5.13 Bridge Crossing or Aerial Crossing

The sanitary sewer gravity main or sanitary sewer force main that shall cross near a bridge shall be designed to be installed with at least three (3 ft.) feet of cover and at least twenty (20 ft.) feet from the bridge supports where practical. If the utility line cannot be installed underground under those conditions then the utility line may be attached to the bridge structure in accordance with all NCDOT requirements for attachments. Aerial type crossings are not preferred by the HRW (See Aerial Crossings under Section 5.11 above).

All utility lines installed with an aerial crossing must be provided with a means for expansion and contraction. All utility lines installed with an aerial crossing must be provided with insulation or a means to prevent the line from freezing during adverse weather conditions generally expected in the winter months. The supports shall be designed to handle the weight of the full utility line, insulation material, supports, straps, bolts and any other weight that may occur through icing or flooding conditions.

Section 5.15 Easements

In all cases where it is necessary to construct sewer mains crossing private property, an easement designated specifically for the construction, operation and maintenance of water/sewer improvements shall be dedicated exclusively to Harnett Regional Water. Dimensions of the easement shall be in keeping with the herein stated separation requirements. A minimum permanent easement width of 20" shall be provided where it is necessary to install main- line sewer outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels. The Professional Engineer (P.E.) or the Registered Land Surveyor (R.L.S.) shall stake out the center line of all existing and proposed easements relative to the project for the contractor to follow.

Section 5.16 Protection of Water Supplies

5.15.1 Water Supply Interconnections

There shall be no physical connections between a public or private potable water supply system and a sewer or other non-potable water source (irrigation), or appurtenance which would permit the passage of any sewage or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

5.15.2 Relation to Water Works Structures

A. Horizontal Separation (See Horizontal Separation Section 5.4.7)

Sewers shall be laid at least 10 feet (3.0m) horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a separation of 10 feet (3.0m), Harnett Regional Water may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to the water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so that the bottom of the water main is at least 18 inches (46 cm) above the top of the sewer and both water and sewer main are constructed of ferrous pipe materials. The Engineer shall provide additional details for such installation in addition to the HRW Standard Details.

B. Crossings (See Vertical Separation Section 5.4.6)

Sanitary sewer lines crossing water mains shall be laid to provide a minimum vertical distance of 24 inches (61 cm) between the bottom (outside) of the water main pipe above the top (outside) of the sanitary sewer main. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water joints, preferably ten (10ft.) feet from the center of the crossing.

In cases where it is not practical to maintain 24 inches of separation, Harnett Regional Water may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to the water main, provided that the water main and the sewer main are constructed of ferrous pipe materials and the minimum of 18 inches of separation are maintained between the potable water main and the sewer main. The Engineer shall provide additional details for such installation in addition to the HRW Standard Details.

C. Special Conditions

When it is impossible to design the proper horizontal and vertical separations as stipulated above, the sanitary sewer shall be designed to be constructed of ferrous pipe materials equal to the water pipe and shall be pressure tested to assure water-tightness prior to backfilling. Where these separations cannot be maintained then the sanitary sewer main and the potable water main shall be installed with ductile iron pipe and the minimum vertical separation of eighteen (18") shall be maintained at the crossing or a minimum of five feet shall be maintained horizontally.

Section 6.10 Pipe Installation Standards and Procedures

6.10.1 Standards

Installation specifications shall contain appropriate requirements based on the criteria, standards and requirements established by industry in its technical publications. Requirements shall be set forth in the specifications for the pipe and methods of bedding and back filling thereof so as not to damage the pipe or its joints, impede cleaning and future tapping nor create excessive side fill pressures or ovulation of the pipe, nor seriously impair flow capacity.

6.10.2 Trenching

A. The width of the trench shall be ample to allow the pipe to be laid and jointed properly and to allow the backfill to be placed and compacted as needed to adequately support the pipe. The trench sides shall be kept as nearly vertical as possible. When wider trenches are dug, appropriate bedding class and pipe strength shall be used.

B. Boulders, large stones, and other large materials shall be removed to provide a minimum clearance of 12 inches (30 cm) below and on each side of all pipe(s).

C. All organic material shall be removed from the sub base of the trench.

6.10.3 Bedding

A. Bedding classes A, B, or C, as described in ASTM C1274 (ANSI A 106.2) or WPCF MOP NO. 9 (ASCE MOP NO 37) shall be used for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load.

B. Bedding Class I, 1/4 inch to 1-1/2 inch graded stone bedding, as described in ASTM D 2321 (ANSI K 65.171) shall be used for all flexible pipe will be installed in bedding placed four (4) inches below the pipe barrel and brought up to the top of the pipe. Class I, II, or III materials will be used for initial backfill up to six (6) inches above the top of the pipe over the full width of the trench.

6.10.4 Backfill

A. Backfill shall be of suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or, other unstable material shall not be used for backfill. Backfill will be hand tamped or pneumatically tamped to twenty-four (24) inches above the top of the pipe. Backfill to the top of ground will be in eight (8) inch loose thickness lifts compacted. Compaction density shall be a minimum of 95% standard proctor under all paved areas and 90% standard proctor in all other areas. Compaction testing as approved by the HRW shall be provided in all paved areas.

B. Backfill shall be placed in such a manner as not to disturb the alignment of the pipe. Any pipe displaced or broken during backfilling or compaction will be replaced.

6.10.5 Deflection Test

A. Deflection tests shall be performed on all pipe (100%). The test shall be conducted after the final backfill has been in place at least 15 days. The mandrel and proving ring will be furnished by the contractor.

B. No pipe shall exceed a deflection of 5%, calculated by using the base inside diameter as furnished by ASTM.

C. If the deflection test is to be run using a rigid ball or mandrel, it shall have a diameter equal to 95% of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices. The contractor is responsible for providing mandrel and associated equipment at the time of inspection. The latest applicable ASTM standard for the mandrel shall be used by the contractor. 93

Section 6.11 Joints and Infiltration

6.11.1 Joints

The installation of joints and the materials used shall be included in the specifications. Sewer joints shall be installed to minimize infiltration (100 gpd/inch diameter of pipe/mile or less) and to prevent the entrance of roots throughout the life of the system. Junctions of dissimilar pipes or junctions requiring some form of rubberized banding material shall be totally encased with a minimum of 6" of concrete surrounding the junction for a distance of 2' either side of the end of the banding material.

6.11.2 Leakage Tests

Leakage tests shall be required for all main line sewers and shall include installed services. Such tests shall be by the low pressure air testing method. The air test shall, at a minimum, conform to the test procedure described in the last edition of ASTM. The testing methods selected should take into consideration the range in groundwater elevations projected and the situation during the test.

6.11.3 Inspection

The specifications shall include a requirement for inspection of manholes for water-tightness prior to placing into service. Prior to inspection, all lines must be flushed and cleaned.

Section 6.12 Flushing and Cleaning

Flushing and cleaning shall be the responsibility of the contractor. The contractor shall pump dry and dispose of all extraneous ground water and other sand, gravel and foreign objects within the sewer main. Such material shall not be flushed into the existing operating sewer mains, pump stations, or pertinent facilities. Flushing of main line sewers under construction into main lines is prohibited. Water for flushing and cleaning, as herein referenced, shall be provided by the HRW upon payment of appropriate fees for the installation of a fire hydrant meter in keeping with HRW established standards, rates and regulations to meter all water usage. The water used for road construction must be kept separate from the water used in the construction, cleaning, flushing and of the sanitary sewer system improvements for billing purposes.

Section 6.13 Main Line Location

In both public and private road right-of-ways, main line sewers shall be located in accordance with the HRW. A minimum permanent easement width of 20' shall be provided where it is necessary to install main line sewer outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels.

Section 6.14 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the standards established by North Carolina Department of Transportation (NCDOT). Under no circumstances shall open cuts in the existing state maintained roadways remain unpaved or patched in keeping with highway standards for more than 2 days. Failure on the part of the contractor to take adequate action on patching will force Harnett Regional Water to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs.

Section 6.15 Aerial Crossings

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. For aerial stream crossings, the bottom of the pipe should be placed no lower than the elevation of the 100-year flood plain per the plans and profiles designed by the Professional Engineer (P.E.). The P.E. shall specify any and all special fittings, hangers, brackets, or supports that may be required for the aerial crossing and provide details of such special fittings, hangers, brackets, or supports in the project plans. 94

Please see Chapter 12, General and Special Conditions, Section Special Construction Technical Specifications for additional information and requirements for construction.

CHAPTER 6

CONSTRUCTION OF SANITARY SEWER IMPROVEMENTS

REQUIREMENTS

Chapter 6 CONSRUCTION OF SANITARY SEWER IMPROVEMENTS- REQUIREMENTS

Section 6.1 Construction of Sanitary Sewer Improvements

Contractors shall install all sanitary sewer improvements per the engineer's design as approved by HRW and permitted by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR-DWQ) unless the existing site conditions preclude such installation or significantly impact the project. Should site conditions warrant plan revisions then follow the procedures outlined in Section 4. 1. 11 above. All materials used in the sanitary sewer system improvements shall meet the requirements specified in the sections below unless otherwise approved by the HRW Engineering staff.

Once each project has been approved by the HRW and permitted by the state, the approved plans will be issued to the Contractor by the HRW. Copies of the approved plans will be stamped by the HRW Engineer as "Released For Construction," signed and dated to verify all plan changes requested by the state and the HRW have been addressed by the design engineer. During the pre-construction conference, the HRW Engineering staff will provide a copy of the state approved plans stamped as "Released For Construction" to the Contractor and the HRW Utility Construction Inspector. Only the state approved plans stamped by the HRW Engineer as "Released For Construction" shall be used for construction of any sanitary sewer system improvements. Preliminary plans or other plans not marked as "Released For Construction" by the HRW shall cause an immediate work stoppage until the approved plans marked as "Released For Construction" shall be issued and maintained on site by the Contractor.

Section 6.2 Construction Requirements for Sanitary Sewer Improvements

6.2.1 Material Submittals and Shop Drawings

All materials to be used in the extension of or connection to the existing Harnett Regional Water's sanitary sewer collection system must be approved by HRW before they are purchased and delivered on any project site. Submit six (6) copies of the following material specification sheets and all associated shop drawings for the material to be used in the in accordance proposed project shall be furnished to the HRW Engineer or the HRW Utility Construction Inspector to demonstrate compliance with the stipulated requirements as set forth herein these specifications under the "General Conditions." The contractor shall furnish all types of pipe and other incidentals required for the construction of a complete sanitary sewer system as shown on the drawings and as specified herein. Unless otherwise noted, the materials listed below are acceptable to the HRW for use in the construction of any extension of Harnett Regional Water's sanitary sewer collection system. Should the contractor desire to use materials not listed in these specifications, written permission must be obtained from both the Professional Engineer (P.E.) of record and the HRW Engineer or designated personnel as approved by the HRW Director.

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purposes specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail. Connect to existing sanitary sewer mains and manholes as indicated by the project plans and under the direct supervision of the HRW Utility Construction Inspector or equivalent engineering representative of the HRW. Provide sanitary sewer main pipe, manholes, fittings, seals, combination air valves, air/vacuum valves, rubber seals, check valves, sanitary sewer service laterals, valve boxes, concrete valve box protective rings (donuts) and other system appurtenances as specified and where indicated per project utility plans approved by the HRW and permitted by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR- DWQ).

6.2.2 Material Approval

All material used in the construction of sanitary sewer improvements to Harnett Regional Water's existing sanitary sewer collection system must be approved by the HRW prior to purchase of the material. The HRW Engineer must receive the approved material submittals from the Engineer of Record by stamping one copy of the material submittal package and returning that stamped copy to the contractor and HRW. The contractor may then order the materials and have them delivered on site at the project location. Any materials that the HRW Utility Construction Inspector finds on site that have not been approved by the HRW Engineer shall be removed immediately and construction shall be halted until the materials have been removed from the project site entirely. 71

Section 6.3 Materials For Construction of Sanitary Sewer Improvements

The Contractor shall use the materials specified by the Engineer in the project plans for the construction of any and all sanitary sewer improvement mains. The materials selected by the Engineer shall be utilized unless the material selected cannot be adapted to local conditions. In such cases the Professional Engineer (P.E.), the HRW Utility Construction Inspector and the HRW Engineer should be notified prior to the start of construction to request a change order for the material. The change order must be approved by the P.E. and the HRW Engineer before material changes shall be made by the contractor. Materials used in the construction of any and all sanitary sewer improvements shall conform to the following specifications:

6.3.1 Pipe

A. PVC Plastic Pipe (Standard Dimension Ratio) SDR 35 ASTM D3034

PVC Plastic Pipe (Standard Dimension Ratio) SDR 26 ASTM D3034

All pipe in this class shall conform to ASTM Standard D3034 for "Type PSM polyvinyl chloride (PVC) Sewer Pipe and Fittings." The pipe shall be made of PVC plastic with integral wall bell and spigot joints for the conveyance of domestic sewer. The pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13364-B (with minimum tensile modulus of 3,450 MPa (500,000 psi) as defined in ASTM Standard D1784. The pipe fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13343-C as defined in ASTM Standard D1784. Compounds with superior properties are also acceptable.

1. Joints
Jointing system shall be elastomeric gasket type joints or push-on joints providing a watertight seal. Assembly of the joints shall be in accordance with the pipe manufacturer's recommendations. The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

2. Gaskets
Gaskets for the flanged joints shall conform to ASTM Standard C1330, Grade I rubber, full face type at least 1/8" thick. The mechanical joint gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable for the gaskets.

3. Markings
Pipe in compliance with this standard shall be clearly marked at intervals of 5 feet as follows:

- Manufacturer's name or trademark.
- Nominal pipe size.
- The PVC cell classification (for example 12454-B)
- The legend "Type PSM SDR 35" and the designation ASTM 3034

Fittings in compliance with this standard shall be clearly marked as follows:

- Manufacturer's name or trademark.
- Nominal pipe size.
- The PVC cell classification (for example 12454-B)
- The legend "Type PSM SDR 35" and the designation ASTM 3034

4. Service Taps
All service taps shall be designed to be made on the PVC pipe using a Romac CB saddle or Fowler Inserta Tee hubbed with a schedule 40 or SDR 23.5 gasketed bell, rubber boot per ASTM Standard C443 and a stainless steel band. All taps must be designed to withstand low pressure air test required for the sewer main. Service taps installed with the newly constructed sewer mains shall be designed using an in-line wye fitting of the same material of the sanitary sewer main.

5. Service Pipe
All 4" and 6" sanitary sewer service laterals, service lines, cleanouts and associated fittings shall be Schedule 40 PVC conforming to ASTM Standards D2466 and D2672 respectively or SDR 23.5 conforming to ASTM Standard D2665 D3034 with glued or gasketed joints. The sanitary sewer service lateral shall include a long sweeping wye with a plug to cover the end of the cleanout until the final service line connection is completed by the plumber hired by the builder/owner.

6. Testing and Acceptance
Low pressure air tests will be performed on all newly laid sewer lines and associated service taps. The pressure holding time is based upon an average of 3 psi gage or a drop from 3.5 psi to 2.5 psi per the requirement of the ASTM Standard C828, latest revision. PVC pipe shall be capable of withstanding a two hour immersion test in a sealed container of 99.5 % Anhydrous Acetone and show no signs of flaking on interior or exterior when tested in accordance with ASTM Standard D2152. PVC pipe strength shall be capable of withstanding stiffness, flattening and impact test as scheduled or referenced in ASTM Standard D3034-73, SDR 35.

Tests shall be conducted to demonstrate joint performance at 5% maximum diametric deflection of the spigot as specified in ASTM Standard D3212. Maximum allowable pipe deflection shall be five (5%) percent of inside diameter. Deflection shall be checked by the contractor in the presence of the engineer and the HRW Utility Construction Inspector using a mandrel go/no-go device a minimum of 30 days following the installation. The mandrel device must be cylindrical in shape. The mandrel's length and diameter (ID of proving ring) shall be sized for the sewer pipe installed on each project in accordance with Table 1 below. The mandrel shall be subject to the approval of the HRW Utility Construction Inspector and the Professional Engineer (P.E.).

Table 1

Nominal Diameter	Length	Diameter of Mandrel (Proving Ring)
6"	6"	5.65"
8"	8"	7.56"
10"	10"	9.45"
12"	10"	11.26"
15"	12"	13.78"

7. Leakage
All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

8. Infiltration
The contractor shall provide HRW a guarantee that infiltration shall not exceed 100 gallons per mile per day per inch diameter of pipe. The contractor shall provide the Professional Engineer (P.E.) a means to test infiltration after the completion of pipe installation prior to final acceptance.

B. Ductile Iron Pipe Centrifugally Cast for Water ANSI/AWWA C151/A21.51 Class 50 and ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer main shall be made because of the width and depth of trench where necessary to withstand extraordinary superimposed loading, special bedding, concrete cradle or special construction may be used. PVC plastic pipe DR 35 ASTM D3034 shall be used above 18 feet. Ductile iron ANSI A21.51 Class 50 shall be used below 18 feet. When transitioning from one pipe material to another, the pipe material must be consistent from one manhole to the next unless prior approval is given by the HRW.

All pipe in this class shall conform to either ANSI/AWWA C151/A21.51 Class 50 for "Ductile Iron Pipe, Centrifugally Cast for Water" or ASTM A746, Standard Specification for "Ductile Iron Gravity Sewer Pipe" or better. 73

1. Gaskets
Gaskets for the flanged joints shall conform to ASTM Standard C1330, Grade I rubber, full face type at least 1/8" thick. The mechanical joint gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable for the gaskets.

2. Markings
Pipe in compliance with this standard shall be clearly marked at intervals of 5 feet as follows:

- Manufacturer's name or trademark.
- Nominal pipe size.
- NSF and UL approvals
- The legend "DI" and the designation ANSI C151

Fittings in compliance with this standard shall be clearly marked as follows:

- Manufacturer's name or trademark.
- Nominal pipe size.
- NSF and UL approvals
- The legend "DI" and the designation ANSI C151

3. Joints
The pipe shall have push-on joints, flanged joints or mechanical joints. The push on joints shall conform to ANSI/AWWA C110/A21.11, except the gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable for the gaskets. Restrained push on joints shall be American "Lok-Fast" or "Lok-Ring"; U.S. Pipe "TR Flex" or Griffin "Snap-Lok" or "Field-Lok 350" gaskets. Flanged joints shall be ductile iron, flat faced to conform to ANSI/AWWA C115/A21.15, latest revision. Bolts shall be chamfered or rounded ends projecting ¼ to ½ inch beyond outer face of the nut to conform to ASTM Standard A307. Nuts shall conform to ASTM Standard A30, hexagonal per ANSI Standard B118.2.2, heavy semi-finished pattern.

4. Field Joints
Joints in buried locations shall be mechanical joint or push-on type unless otherwise indicated on the drawings. Bells on wall castings and wall sleeves shall be mechanical joint type with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the drawings. Grooved end couplings may be used in lieu of flanges provided rigid radius grooving is used to preclude pipe movement.

5. Mechanical Joints

Mechanical joints shall have grip rings and they shall be carefully assembled in accordance with the manufacturer's recommendations. "Megalug" fittings shall only be used for pipe sizes greater than 12 inches diameter. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Tie rods for mechanical joints shall conform to ASTM Standard A307. All bolts shall be uniformly tightened to the torque values listed in Appendix A of the ANSI/AWWA Standard C111/A21.11. Over tightening of bolts to compensate for poor installation practice will not be permitted. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry. 74

6. Push-On Joints

The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

7. Flanged Joints

Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline. When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate, so that gasket compression is uniform. Special care shall be taken when connecting to pumping equipment to ensure that pipe stresses are not transmitted to the pump flanges. All such piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of abutting pump and piping flanges are obtained before installation of any bolts in those flanges. In addition, pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened.

8. Flanged Coupling Adapters

Flanged coupling adapters shall be installed in strict accordance with the coupling manufacturer's recommendations. After the pipe is in place and bolted tight, the proper location of holes for the anchor studs shall be determined and the pipe field drilled. Anchor stud holes shall be drilled completely through the pipe wall. The hole diameter shall be not more than 1/8 inch larger than the diameter of the stud projection.

9. Mechanical Couplings

Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. A space of at least 1/4 inch and not more than one inch shall be left between the pipe ends. Pipe and coupling surfaces which contact gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of the Engineer.

10. Wall Castings

Unless otherwise indicated on the drawings, wall castings shall be provided where cast iron pipes pass through concrete walls. Where a flange and mechanical joint piece is to

connect to a mechanical joint wall casting, the bolt holes in the bell of the wall casting shall straddle the top (or side for vertical piping) centerline of the casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall casting at the foundry. Wall castings shall have mechanical joints with water stop and tapped holes; single casting or fabricated ductile iron shall be "Adjustable Wall Pipe" as manufactured by Midwest Pipe Fabricators, Omaha, Nebraska or approved equal. All holes shall be sized according to project plans and provided with removable plugs.

11. Reducers
Reducers adjacent to flow meters and pumps shall be eccentric pattern. Eccentric reducers shall be installed with the straight side on top so that air traps are not formed. Unless otherwise indicated on the drawings, all other reducers shall be concentric pattern.

12. Outlets
Where a 12" or smaller branch outlet is indicated and the diameter of the line pipe is at least twice the diameter of the branch, either a tee, factory welded-on boss, or a tapping saddle will be acceptable. Gauge connections in the cast iron piping shall conform to the requirements of the pressure gauge manufacturer"s recommendations and this section. 75

Connection of gauges to cast iron-pipe six (6") inches and smaller shall be made using a tapping saddle or a tee complete with a blind flange drilled and tapped to accept the gauge piping specified. Connection to gauges to 8 inch and larger piping shall be made by means of a factory welded-on boss or a tapping saddle. Drilling and tapping of the pipe wall will also be acceptable provided the wall thickness, minus the foundry tolerance, at the point of connection equals or exceeds the wall thickness required for a full 4-thread engagement in accordance with Table A.1, Appendix A of ANSI/AWWA Standard C151/A21.51.

13. Shop Coating and Lining
The interior of all pipe and fittings for water service shall be coated with Protecto 401 or approved equal for protection against attach by sewer gases such as methane and hydrogen sulfide. The exterior surfaces of all pipe and fittings which will be exposed to interior locations shall be shop primed and then painted after installation. Flange faces shall be coated with rust-preventive compound. Exterior surfaces of all other pipe and fittings shall be asphaltic coated.

14. Handling
Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Pipe and fittings in which the lining has been damaged shall be replaced. With the concurrence of the Engineer, small and readily accessible damaged areas may be repaired. All pipe coating which has been damaged shall be repaired by the contractor before the pipe is installed.

15. Cutting Pipe
Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file or power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitable beveled. Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be permitted. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be permitted.

16. Cleaning
The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation and shall be kept clean until the work has been accepted. Before joining pipe sections, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed. Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other materials shall not be placed in or allowed to enter the pipe. Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

17. Inspection
Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site of the work.

18. Alignment
Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated in Table 5 or Table 6 of the AWWA Standard C600, unless specially designed bells and spigots are provided. Either shorter pipe sections or fittings shall be installed where required to conform to the alignment or grade indicated on the drawings. 76

19. Laying Pipe
Pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions. Pipe shall be laid with the bell ends facing the direction of laying except when reverse laying is specifically authorized by the Engineer.

20. Connections with Existing Piping:
Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the HRW. The customers shall be provided at least 48 hours' notice for any planned service outages by placing a door hanger notice on each door of the customers" dwellings before the existing lines may be shut off or removed from service. Facilities shall be provided for proper dewatering and disposal of all water removed from dewatered lines and excavations without damage to adjacent property. Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water, mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings and valves installed in such connections shall be thoroughly cleaned and then swabbed with, or dipped in, chlorine solution having a chlorine content of 200 milligrams per liter (mg/l).

21. Concrete Encasement
Concrete encasement shall be installed as indicated on the drawings. Concrete and reinforcing steel shall be as specified in the cast-in-place concrete section. All pipe to be encased shall be suitably supported and blocked in proper position, and shall be anchored to prevent flotation.

22. Reaction Anchorage and Blocking
All exposed piping with mechanical couplings, push-on or mechanical joints, or similar joints subject to internal pressure shall be blocked, anchored, or harnessed to preclude separation of joints. All push-on and mechanical joint tees, wye (Y) fittings, bends

deflecting 22.5° degrees or more, and plugs which are installed in buried piping (subjected to internal hydrostatic heads in excess of 30 feet) shall be provided with suitable reaction blocking, anchors, joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure

Concrete blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by the Engineer. If adequate support against undisturbed ground cannot be obtained, metal harness anchorages shall be installed to provide the necessary support. Metal harness anchorages shall consist of steel rods extending across the joint and securely anchored to pipe and fitting, or other adequate anchorage facilities shall be installed to provide the necessary support. If the lack of suitable solid vertical excavation face is due to improper trench excavation, metal harness anchorages shall be furnished and installed by the contractor and at the expense of the contractor. Reaction blocking, anchorages, or other supports for fittings installed in fills or other unstable ground, above grade, or exposed within structures, shall be provided as required by the drawings or as directed by the Engineer.

All steel clamps, rods, bolts, and other metal accessories used in tapping saddles, reaction anchorages, or joint harness subject to submergence or contact with earth or other fill material and not encased in concrete shall be protected from corrosion by two coats of thixotropic coal tar applied in the field to clean dry metal surfaces. The first coat shall be dry and hard before the second coat is applied. Metal surfaces exposed above grade or within structures shall be painted in accordance with the painting section.

23. Service Taps

All service taps made on the existing sewer mains constructed with ductile pipe shall be made with a Romac CB saddle or Fowler Inserta Tee hubbed with a schedule 40 or SDR 23.5 Gasketed bell, rubber boot per ASTM Standard C443 and a stainless steel band. All taps must be able to withstand low pressure air test required for the sewer main. Service taps installed with the newly constructed sewer mains shall be installed using a wye fitting of the same material of the sewer main.

24. Service Pipe

All 4" and 6" sanitary sewer service laterals, service lines, cleanouts and associated fittings shall be Schedule 40 PVC conforming to ASTM Standards D2665 and D2466 respectively and/or SDFR 23.5 conforming to ASTM Standard D3034 with glued or gasketed joints.

25. Testing and Acceptance

Low pressure air tests will be performed on all newly laid sewer lines and associated service taps. The pressure holding time is based upon an average of 3 psi gage or a drop from 3.5 psi to 2.5 psi per the requirement of the ASTM Standard C828, latest revision. Maximum allowable pipe deflection shall be five (5%) percent of inside diameter. Tests to demonstrate deflection of rigid pipe by using a mandrel go/no-go device are not required by the HRW.

26. Leakage

All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

27. Infiltration

The contractor shall provide HRW a guarantee that infiltration shall not exceed 100 gallons per mile per day per inch diameter of pipe. The contractor shall provide the

Professional Engineer (P.E.) a means to test infiltration after the completion of pipe installation prior to final acceptance.

28. Dimensions
The thickness class for cast iron pipe shall be as indicated in the following table:

Location	Nominal Size (Inches)	Pressure Class (psi)
All push-on	3 through 12	350
All flanged	3 through 12	350

29. Drawings and Data
Complete layout drawings, details and specifications covering all cast iron piping and accessories shall be submitted to the HRW during the plan approval and the pre-construction conference as outlined in these specifications.

C. Semi-Rigid PVC Truss Pipe for Gravity Sewer ASTM D2680

All semi-rigid PVC truss pipe in this class shall be manufactured by extruding Class 12454 PVC resin per ASTM Standard D1784 into a truss shape forming an inner and outer wall supported by webs. After extrusion the voids between the trusses shall be filled with an air entrained Portland cement perlite filler or other inert filler material exhibiting the same degree of performance. The pipe shall exhibit minimum pipe stiffness of 200 psi when tested in accordance with ASTM Standard D2412 and shall be furnished in laying lengths of 12 feet 6 inches. The pipe shall meet or exceed ASTM Standard D2680 or latest revision.

The pipe fittings shall conform to ASTM Standard D2680, latest revision. The pipe joints shall be supplied with elastomeric (Gasketed) seals that meet the requirements of ASTM F477, latest revision and when these joints are assembled they shall conform to the test of ASTM 3212 showing no leakage.

1. Installation
For pipe installed to depths of 15 feet or less, semi-rigid Gasketed PVC truss pipe shall be installed per the manufacturer"s recommendations and shall meet the ASTM Standard D2640, Appendix XI. Backfill material used to a point one (1) foot above the barrel of the pipe shall be select materials that are free of large stones and clods larger than 1-1/2 inches in diameter. Class I, II, III or IV materials per ASTM 2680, 78

Appendix XI are suitable for bedding, haunching and initial backfill. The haunching and initial backfilling for Class II, III or IV soils shall be placed completely under pipe haunches and up each side in uniform layers not exceeding 6 inches in depth with each layer carefully and uniformly compressed or compacted. Where sub grade is unstable or water is present in quantities sufficient to make uniform bedding of the pipe impossible, the contractor will be required by the engineer to stabilize the trench bottom with stabilization stone, 4 inches minimum, or as directed by the HRW Engineer or the HRW Utility Construction Inspector. All trench stabilization stone shall be placed in the trench carefully to avoid damage to previously installed sections of pipe.

For pipe installed to depths greater than 15 feet, the contractor shall bed the pipe with granular stone (Class I) bedding no less than 6 inches thick below the pipe barrel and up to the spring line of the pipe to the full width of the trench. All bedding stone at these depths shall be included with the pipe price submitted per linear foot of pipe installed.

2. Service Taps
All service taps shall be designed to be made on the PVC pipe using a Romac CB saddle or Fowler Inserta Tee hubbed with a schedule 40 or SDR 23.5 gasketed bell, rubber boot

per ASTM Standard C443 and a stainless steel band. All taps must be designed to withstand low pressure air test required for the sewer main. Service taps installed with the newly constructed sewer mains shall be designed using an in-line wye fitting of the same material of the sanitary sewer main.

3. Service Pipe
All 4" and 6" sanitary sewer service laterals, service lines, cleanouts and associated fittings shall be Schedule 40 PVC conforming to ASTM Standards D2466 and D2672 respectively or SDR 23.5 conforming to ASTM Standard D2665 D3034 with glued or gasketed joints. The sanitary sewer service lateral shall include a long sweeping wye with a plug to cover the end of the cleanout until the final service line connection is completed by the plumber hired by the builder/owner.

4. Testing and Acceptance
Low pressure air tests will be performed on all newly laid sewer lines and associated service taps. The pressure holding time is based upon an average of 3 psi gage or a drop from 3.5 psi to 2.5 psi per the requirement of the ASTM Standard C828, latest revision. PVC pipe shall be capable of withstanding a two hour immersion test in a sealed container of 99.5 % Anhydrous Acetone and show no signs of flaking on interior or exterior when tested in accordance with ASTM Standard D2152. PVC pipe strength shall be capable of withstanding stiffness, flattening and impact test as scheduled or referenced in ASTM Standard D3034-73, SDR 35.

Tests shall be conducted to demonstrate joint performance at 5% maximum diametric deflection of the spigot as specified in ASTM Standard D3212. Maximum allowable pipe deflection shall be five (5%) percent of inside diameter. Deflection shall be checked by the contractor in the presence of the engineer and the HRW Utility Construction Inspector using a mandrel go/no-go device a minimum of 30 days following the installation. Deflection tests will not be required for semi-rigid pipe with a pipe stiffness of 150 psi or greater per ASTM Standard D2412.

5. Leakage
All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor.

6. Infiltration
The contractor shall provide HRW a guarantee that infiltration shall not exceed 100 gallons per mile per day per inch diameter of pipe. The contractor shall provide the Professional Engineer (P.E.) a means to test infiltration after the completion of pipe installation prior to final acceptance. 79

D. Reinforced Concrete Pipe (RCP) for Gravity Sewer ASTM D2680

This specification covers reinforced concrete pipe (RCP) intended to be used for the conveyance of sewage, industrial wastes, and storm water, and for the construction of culverts. Pipe manufactured in accordance with this specification shall be of five classes identified as Class I, Class II, Class III, Class IV, and Class V. Pipes shall conform to the ASTM Standard C76 Class III, Class IV, and Class V of the design and strength requirements for diameter, wall thickness, and compressive strength as shown on the drawings. The approval and acceptability of the pipe shall be determined by the results of testing concrete batch samples, cores and cylinders using the three-edge bearing test, absorption test, material test, visual inspection, crushing test, and compression test methods.

The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform. The pipe manufacturing process shall be of the "wet cast" type or of the "dry cast" type using the BiDi manufacturing process or the counter-rotating packer head manufacturing process or the internal care and external jacket process. "Wet cast" forms shall not be removed for at least 8 hours after concrete placement or until the concrete strength has reached 2,000 psi, whichever comes first. For the BiDi and counter-rotating packer head process, plastic or fiberglass form rings shall be placed on the spigot end of the pipe immediately after removal of the forms and shall not be removed prior to the initial set of the concrete. Pipe shall be steam cured after forming. Pipe forms and equipment shall be maintained in excellent condition and shall be kept clean and free of any condition which may contribute to lower quality pipe.

Cement shall be non-air-entraining Portland cement conforming to ASTM C150, Type II. The use of any admixture shall be subject to the specific approval of the HRW Utility Construction Inspector and the Engineer. The aggregate shall be so sized, proportioned, graded, and mixed with such proportions of Portland cement, blended hydraulic cement, or Portland cement and supplementary cementing materials, or admixtures, if used, or a combination thereof, and water to produce a homogeneous concrete mixture of such quality that the pipe will conform to the test and design requirements of the ASTM Standard C76 and these specifications. Fine aggregate shall consist of washed inert natural and conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed dolimitic or calcitic limestone otherwise conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. The minimum alkalinity of the finished concrete shall be 50 percent as a calcium carbonate equivalent. Documentation that the aggregates to be used in the manufacture of reinforced concrete pipe meet these requirements shall be submitted to the HRW Utility Construction Inspector and the Engineer.

Pipe reinforcement methods considered in this specification are circumferential reinforcement, longitudinal reinforcement, and joint reinforcement. Pipe shall be subjected to either steam curing, water curing, or the two methods combined, provided that the required compressive strength is attained as prescribed herein these specifications. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe and cylinder testing shall not be less than the design compressive strength for each RCP size and class. The concrete mass shall be dense and uniform. Reinforcement shall be circular for all concrete pipe(s). Quadrant steel shall not be used.

Pipe reinforcement shall be as specified in the ASTM Standard C76 with the following exceptions:
The maximum variation in the radial position of the reinforcement in the pipe wall shall be + ¼" inch for the outer layer and + ½" inch and ¼" for the inner layer. Reinforcement shall be secured by steel spacers that tie the inner cage to the outer cage and brace to the outside form only. Spacers shall be located circumferentially around the pipe at not less than 90 degrees radial spacing and axially along the pipe at not less than 24-inch spacing. Reinforcement shall be installed in both the bell and the spigot. . At least three circumferential reinforcement wires shall be in the bell area, and longitudinal reinforcement shall extend to the end of the bell and shall be continuous with the wires in the barrel. At least two circumferential reinforcement wires shall be in the spigot area, and longitudinal reinforcement shall extend to within 1" inch of the end of the spigot.

Only one layer of steel mesh shall be allowed for each cage. The minimum steel area specified by ASTM C76 for each cage shall be met with one layer of steel reinforcement.

Pipe may be rejected for any of the following reasons:

- Exposure of any steel reinforcement in any surface of the pipe, except for ends of longitudinal reinforcing in the bell ends of reinforcement spacers.
- Any shattering or flaking at a crack.

- Voids exceeding ¼" inch in depth, with the exception of a few minor bug holes, on the interior and exterior surfaces of the pipe.
- Unauthorized pipe repair or application of any wash coat of cement or grout.
- A deficiency greater than ¼" inch from the specified wall thickness of pipe 30 inches or smaller in internal diameter.
- A deficiency greater than 6% percent from the specified wall thickness of pipe larger than inches in internal diameter, except that the deficiency may be 8 percent adjacent to the longitudinal form joint, provided that the additional deficiency does not lie closer than 20 percent of the internal diameter of the pipe. The deficiencies in wall thickness permitted herein do not apply to gasket contact surfaces in gasketed joint pipe.
- A variation from the specified internal diameter in excess of 3 percent or interior surfaces which have been reworked after placing of concrete. The variation in internal diameter permitted herein does not apply to gasket contact surface in gasketed joint pipe.
- A hollow spot (identified by tapping the internal surface of the pipe) which is greater in any dimension than the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified herein.
- Defects that indicate imperfect molding of concrete or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension equal to the wall thickness or deeper than two times the maximum graded aggregate size, or local deficiency of cement resulting in loosely bonded concrete, the area of which exceeds in size limits of area described above when the defective concrete is removed. Repair of such defects not exceeding these limits may be made as specified herein.
- Any of the following:
    - A crack having a width of 0.01 throughout a continuous length of 36 inches or more.
    - A crack having a width of 0.01 inch to 0.03 inch or more throughout a continuous length of 1 feet or more.
    - Any crack showing two visible lines of separation for a continuous length of 2 feet or more or an interrupted length of 3 feet or more anywhere in evidence, both inside and outside.
    - Cracks anywhere greater than 0.03 inches in width.

The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the HRW Utility Construction Inspector and the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained full strength for each RCP size and class and not before 5 days after manufacture and/or repair, whichever is the longer.

Pipe shall have a minimum laying length of 12 feet, except for closure at structures. Shorter lengths of pipe for closure of structures shall be obtained by saw-cutting full lengths of pipe. The length of the incoming and outgoing concrete pipe at each structure shall be at least 4 feet beyond the outside face of the structure wall. Each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1-1/2" longer than that shown on the shop drawings shall not be used. Variations in length 81
of the same pipe shall not exceed ASTM C76 requirements.

During manufacturing measuring devices shall be used to assure joint assembly is within the tolerance of ASTM C76 and these specifications. The Engineer shall have the right to take samples of the concrete after it has been mixed or as it is being placed in the forms or molds and to make inspection and tests thereof.
At the time of inspection, the pipe will be carefully examined for compliance with the specifications and the approved shop drawings. All pipes shall be inspected for general appearance, dimension, blisters, cracks, roughness, soundness, etc. The surface shall be dense, smooth, and close-textured. Cores also shall serve as a basis for rejection of pipe if lamination or poor bond of reinforcement is apparent.

Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and, if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced at the discretion of the HRW Utility Construction Inspector.

Pits, blisters, rough spots, breakage and other imperfections may be repaired, subject to the approval of the Engineer and the HRW Utility Construction Inspector, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar shall be used for repairs and shall have a minimum compressive strength of 6,000 psi at 7 days and 7,000 psi at 28 days when tested in 3-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.
The first 6 inches of the bell and spigot ends of each piece of pipe shall be painted at the place of pipe manufacturing with a latex paint to be approved by the Engineer and the HRW Utility Construction Inspector. Coordinate type of paint (or alternative coating) with the joint testing apparatus manufacturer as specified.

At the start of the pipe manufacture, a set of three test cylinders shall be taken, cured, and tested. One core shall be taken and tested from each of the first ten pieces of pipe produced. No additional pipe shall be manufactured until the Engineer has inspected the cores, the cylinders and cores have been tested, and the Engineer has reviewed the results of the core and cylinder testing. A relationship shall be established between the compressive strength of test cylinders stored in a standard manner compared to cores taken from the corresponding finished pipe. All cylinders, coring, and testing shall be by the pipe manufacturer. The results shall be furnished immediately to the Engineer and to the HRW Utility Construction Inspector upon request. If a satisfactory relationship between core and cylinder test strengths is demonstrated as specified herein, further core testing may be waived by the Engineer and the HRW Utility Construction Inspector except as specified herein. Should this relationship not be established, one core shall continue to be taken and tested from each piece of pipe until the manufacturer's quality control has been improved to the extent that a satisfactory relationship between core and cylinder test strengths is demonstrated between the compressive strength of test cylinders stored in a standard manner compared to cores taken from the corresponding finished pipe.

The Engineer and the HRW Utility Construction Inspector shall each have the right to direct that test cores be taken from pieces of the finished pipe as he selects for inspection and for such tests as he may wish to apply. Holes left by the removal of cores shall be filled with non-shrink grout by the manufacturer as approved by the Engineer and the HRW Utility Construction Inspector. Core drilling, testing, and filling shall be carried out by the pipe manufacturer as a subsidiary requirement of the manufacturer. A 9-inch x 9-inch waterproofing self-adhering membrane (Gator Wrap, Mac Wrap or equal) shall be placed over the core holes on the exterior of the pipes. The number of cores shall not exceed the requirements of ASTM C76. 82

One test core shall be taken for every 500 linear feet of pipe manufactured but not less than once each day on which pipe is manufactured for the project. Cores may be reduced to one set of two per week but not less than one set for every 1,500 linear feet, if a continued satisfactory relationship is established between cores and cylinders made and cured in the standard manner. This relationship shall not vary by more than 10 percent more or less from the average ratio. Cores may be drilled in any manner which will provide a smooth core face. All pipe cylinders and cores shall be 4-inches in diameter. Cores shall be carefully saw-trimmed and capped in a vertical position with a sulfur cap of minimum thickness at least one day before being tested.

Cylinder and core testing shall conform to Standard ASTM Methods and may be performed by the manufacturer at his test facilities if approved by the Engineer. Otherwise, the manufacturer shall employ an independent testing laboratory for cylinder and core testing at no additional cost to the HRW. All other ASTM Standards, including but, not limited to the following, shall apply to elements and components of RCP as follows:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete

A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
C33 Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete

1. Joints for Concrete Pipe

Joints for concrete pipe shall be the bell and spigot type joint conforming to ASTM C443/C361 and the Bureau of Reclamation Type R -4 except as modified by these specifications with provisions for using a round rubber o-ring gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1 ½ degrees and 2 degrees. The diameters of the joint surfaces which compress the gasket shall not vary from the true diameters by more than 1/16th of an inch. Longitudinal reinforcement shall be continuous from end of spigot to end of bell and shall be expanded within the bell.

The round rubber o-ring gaskets shall conform to ASTM C443 except as otherwise specified herein. Gaskets shall be furnished by the supplier. The gasket manufacturer shall have the following tests performed by a qualified independent testing laboratory on the gaskets proposed for this project. Specimens of the gaskets shall be heated in a dry oven to 150 degrees F for 6-hours duration, and five specimens shall be tested by immersion, one each as follows: 72-hour immersion in saturated hydrogen sulfide solution, 72-hour immersion in 1 percent NaOH solution, 72-hour immersion in standard soap solution (80 percent alcohol), 72-hour immersion in 10 percent NaCl solution. Specimens of the gaskets shall be subjected to tensile tests of approximately 100 psi before and after immersion and heating tests and shall show an elongation of at least 25 percent. Upon release from the tensile tests, each specimen shall return to its original length. The specimens shall show no detrimental change in color, texture, or feeling upon completion of the above tests. The manufacturer shall supply test data and affidavits showing compliance with these requirements. Tests shall have been conducted within six months of the start of manufacture of the pipe.

The pipe and pipe joints shall be designed and manufactured so that the pipe and joints will withstand an external water pressure of 15 psi without leakage through the pipe wall or by the gasket. The pipe manufacturer shall provide facilities and factory test all pipe used in the Contract Work. Such tests shall be made by an internal vacuum as specified below. The Engineer and the HRW Utility Construction Inspector shall be notified for witnessing all tests.

Install sealed end caps/plugs fabricated with the specified joints and gaskets identical to those of the pipe. Connect a vacuum source with shut-off valve and vacuum gage.
Draw a vacuum of 7 inches of mercury (Hg) then shut off valve and disconnect vacuum source. Measure the length of time required for the vacuum to decrease from 7 to 5 inches of mercury (Hg). Times shall not be less than the following:

Minimum Time for 2 inches of mercury (Hg) pressure

decrease or drop in the pipe between manholes

Pipe Diameter (inches)	8 ft. pipe (min-sec)	12 ft. pipe (min-sec)
24	0:50	1:15
27	1:03	1:35
30	1:18	1:57
36	1:52	2:49
42	2:33	3:50
48	3:20	5:00
54	4:13	6:20
60	5:13	7:49

If the vacuum test fails, determine if the failure was a joint failure, or wall porosity failure. Mark the pipe and remove it to eliminate any possibility that the pipe will be shipped to the project site for any Contract Work. Correct product quality control to conform to all test requirements and standards. All pipe furnished shall be so tested and shall meet the test requirements. The pipe and ends of the pipe shall be made true to form and dimension. The manufacturer shall inspect and measure all pipe ends for out-of-roundness and square and shall mark his certification on the interior of the pipe. The manufacturer shall furnish the Engineer and the HRW Utility Construction Inspector upon request affidavits showing the results of these measurements and stating pipe meets the requirements of ASTM C76 and ASTM C443/C361 and these specifications.

2. RCP/DIP Adaptors: Ductile iron pipe (DIP) shall conform to these specifications for DIP and reinforced concrete pipe (RCP) shall conform to these specifications for RCP for gravity sewer pipe. Where concrete collars are to be poured around the DIP, the pipe shall be cleaned to bear metal by grinding, wire brushing or sandblasting. One-half (1/2") inch round studs are to be welded to the DIP at quarter points of pipe in center segment with wire one (1") inch minimum cover. DIP shall then be coated with concressive liquid Bonding Agent and allowed to cure in accordance with the ASTM Technical Bulletin.

WWF shall be shaped to proper Radius and lap welded. WWF shall be sized and shape to conform to ASTM specifications for the appropriate size and class of concrete pipe. WWF shall be held in place with WWF spacers not more than 18" apart circumferentially. Concrete shall be a minimum of 5000 psi.

3. Pipe Installation: Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe. Pipe shall not be dropped. All pipe shall be examined by the Contractor before laying, and installation. The Engineer and the HRW Utility Construction Inspector shall be notified of any defect. No piece shall be installed which is defective in any way unless authorized in writing by the Engineer and the HRW Engineer.

Any pipe damaged during transport or unloading at the site or during construction operations shall be immediately set aside and stored by the Contractor for inspection by the Engineer and the HRW Utility Construction Inspector. Any pipe damaged during manufacturing or shipping operations shall be immediately set aside and stored by the manufacturer for inspection by the Engineer and the HRW Utility Construction Inspector. If any damaged pipe is approved for repair, the pipe shall be repaired with epoxy mortar by the manufacturer and re-inspected by the Engineer and the HRW Utility Construction Inspector. If not approved for repair, the pipe shall be removed from the site and replaced by the manufacturer.
Excavation, bedding and backfill and other earthwork requirements shall be as specified in Chapter 6 construction of Sanitary Sewer Improvements. As soon as the excavation is completed as shown on the drawings and confirmed by a laser to the required sub grade elevation, the Contractor shall compact the sub grade, remove excess earth from the trench by hand, and place, grade, and compact the stone bedding material in the trench to a depth called for in these

specifications. There shall be no water observable in the trench bottom or bedding. Should water be present, all pipe installation shall immediately cease until dewatering of the site is improved to the extent that no water is present in the trench or the bedding material.

A depression shall be formed with hand tools in the compacted bedding material along the pipe to final bedding elevation and shall be contoured to match the curvature of the pipe for continuous support of at least the bottom 30 degrees of the pipe. The depression shall be slightly deeper at the joint to prevent bedding material from entering the bell and interfering with seating the spigot of the next pipe section and to provide space for installing the membrane collar and the grade checked by laser and adjusted as necessary, always providing full support of the bottom 30 degrees of the pipe. Blocking under the pipe will not be permitted. Before the pipe is lowered into the trench, the spigot and bell shall be clean and free from dirt. Gasket and bell shall be lubricated by a vegetable lubricant which is soluble in water and harmless to the rubber gasket. The pipe shall be properly aligned in the trench to avoid any possibility of contact with earth or bedding and fouling the bell, spigot, or gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home by an approved method. The preferred driving method shall be as follows: Pipe sections are driven home by using a section of pipe or other ramming device that will apply even pressure to a round section of forgiving material such as hard rubber or wood that covers the entire circumference of the spigot end of the pipe to avert damaging the ends of the pipe during installation. The maximum gap on the inside of the pipe shall be 0.05 foot. The maximum gap on the outside of the pipe shall be 0.10 foot.

As soon as the pipe is in place and its correct position is confirmed and bedding material is in place and compacted as indicated on the drawings for at least one-half the length of pipe. Each joint between every manhole section, catch basin or pipe joint shall be sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal.

The assembled joint shall be tested in accordance with ASTM C 1103 with a joint tester to verify the joint seal. If test indicates a improper seal, the pipe shall be removed, cleaned, remade, and retested until a good seal is achieved between pipe sections. Bedding material shall then be place and compacted to the required depth as shown on the drawings and the pipe backfilled in compacted layers of common fill as shown on the drawings, details and these specifications. The Contractor shall protect the installed pipe against the inflow of surface water against floatation until the work is completed, inspected and accepted by the HRW.

4. Leakage
All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated by in the Harnett Regional Water's General Conditions set forth per contract or within the one (1) year warranty period after approval shall be repaired by the contractor and at the expense of the contractor

6.3.2 Manhole Material

Manholes shall be constructed using pre-engineered, pre-cast reinforced concrete base sections, extended base sections, riser sections, cone sections to simplify field installation for all manholes installed in Harnett County. All manholes shall meet or exceed the ASTM standards and these specifications herein for the concrete, structural design, polypropylene reinforced steps, butyl-rubber mastic seal and wraps for water tightness. The pre-cast concrete sections that form the manhole assembly shall be designed to conform to the latest standards established by the North Carolina Department of Transportation (NCDOT) and to support the HS-25 loading for vehicular traffic. Manholes shall be manufactured utilizing wet cast concrete and cast-in style boots for each pipe entering the manholes. Manholes shall be provided by local manufacturers where practical and Harnett Regional Water approves the use of manholes manufactured by Stay Right, Carolina Precast or approved equal. The cast ring and cover assemblies shall be manufactured and supplied by domestic manufacturers and suppliers not foreign companies. Harnett Regional Water prefers to support local businesses and companies where practical. Foreign manufacturers and suppliers are not approved by the HRW for manhole ring and cover assemblies. Manholes may be formed and

poured on site if the completed concrete structure meets or exceed the structural integrity of the manholes assembled using the pre-engineered, pre-cast reinforced concrete base sections, extended base sections, riser sections, cone sections conforming to the following applicable ASTM standards:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
C33 Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
and Section 5.4.1 d above for reinforced concrete pipe (RCP).

Any work to construct manholes by forming and pouring on site shall be directly supervised by the Professional Engineer (P.E.).

Section 6.4 Manholes

6.4.1 Location

Manholes shall be installed and constructed at the prescribed stations and elevations per the project plan and profile as designed by the Professional Engineer (P.E.) using pre-fabricated, pre-formed concrete manhole barrel, cone and riser sections. Manholes shall be installed at the end of each line and at all intersections. Manholes shall not be installed at distances greater than 400 feet (121.92 m). Any plans that indicate the manholes are more than 400 feet apart should be identified during the pre-construction conference and the location of these manholes will be approved by the HRW in writing prior to construction. Otherwise the manholes should not be installed more than 400 feet apart. Manholes shall be installed square and plumb to be flush with the finished grade when installed in the streets, sidewalks, parking lots. Otherwise the manholes shall be installed square and plumb to an elevation at least two (2 ft.) feet above finished grade or at least two (2 ft.) feet above the 100 year flood plain. Cleanouts may be used only for sanitary sewer service laterals and special conditions approved by HRW. Cleanouts shall not be substituted for manholes nor installed at the end of laterals greater than 100 feet (45.72 m) in length.

6.4.2 Drop Pipe

A drop structure manhole may be installed in accordance with plans and profiles designed by the Professional Engineer (P.E.) and approved by the HRW Engineer. Drop structure manholes must be installed to satisfy these specifications and be constructed with manholes having a diameter of five (5 ft.) feet or greater for inside drops. Drop pipes shall be installed in such a manner to secure the inside drop pipe to the manhole wall without blocking

the access in or from the manhole invert. Inside drop connections must be secured with stainless steel straps and bolts. A drop pipe should be installed to keep the flow of wastewater directed toward the invert out without impeding the interior area more than necessary in order to allow room for future connections to the manhole.

Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches (61 cm), the invert of the transition should be filled to prevent solids deposition and the contractor shall cut a small cross section of eight (8) inch PVC pipe and imbed it in the invert slope by grouting it in place to form a PVC pipe slide in the transition area. All other areas surrounding the invert should be tapered to drain toward the invert out and the interior of the manhole shall be coated and sealed with coal tar epoxy, Flex-Seal Utility Sealant ™, Spectrashield Liner ™ or HRW approved equal as outlined herein these specifications and the plan details.

Drop structure manholes constructed with an outside drop connection shall require a manhole with a diameter of at least 48 inches or greater. Outside drop structure manholes shall incorporate a tee with a removable plug to allow the HRW Collections staff to clean the tee on a routine basis. Due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection shall be encased in concrete for all outside drop structure manholes. The HRW Utility Construction Inspector must inspect and approve all pipe work for a drop structure manhole prior to concrete encasement of the drop pipe.

6.4.3 Diameter

The minimum diameter of manholes shall be 48 inches (1.22m) larger diameters are preferable for large diameter sewers. A minimum access diameter of 24 inches (61 cm) shall be provided. Larger diameter manholes shall be required for all inside drop structure manholes and where sanitary sewer force mains discharge. Any deviations must be approved by the Professional Engineer and the HRW Engineer in writing before other manholes may be ordered, delivered or installed on the project site.

6.4.4 Flow Channel

The flow channel through manholes should be made to conform in shape and slope to that of the sewers. Change in direction of the channel shall not be less than 90o between the invert in and the invert out without prior approval of the HRW Engineer. The manhole flow channel shall be pre-formed by the manhole manufacturer where practical. Otherwise, the contractor may form the invert channel with brick and blocks being grouted in place. The contractor shall request the approval of the brick and block work prior to grouting the flow channel in the invert of the manhole if the flow channel is not constructed using a pre-formed channel from the manhole manufacturer. Adequate time shall be provided for curing grout work before scheduling the air/vacuum tests to avoid disturbing the invert flow channel.

6.4.5 Exterior Sealing for Water-Tightness

All manholes shall be waterproofed to prevent inflow and infiltration. The inlet and outlet pipes shall be joined to the manhole with a cast in place booted gasket and secured with stainless steel clamps. Manhole frame and covers shall be minimum 310 lbs. in weight and shall be cast from domestic foundries. Each joint between every manhole section shall be sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal. The seal shall be made of a stretchable, self-shrinking, intra-curing halogenated based rubber with a minimum thickness of 30 mils. The back side of each unit shall be coated with a cross-linked re-enforced butyl adhesive. The butyl adhesive shall be non-hardening sealant, with a minimum thickness of 30 mils. The seal shall be designed to stretch around the substrate then overlapped creating a cross-link and fused bond between the rubber and butyl adhesive. The application shall form a continuous rubber seal that applies inward pressure on the protected area for the life of the application. The butyl adhesive and the inward pressure exerted on the substrate will prevent the intrusion of water and soil through the joint sections of a manhole, catch basin or concrete pipe. External rubber sleeve shall be UV and Ozone resistant and it shall meet or exceed the following:

Sheer Strength shall be 20 psi minimum per ASTM test method D816
Tensile Strength shall be 50 psi minimum per ASTM test method D412
Elongation % shall be 500 % per ASTM test method D412
Penetration shall be 60/140 MM minimum per ASTM test method D217

Low temperature shall be -49° F flexibility per ASTM test method D746
Heat aging, the material shall be able to withstand 90°C for 7 days and be able to reach 300% elongation at break and have a minimum tensile strength of at least 100 psi.

6.4.6 Interior Sealing for Water-Tightness

A. No-Flow (HDPE) Manhole Inserts

A No-Flow, dish type insert shall be installed in the top of each manhole that is installed within a paved street, driveway, parking lot, concrete sidewalk or any other impervious surface when the manhole cover will be flush with the finished grade and located at the lowest point in the project where the potential for inflow is the greatest. The dish inserts shall be constructed of an ultra high density polyethylene copolymer material that meets ASTM Standard D1248, Class A, Category 5, Type III with a minimum impact brittleness temperature of less than -131°F. The thickness shall be uniform 1/8" or greater. The material shall be corrosion proof from all gases associated with waste water collection systems and the inserts will include the following:

1. Lift Strap – The lift strap shall be made of a woven polypropylene web material attached to the bowl of the dish by a wide head stainless steel rivet with a stainless steel backup washer ¾" in diameter. All cut edges shall be seared to prevent unraveling.

2. Vent – ventilation shall be provided by a 1/8" hole and/or a valve located on the side of the bowl. The hole or the valve shall allow a maximum release of 10 gallons of water per 24 hours and shall not be affected by debris that can collect at the bottom of the dish. Sewer gases shall be vented at one (1 psi) pound per square inch or less.

3. Density – The density shall be at least fifty-nine (59 lbs. /ft3) pounds per cubic foot and conforming to ASTM D1505.

4. Tensile Strength – The tensile strength shall be 3,600 psi and conforming to ASTM D638 Type IV.

5. Brittleness Temperature – The brittleness temperature shall be greater than or equal to -131°F and conforming to ASTM D1505.

B. Internal Manhole Seals

Manhole seal shall be designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. Extensions shall include but is not limited to lifting rings, brick and/or block material that may have been used to achieve grade. The seal shall remain flexible allowing for the repeated vertical or horizontal movements of the frame due to frost lift, ground movement or the thermal movement of pavements. The final liner material shall be made no less than 170 mils of corrosion resistant aromatic flexible urethane resin coating to be applied to the inside wall of the entire chimney area as described above. The product shall have a minimum elongation of 800% and hardness (Durometer) of 75. Final liner shall have a minimum tensile and adhesion strengths of 1150 psi and 175 lb. l/in. respectively. The manhole sealing system shall conform to the physical requirements of ASTM D- 412. The lining product shall have an aromatic urethane primer resin on the complete surface. The sealing system shall line the interior of the adjustment area from the cone/top of the manhole and onto the inside of the casting. If the manhole has been relined prior to the seal installation the seal shall cover a minimum of 12 vertical inches or a minimum of 1 kit.

All loose and protruding mortar and brick that would interfere with the seal's performance shall be removed. Any lips for gravel pan supports shall be cut off flush with casting. Patching cement shall conform to requirements of the manufacture. Any profiling cement work will require the contractor to contact the sealant manufacture to determine in writing the proper time required for the cement to

completely cure prior to installing this item. Preparation of the surface should include sandblasting (minimum of 70CFM) and an acetone wet wipe to ensure a clean surface as required by manufacture. Active leaks (infiltration) must be corrected by a method approved by the HRW Engineer prior to installing an Internal Manhole Seal. The substrate surface must be free of sand, loose debris, latencies, dust, oil, grease or chemical contamination. A blower or torch may be required to completely dry the substrate surface or as recommended by the manufacturer. Flex-Seal Utility Sealant or approved equal may require the proper mixing of agents, as recommended by the manufacturer's instructions. Ensure casting and structure surfaces are clean and dry where the primer is intended to adhere. After allowing for proper drying of primer to occur, sealant may be applied by brush as evenly as possible over the entire chimney area that includes the frame joint area and the area above the manhole cone including all extensions to the chimney area. The contractor is to furnish the HRW Utility Construction Inspector Engineer two (2) mirrors with extension handles that can be used to inspect sealant application to areas underneath frame without entry of manhole. These items will become the property of HRW upon completion and at no additional cost of this item. Cost for these items shall be included in the bid items for internal manhole sealing work.

6.4.7 Interior Coating for Manholes Receiving Wastewater Discharge from a Force Main

Where force mains are discharged to manholes, such manhole interior shall be adequately protected with a HRW approved coating to prevent hydrogen sulfide damage. The interior coating shall be either coal tar epoxy, Flex-Seal Utility Sealant ™, Spectrashield Liner ™ or HRW approved equal. The Spectrashield Liner ™ must be applied by the manufacturer's authorized representative due to the trademark rights, proprietary, legal and quality control reasons due to the special heat application equipment. The Flex-Seal Utility Sealant manufactured by Sealing Systems, Inc. may be applied by any competent contractor once certified by the manufacturer and the sealant must be applied at ambient temperatures at 45° F or higher with minimal humidity in the atmosphere for ideal application conditions. The sealant must be applied by brush to achieve a sealant layer of at least 170 mils thick. The manufacture must in writing certify that each of the contractor's representatives are approved to install Flex-Seal Utility Sealant or approved equal for this item. The training shall be included in the bid items for internal manhole seals. The appropriate certification by the manufacturer must be provided for each contractor that will apply the sealant to the manholes. The contractor shall submit shop drawings in accordance with the General Contract Conditions. The manufacturer's specifications for the materials and method for proposed installation of this item shall be submitted to the HRW Engineer for the approval before internal sealing work commences.

6.4.8 Paved and Unpaved Roads

When manholes are placed in unpaved roads, the top of the manhole shall be 4 inches below grade of the road and constructed in order that the manhole may be lowered 6 inches by including a riser section above the cone section and below the ring and cover. The riser section may be removed and replaced with a different riser section in the future to adjust the manhole rim elevation to the finished grade of the road should it be paved in the future.

6.4.9 Final Adjustment to Finished Grade with Rubber Riser Rings

Foe manholes located in the paved streets and parking lots subject to vehicular traffic, rubber riser ring sections shall be located between the cone section of the manhole and the cast ring and cover assembly and it shall be bolted down through the ring into the last concrete riser section. The rubber riser will reduce vibration from the vehicular traffic and will protect the structural integrity of the manhole assembly below the finished grade of the street.

When manholes are placed in paved roads, the top of the manhole shall be installed to be flush with the finished grade of the street including the rubber riser ring that can vary from ½ inch to 3 inches. During construction process the top of the cone section of the manhole shall have at least 48 square inches of concrete poured around it to keep it stable prior to paving the street or parking lot. This will keep the structure in placed should the paving contractor bump the top of the manholes ring and cover. The concrete shall be formed and poured to at least six (6") inches below finished grade of the road. The concrete poured in the form around the top of the riser section shall be rated for at least 3,000 psi or greater. Manholes shall be adjusted to finished grade using Infi-Shield Uni-Band manhole adjustment rings or approved equal. The Uni-Band seal manhole sealing system shall be installed to prevent leakage of water into the manhole through the frame joint area and through the adjustment ring area. All sealing materials

required for the installation of the Uni-Band manhole sealing system shall be furnished by the contractor and shall be new, of first grade, and shall be of reputable domestic manufacturers. The frame or ring casting shall be sealed to the concrete manhole structure with a Uni-Band sealing system as manufactured by Sealing Systems, Inc. or approved equal. The seal shall be a continuous seamless band made of high quality EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils. There shall be a preformed L shaped corner molded into the top of the seal. The top section and the side section will extend from the L shaped corner at a generally 90-degree angle to each other. Wherein the seal is pre-formed in substantially the same shape as when attached to the manhole structure, the thickness of the L shaped corner extending 1" into the top section and 1" down the side 89 section is increased and may be at least twice the thickness of the top section reinforcing the seal at this particular area. There shall be a 2" to 3" wide strip of butyl mastic attached to the underside of top section of the seal. There shall be a 2" wide strip of butyl mastic attached to the inside of the side section at the bottom of the seal. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 1/8", and shall seal to the cone/top of the manhole section and over the flange of the casting frame. An aerosol primer shall be used to enhance the bond strength of the seal to the structure. The Uni-Band seal sealing system shall be installed according to the manufacturer's recommendations. The top section of the seal shall extend up from ½" to 3" (in ½" sections) attaching to the casting base/flange with the side section covering over the entire grade adjustment ring area and onto the cone section a minimum of two (2") inches.

6.4.10 Main Line Location

In both public and private road right-of-ways, main line sewers shall be located in accordance with the HRW specification and NCDOT standards. A minimum permanent easement width of 20' shall be provided where it is necessary to install main line sewer outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels.

6.4.11 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the standards established by North Carolina Department of Transportation (NCDOT). Under no circumstances shall open cuts in the existing state maintained roadways remain unpaved or patched in keeping with highway standards for more than 2 days. Failure on the part of the contractor to take adequate action on patching will force Harnett Regional Water to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs as required by the NCDOT.

Section 6.5 Access

Access steps shall be provided in all manholes, concrete vaults and concrete structures. The access step shall be so located to be easily reached by the HRW staff for simple means of entry. Steps shall be of a non-corrosive material such as polypropylene per HRW Standard details. The manhole ring and cover shall not be less than 24" in diameter to provide adequate room for access to the manhole interior. The distance from the finished grade to the first step shall not exceed 24 inches.

Section 6.6 Pipe Connections to Existing Manhole

Pipe connections to existing manholes shall be made in such a manner that the finished work will conform as nearly as practical to the essential requirements specified for new manholes, including all necessary concrete work, cutting and shaping. The connection shall be at a right angle target (centered) to the manhole. Holes for the new pipe shall be large enough to facilitate a Harnett Regional Water approved rubberized water stop and allow packing cement mortar around the entire periphery of the pipe but no larger than 1-1/2 times the diameter of the pipe. No manhole may be core drilled until a representative of HRW may be present to witness the drilling operation, pipe installation and sealing of the new opening in the manhole wall. All openings of existing manholes shall be properly sealed once the new sewer pipe has been installed to grade and fit position within the manhole structure.

Section 6.7 Sanitary Sewer Service Laterals

6.7.1 Residential Sewer Service Lateral Connections

A. Materials

4" Polyvinyl Chloride (PVC) - All pipe fittings shall conform to latest edition ASTM D 1785, Schedule 40.

6" Polyvinyl Chloride (PVC) - All pipe and fittings shall conform to latest edition ASTM D 3034, SDR 35.

B. Clean Out Location

Residential sanitary sewer service laterals shall not be less than four (4") inches or greater than six (6") inches (Polyvinyl Chloride ASTM D 3034). A clean out sized to match the sanitary sewer lateral shall be provided as specified in the project plans to be positioned within one (1 ft.) foot inside the right-of-way or utility easement. The cleanout cap shall be bronze, ductile or cast iron with an 18" x 18" x 4 or an 18" x 18" x 6" concrete collar to protect the clean out. The concrete collar shall be installed to finished grade and the clean out cap shall be between 1"-2" below the top of the concrete collar. This cleanout establishes the point of termination for maintenance responsibility by Harnett Regional Water. In case of easements, a terminal cleanout shall be provided not greater than 10 feet from center line of sanitary sewer main. All sanitary sewer clean outs shall be designed to be positioned at least one (1 ft.) foot inside the right-of-way or utility easement. The cleanout stack shall be designed to be at least two (2 ft.) feet above finished grade and capped with a temporary cap until the plumber can make the connection to the building and lower the clean out to the finished grade. . No sanitary sewer service lateral shall be connected to any manhole unless approved by the HRW in writing.

Field Measurements: The contractor shall keep a log of field measurements while the sewer main and laterals are installed to measure the following distances:

- The distance L-1between the downstream manhole and the in-line wye fitting for each residential sanitary sewer service lateral,

- The distance L-2between the in-line wye fitting on the sanitary sewer main to the sanitary sewer clean out for each residential sanitary sewer service lateral,

These measurements must be provided to the Professional Engineer (P.E.) at the conclusion of the project to be documented in the As-Built Record Drawings to be provided to the HRW Engineer.

6.7.2 Grease Traps

All grease traps shall be installed in accordance with the project plans and profiles as designed by the Professional Engineer (P.E.) and approved by the HRW. The contractor shall notify the HRW Utility Construction Inspector and the HRW Pretreatment Coordinator of the scheduled installation date at least 24 hours in advance of installation to allow the HRW staff an opportunity to inspect the grease trap prior to installation. All grease traps shall be manufactured in conformance ASTM standards, including but, not limited to the elements and components of reinforced concrete structures as follows:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
C33 Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete

Section 6.8 Easements

In all cases where it is necessary to construct sewer mains crossing private property, an easement designated specifically for the construction, operation and maintenance of water/sewer improvements shall be dedicated exclusively to the County of Harnett. Dimensions of the easement shall be in keeping with the herein stated separation requirements. A minimum permanent easement width of 20" shall be provided where it is necessary to install a sanitary sewer main outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways or commercial areas, the easement shall be at least 30 feet wide to include a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels.

All construction shall be kept within the temporary construction easement outlined in the plans designed by the Professional Engineer (P.E.) and as staked out by the Registered Land Surveyor (R.L.S.). All easements must be graded to finished grade in accordance with the plans and profiles. The easements must be seeded and covered with straw or tacked down to establish vegetative growth over the entire easement before the construction project ends. If the vegetative growth has not been established as required the contractor shall repeat the seeding process again until the vegetative growth is established at no additional cost to the HRW.

Section 6.9 Protection of Water Supplies

6.9.1 Water Supply Interconnections

The contractor shall not make any physical connections between a public or private potable water supply system and a sewer or other non-potable water source (irrigation), or appurtenance which would permit the passage of any sewage or polluted water into the potable water supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

6.9.2 Relation to Water Works Structures

A. Horizontal and Vertical Separations

The Contractor shall install the sanitary sewer improvements in accordance with plans and profiles as designed by the Professional Engineer (P.E.) maintaining the proper horizontal and vertical separations outlined in these specifications under Section 5.4 and as approved by the HRW Utility Construction Inspector. The sanitary sewer lines shall be laid at least 10 feet (3.0m) horizontally and at least 24 inches (61 cm) vertically from any existing or proposed potable water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, Harnett Regional Water may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to the water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so that the bottom of the water main is at least 18 inches (46 cm) above the top of the sewer and both water and sewer main are constructed of

ferrous pipe materials. The Engineer shall provide additional details for such installation in addition to the HRW Standard Details.

B. Crossings

Sanitary sewer lines crossing potable water mains shall be laid to provide a minimum vertical distance of 24 inches (61 cm) between the bottom (outside) of the water main pipe above the top (outside) of the sanitary sewer main. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water joints, preferably ten (10ft.) feet from the center of the crossing. In cases where it is not practical to maintain a vertical distance of 24 inches (61 cm) separation, Harnett Regional Water may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to the water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so that the bottom of the water main is at least 24 inches (61 cm) above the top of the sewer and both water and sewer main are constructed of ferrous pipe materials. The Engineer shall provide additional details for such installation in addition to the HRW Standard Details.

C. Special Conditions

When it is impossible to install the sanitary sewer lines with the proper horizontal and vertical separations as stipulated above, the sanitary sewer shall be constructed of ferrous pipe materials equal to the water pipe and shall be pressure tested to assure water-tightness prior to backfilling. Where these separations cannot be maintained then the sanitary sewer main and the potable water main shall be installed with ductile iron pipe and the minimum vertical separation of eighteen (18") shall be maintained at the crossing or a minimum of five feet shall be maintained horizontally.

Section 6.10 Pipe Installation Standards and Procedures

6.10.1 Standards

Installation specifications shall contain appropriate requirements based on the criteria, standards and requirements established by industry in its technical publications. Requirements shall be set forth in the specifications for the pipe and methods of bedding and back filling thereof so as not to damage the pipe or its joints, impede cleaning and future tapping nor create excessive side fill pressures or ovulation of the pipe, nor seriously impair flow capacity.

6.10.2 Trenching

A. The width of the trench shall be ample to allow the pipe to be laid and jointed properly and to allow the backfill to be placed and compacted as needed to adequately support the pipe. The trench sides shall be kept as nearly vertical as possible. When wider trenches are dug, appropriate bedding class and pipe strength shall be used.

B. Boulders, large stones, and other large materials shall be removed to provide a minimum clearance of 12 inches (30 cm) below and on each side of all pipe(s).

C. All organic material shall be removed from the sub base of the trench.

6.10.3 Bedding

A. Bedding classes A, B, or C, as described in ASTM C1274 (ANSI A 106.2) or WPCF MOP NO. 9 (ASCE MOP NO 37) shall be used for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load.

B. Bedding Class I, 1/4 inch to 1-1/2 inch graded stone bedding, as described in ASTM D 2321 (ANSI K 65.171) shall be used for all flexible pipe will be installed in bedding placed four (4) inches below the pipe barrel and brought up to the top of the pipe. Class I, II, or III materials will

be used for initial backfill up to six (6) inches above the top of the pipe over the full width of the trench.

6.10.4 Backfill

A. Backfill shall be of suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or, other unstable material shall not be used for backfill. Backfill will be hand tamped or pneumatically tamped to twenty-four (24) inches above the top of the pipe. Backfill to the top of ground will be in eight (8) inch loose thickness lifts compacted. Compaction density shall be a minimum of 95% standard proctor under all paved areas and 90% standard proctor in all other areas. Compaction testing as approved by the HRW shall be provided in all paved areas.

B. Backfill shall be placed in such a manner as not to disturb the alignment of the pipe. Any pipe displaced or broken during backfilling or compaction will be replaced.

6.10.5 Deflection Test

A. Deflection tests shall be performed on all pipe (100%). The test shall be conducted after the final backfill has been in place at least 15 days. The mandrel and proving ring will be furnished by the contractor.

B. No pipe shall exceed a deflection of 5%, calculated by using the base inside diameter as furnished by ASTM.

C. If the deflection test is to be run using a rigid ball or mandrel, it shall have a diameter equal to 95% of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices. The contractor is responsible for providing mandrel and associated equipment at the time of inspection. The latest applicable ASTM standard for the mandrel shall be used by the contractor. 93

Section 6.11 Joints and Infiltration

6.11.1 Joints

The installation of joints and the materials used shall be included in the specifications. Sewer joints shall be installed to minimize infiltration (100 gpd/inch diameter of pipe/mile or less) and to prevent the entrance of roots throughout the life of the system. Junctions of dissimilar pipes or junctions requiring some form of rubberized banding material shall be totally encased with a minimum of 6" of concrete surrounding the junction for a distance of 2' either side of the end of the banding material.

6.11.2 Leakage Tests

Leakage tests shall be required for all main line sewers and shall include installed services. Such tests shall be by the low pressure air testing method. The air test shall, at a minimum, conform to the test procedure described in the last edition of ASTM. The testing methods selected should take into consideration the range in groundwater elevations projected and the situation during the test.

6.11.3 Inspection

The specifications shall include a requirement for inspection of manholes for water-tightness prior to placing into service. Prior to inspection, all lines must be flushed and cleaned.

Section 6.12 Flushing and Cleaning

Flushing and cleaning shall be the responsibility of the contractor. The contractor shall pump dry and dispose of all extraneous ground water and other sand, gravel and foreign objects within the sewer main. Such material shall not

be flushed into the existing operating sewer mains, pump stations, or pertinent facilities. Flushing of main line sewers under construction into main lines of Harnett Regional Water is prohibited. Water for flushing and cleaning, as herein referenced, shall be provided by the HRW upon payment of appropriate fees for the installation of a fire hydrant meter in keeping with HRW established standards, rates and regulations to meter all water usage. The water used for road construction must be kept separate from the water used in the construction, cleaning, flushing and of the sanitary sewer system improvements for billing purposes.

Section 6.13 Main Line Location

In both public and private road right-of-ways, main line sewers shall be located in accordance with the HRW. A minimum permanent easement width of 20' shall be provided where it is necessary to install main line sewer outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels.

Section 6.14 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the standards established by North Carolina Department of Transportation (NCDOT). Under no circumstances shall open cuts in the existing state maintained roadways remain unpaved or patched in keeping with highway standards for more than 2 days. Failure on the part of the contractor to take adequate action on patching will force Harnett Regional Water to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs.

Section 6.15 Aerial Crossings

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. For aerial stream crossings, the bottom of the pipe should be placed no lower than the elevation of the 100-year flood plain per the plans and profiles designed by the Professional Engineer (P.E.). The P.E. shall specify any and all special fittings, hangers, brackets, or supports that may be required for the aerial crossing and provide details of such special fittings, hangers, brackets, or supports in the project plans. 94

Please see Chapter 12, General and Special Conditions, Section Special Construction Technical Specifications for additional information and requirements for construction.

CHAPTER 7

DESIGN OF SEWAGE PUMPING STATIONS

REQUIREMENTS

Chapter 7 DESIGN OF SEWAGE PUMPING STATIONS- REQUIREMENTS

Section 7.1 Design and Minimum Requirements for Sanitary Sewer Lift Stations

7.1.1 Sanitary Sewer Lift Station Design Standards

All engineering plans and profiles of public sanitary sewer lift stations and any associated or proposed system improvements to Harnett Regional Water's sanitary sewer collection systems shall be designed by a Professional Engineer (P.E.) in accordance with industry recognized standards to conform with all applicable rules and regulations established by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR –DWQ) under the Administrative Code Section 15A NCAC 2T - Waste Not Discharged to Surface Waters (EFFECTIVE September 1, 2006) , the standard specifications and details of the HRW as outlined herein this section. All engineering plans and profiles of proposed public and/or private projects, that involve improvements to the Harnett Regional Water's sanitary sewer system, shall be permitted by the NCDENR – DWQ prior to any construction of the proposed improvements. The Professional Engineer (P.E.) shall submit the design plans and profiles of the sanitary sewer system improvements to the HRW Engineer for review and approval prior to the submission of any permit application to the NCDENR – DWQ. The design plans and profiles shall include the following information:

A. pump model number, pump size (HP), pump operating speed (RPM) and pump head rating (feet) for each pump to be installed with any sewer lift station,

B. the pump curve for each pump to be installed with any sewer lift station,

C. the station power requirements showing the voltage and amperage rating for each pump to be installed with any sewer lift station (Note HRW prefers each pump station to be supplied with 480/277 volts unless otherwise approved in writing by the HRW Engineer),

D. wet well diameter (feet) and depth (feet),

E. the electric pump hoist rating (HP) and JIB crane with a boom sized long enough to reach across the wet well to remove and re-install the pumps,

F. the overall sewer lift station layout including the control panel, SCADA panel, the wet well, the generator, valve vault, meter vault, station fencing, odor control and sampling equipment.

G. the topographic lines, existing grade and the proposed finished grade upon project completion,

H. the HRW sanitary sewer details in accordance with these specifications,

I. the erosion control plans and associated details.

7.1.2 Sewer Lift Station Design Capacity

In general, a Professional Engineer (P.E.) shall design any and all sanitary sewer lift stations in accordance with industry recognized standards and conform to the state minimum design rules indicated above and these specifications. The sanitary sewer lift station capacities shall be designed for the estimated ultimate tributary population, except in considering parts of the systems that can be readily increased in capacity. Similarly, consideration shall be given to the maximum anticipated capacity of institutions, industrial parks, shopping centers, other nearby subdivisions and completed build out of the project where the sewer lift station is to be located as determined by Harnett Regional Water's Master Sewer Plan. In determining the required capacities of sanitary sewer lift station(s), the following factors should be considered:

A. Maximum hourly domestic sewage flow;

B. Pump station capacities and interceptor sewers from point of discharge to the treatment works;

C. Inflow and groundwater infiltration;

D. Topography of area;

E. Location of sewage treatment plant;

F. Depth of excavation; and

G. Pumping requirements.

The basis of design for all projects that include a sanitary sewer lift station shall incorporate the size and site of any such sewer lift station necessary to convey wastewater to the nearest publicly-owned treatment works (POTW) facility owned and operated by the HRW. The Professional Engineer (P.E.) shall provide the HRW Engineer with a set of detailed computations and calculations to demonstrate how the pumps and associated wet well for any sanitary sewer lift station have been sized and specified for any project which requires as sewer lift station. The HRW Master Sewer Plan shall be the guiding document for all sanitary sewer improvements and the developer/owner shall abide by the pipe sizes, grades, locations and capacities as determined by the HRW and outlined in the HRW Master Sewer Plan.

7.1.3 Sewer Lift Station Minimum Requirements

The basis of design for all projects that include a sanitary sewer lift station shall incorporate the size and site of any such sewer lift station necessary to convey wastewater to the nearest publicly-owned treatment works (POTW) facility owned and operated by the HRW. The Professional Engineer (P.E.) shall provide the HRW Engineer with a set of detailed computations and calculations to demonstrate how the pumps and associated wet well for any sanitary sewer lift station have been sized and specified for any project which requires as sewer lift station. The HRW Master Sewer Plan shall be the guiding document for all sanitary sewer improvements and the developer/owner shall abide by the pipe sizes, grades, locations and capacities as determined by the HRW and outlined in the HRW Master Sewer Plan.

A. The following minimum requirements, standards, and specifications established by the HRW shall apply to all sewer lift stations constructed after August 2009 and these minimum requirements shall be included with the Utility Notes on all plans:

1. Three (3) phase (480 volts) power must be provided for each sewer lift station. Exceptions must be approved in writing by the HRW Engineer or the HRW Director in advance of the installation of any equipment at any new sewer lift station.

2. Multiple pumps (minimum of 2) each capable of pumping at a rate 2.5 times the average daily flow rate with any one pump out of service. Pump-On/Pump-Off elevations shall be set such that 2-8 pumping cycles per hour may be achieved in the sewer lift station under the average flow rate condition.

3. At least two (2) ground fault circuit interrupter (GFCI) receptacles rated for 110-120VAC shall be installed near the main control panel for each sewer lift station. One GFCI receptacle shall be located on each end of the control panel hood assembly and each one shall be provide with a while-in-use cover.

4. One (1) NEMA 4/4X stainless steel electrical control cabinet with minimum cabinet dimensions of thirty (30") inches width x of thirty (30") inches length x ten (10") inches depth shall be provided for the station pumps. Space should be left under the control panel hood assembly to add another NEMA 4/4X stainless steel electrical control cabinet with minimum cabinet dimensions of thirty (30") inches width x of thirty (30") inches length x ten (10") inches depth shall be provided for the SCADA system to be installed

by HRW. The power (voltage and amps) rating for each control panel shall be labeled on the outside of the station pump control panel, the generator panel, automatic transfer switch (ATS) and disconnect panels with block letters and numbers at least three (3") inches tall. The block letters and numbers should be permanently mounted to the electrical panels and the use of adhesive type (peel & stick) letters and numbers will not be approved by HRW.

5. Gas/liquid barrier junction box or cable support for all cabling that enters the wet well with cord grip type unions. The junction box should be mounted near the top of the wet well with and open raceway providing an air gap above the wet well penetration to the junction box allowing methane and sewer gases to escape between the wet well and the junction box such that all sewer gases from the wet well are prevented from entering the control panel(s).

6. Spare one (1") inch (minimum) conduit with an air gap from the RTU cabinet area to the liquid tight junction box of low voltage signal wire entry into the wet well.

7. Dry contact terminal strip shall be installed to provide SCADA connections for:

a. Pump run indication – Auxiliary contacts from pump motor starters.
b. High level alarm
c. Pump HOA (Hand or Automatic) switch in auto position (contacts on the HOA switches)
d. Pump seal failure and/or priming failure
e. Motor over temperatures
f. Motor overloads
g. Lag pump start
h. Three phase power failure or "single phasing"
i. Circuit breaker tripped or control power failure

8. For totally enclosed lift stations (i.e. Gorman Rupp and Smith & Loveless), provisions must be provided to connect RTU conduit to the motor control cabinet. One (1¼") NPT hole and one (1") inch hole will suffice. Totally enclosed sewer lift stations shall be provided with forced air ventilation and damper vents to reduce heat during the summer months and a heat source (light, heat strip, heat tape, etc.) to avoid freezing during the winter months.

9. Inline control circuit phase failure relays with spare contacts for SCADA monitoring.

10. 100-watt heat strip for moisture and temperature control of the cabinet environment.

11. Each pump installed in conjunction with the sewer lift station shall be equipped with run time meters or hour meters.

12. Each sewer lift station shall have a visible alarm light and an audible alarm horn to signal high level warnings.

13. A stainless steel or aluminum hooded control station must be provided. See the HRW Standard Sewer Details or contact the HRW Engineer for a fabrication guide.

14. All materials and construction shall comply with Standards and Specifications of Harnett Regional Water.

15. The sanitary sewer force main leaving the sewer lift station shall be installed with 12 gauge, insulated, solid copper conductor, tracer wire from the gate valves and/or check valves to the point of discharge manhole. The gate valves and check valves shall be

located in a concrete valve vault with minimum dimensions of four (4") feet width x three (3") feet depth x six (6") feet length near the wet well to meet minimum requirements of the HRW Standards and Specifications. The valve vault shall remain accessible for maintenance and repairs with a positive head for drainage having an aluminum, locking type (Bilco) hatch or approved equal at least thirty (30") inches width x forty-eight (48) inches length.

16. Each sewer lift station must have an approved flow meter rated for sewer service (SCADA ready) installed in a separate concrete vault beside the valve vault with minimum dimensions of four (4") feet width x three (3") feet depth x six (6") feet length. The flow meter should be an EMCO ultrasonic flow meter or approved equal with external transducers clamped onto the outside of the force main. The EMCO ultrasonic flow meter should be equipped with SCADA-Ready 4-20 mA I/O ports and have a cable extended to a remote readout display mounted near the control panel. The flow meter vault shall remain accessible for maintenance and repairs with a positive head for drainage and an aluminum, locking type (Bilco) hatch or approved equal at least thirty (30") inches width x forty-eight (48) inches length.

17. Each sewer lift station shall have potable water service on site consisting of at least one (1) yard hydrant installed during the construction of the project. The yard hydrant shall meet minimum requirements of the HRW Standards and Specifications and this water service should be equipped with an above ground RPZ installed inside a weatherproof housing.

18. Each lift station and pump station shall have an emergency pump connection on the force main with an associated shut-off valve to meet minimum requirements of the HRW Standards and Specifications. The force main(s) shall be at least four (4") inches in diameter unless otherwise approved by the HRW.

19. The wet well for each sewer lift station must be constructed of concrete lined with a protective coating and equipped with a maintenance manhole and/or associated bar screen to meet minimum requirements of the HRW Standards and Specifications. The joints between the prefabricated wet well sections shall be sealed externally with sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal as outlined in Section 5.5.6 of these specifications.

20. Each sewer lift station shall have an emergency generator sized to handle at least 2.5 times the rated electrical load for the entire sewer lift station that shall be mounted upon a concrete pad. In addition the emergency generator should be provided with an automatic transfer switch. An external connector plug sized to handle the output of an emergency generator as outlined above as a minimum requirement on all temporary sewer lift stations as pre-approved by the HRW. An alternative would be to provide HRW with a diesel driven emergency pump rated to handle at least 2.5 times the rated peak flow for the entire sewer lift station.

21. The emergency standby generator shall include a dry contact terminal strip for SCADA connections to monitor:

a. Generator in Automatic Mode
b. Generator Running
c. Common Engine Failure
d. Low Fuel Level and Fuel leak Detection
e. Low and High Water Temperature
f. Low Oil Pressure

22. Each sewer lift station shall be surrounded by security fencing at least six (6") high with twelve (16") feet wide double swinging gate comprised of two - eight (8 ft.) feet wide sections for vehicular traffic and one - three (3 ft.) wide single swinging gate for a personnel entrance. The security fencing installed around the sewer lift station shall be 50 ft. x 50 ft. as a standard area unless the station has pumps greater than 50 hp then the station shall have a 60 ft. x 60 ft. area unless otherwise approved by the HRW Engineer.

23. Each sewer lift station shall be provided with a SCADA pole, a SCADA antenna and associated telemetry to meet minimum requirements of the HRW Standards and Specifications. HRW will install the SCADA system and invoice the developer for the SCADA Fees to cover the equipment and installation costs.

24. Each sewer lift station shall be provided an area security light (mercury vapor bulb) with photocell control. The weather hood over the control panel should include the installation of a fluorescent light fixture with a zero (0°) degree ballast above the control panel mounted far enough from the control panel to allow for full opening of the panel door without obstruction.

25. Each sewer lift station shall have an access road that is properly graded for adequate storm water run-off and at least twenty (20ft.) feet wide. The access road must be paved if the grade is more than 10 % but, it shall have at least six (6") inches of # 57 (crush and run) stone. The developer must provide the HRW a permanent easement for the sewer lift station and associated access road.

26. All bolts, mounting brackets, pump lift chains, etc., shall be stainless steel or manufactured of an approved material with proper corrosion resistance and properly sized and mounted to provide proper support for the applicable loads.

27. All wiring and electrical work shall conform to the latest revised National Electrical Code (NEC) and local guidelines. All wiring shall be identified at each termination on both ends.

28. New installations are required to meet the latest revised OSHA standards at the time of final acceptance. The contractor shall provide and install all site specific OSHA required labels and signs for the sewer lift station equipment. The hatch opening of the wet well shall be provided with a webbing or net to provide fall protection. The webbing or net shall be secured by hooks and reinforced grommets in the webbing or net.

29. The sewer lift station shall be located two (2") feet above the 100-year flood elevation and the 100-year flood elevations should be shown on the plans and As-Built record Drawings. The site for the sewer lift station must be provided with adequate means for drainage of storm water runoff whereby the station site will not be flooded during significant rain events of more than 2" inches of rainfall. The entire site shall be provided with weed blocking material below gravel for adequate drainage inside the station. The gravel shall be ABC washed stone installed at least six (6") inches thick on top of the weed block material.

30. Site visits by the HRW Utility Construction Inspector will be required and scheduled for the following actions:

a. Before final plan approval,
b. Pressure testing the force main
c. When pumps are set,
d. Pump draw down testing,
e. Generator startup testing,
f. Final Inspection of all sewer lift station equipment and when flow is applied.

Final start up testing shall be coordinated with the Design Engineer, the HRW Engineer, the OEM Pump Manufacturer Representative, OEM Generator Manufacturer Representative, the HRW SCADA Supervisor and the HRW Collections System Supervisor. Final start up testing shall include Items D & E above at a minimum. The flow meter shall be calibrated prior to the HRW final acceptance of the sewer lift station.

31The manufacturer is to furnish all recommended spare parts including, at a minimum, two sets of mechanical seals, o-rings, gaskets, and wear rings. Each pump shall be provided with an extra full size impeller in addition to other spare parts recommended by the pump manufacturer. The spare parts shall be provided by start-up date. Spare parts shall be provided in original packaging in factory new condition. In addition to the spare pump assembly, the contractor shall furnish to the HRW one complete set of spare parts for the electric generator including: an air filter, an oil filter, and a fuel filter along with one spare set of accessory belts if applicable. An emergency pump connection shall be designed with a tee, a gate valve and quick connect nozzle for the emergency pump connection between the valve vault and the flow meter vault.

32. The contractor shall provide HRW with at least three (3) sets of OEM operating and maintenance manuals for all equipment. The manuals must be original as provided by the manufacturer and bound. Spare parts as required by HRW shall be boxed for long term storage with part numbers and identification labels. Items subject to handling damage will not be accepted if the factory packaging has been opened. All manuals and spare parts are to be turned over to HRW at final inspection and acceptance of the pump station.

33. The generator must have a mezzanine or catwalk around it to provide adequate access to service, inspect and test the unit. If the doors on the enclosure cannot be opened and removed to service the unit without a ladder or lift then the contractor must construct a mezzanine or catwalk around it to provide adequate access. Generally, when the access door panels are more than two (2") feet above finish grade or the concrete pad then a mezzanine or catwalk will be required by the HRW.

34. The sewer lift station must be provided with a JIB crane, boom and electric hoist to remove and replace the pumps when the pumps are larger than 25 hp. The boom must extend at least twelve (12") feet from the edge of the wet well and be able to lift the pump at least six (6") feet off the ground in order to allow a pump to be loaded into the bed of a service truck. A JIB crane that rotates 360° will be required for pumps greater than 60 hp.

35. The sewer lift station must be provided with a tee and two valves between the flow meter vault and the valve vault in order to accommodate the quick connection of a diesel driven pump. Diesel driven pumps may be used to replace the emergency generator if approved by the HRW in advance and permitted with NCDENR-DWQ before installation.

36. The 911 address for the sewer lift station cannot be assigned until the map for the subdivision has been provided to the Harnett County E-911 Department. Once the 911 address has been assigned for the sewer lift station, each sewer lift station shall have a placard mounted at the gate which clearly identifies the HRW station number and assigned E-911 address for the station per item # 37 below. The Contractor shall be responsible to install the placard sign or pay for the installation thereof.

37. Each sewer lift station shall be provided a standard sign (32" wide x 16" tall) designating the facility as the property of **Harnett Regional Water**. The station sign should have large red letters on a white background denoting the **Sewer Lift Station #** (to be assigned by HRW Collections Department), the **911 address** (to be assigned by

E911) and **In Case Of Emergency call telephone number (910) 893-2424.** The sign shall be permanently mounted on the security fencing of the main gate at eye level. The signs currently posted by Harnett Regional Water (HRW) have been ordered from Advanced Signs of Angier and their telephone number is (919) 639-0794. All questions concerning the station sign should be directed to the HRW Collections Systems Supervisor at (910) 893-7575 extension 3243.

38. The Developer must provide HRW with a map and deed which describes all metes and bounds for the easements for the sewer lift station, the associated force main and the access road. If the project includes a utility easement, then the deed and all pertinent utilities easement(s) must be assigned to HRW and recorded with the Harnett County Register of Deeds office. The Developer or Registered Land Surveyor (RLS) should coordinate all recording of deed(s) and utility easement plat(s) with the HRW Right-of-Way Agent at (910) 893-7575 extension 3277.

7.1.4 Flooding

Sewage pumping station structures and electrical and mechanical equipment for sewer lift stations shall be protected from physical damage by the one hundred (100) year flood by having all structures within the sewage pumping stations to be at least 2 feet above the one hundred (100) year flood stage. Sewage pumping stations should remain fully operational and accessible during the twenty-five (25) year flood.

7.1.5 Accessibility

The pumping station shall be readily accessible by maintenance vehicles during all weather conditions. The facility should be located off the traffic way of streets and alleys. Each sewer lift station shall be provided with an all-weather access road at least 20 feet wide. The entire sewer lift station and the associated access road shall be dedicated to Harnett Regional Water (HRW) as a permanent easement or deeded to the County fee simple.

7.1.6 Grit/Solids

Where it is necessary to pump sewage prior to grit/solids removal, the design of the wet well and pump station piping shall receive special consideration to avoid operational problems from the accumulation of grit/solids. A grit removal chamber may be required by the HRW Engineer if the sewer lift station will serve a significant coverage area.

Section 7.2 Types of Sewer Lift Stations

7.2.1 Sewer pumping stations shall be of the following types:

A. self-priming lift pump type (Gorman Rupp "T" series, Smith & Loveless or equal) above ground stations where the wet well is less than 20 feet deep or

B. submersible pumping stations with non-clog (ABS, F.E. Myers, Homa, Zoeller or approved equal) pumps when the wet well must be deeper than 20 feet. Submersible stations shall not be designed for major transmission facilities as determined by the HRW. All sewer lift stations must be designed to conform the minimum requirements set forth in Section 7.1.3 above.

7.2.2 The following additional requirements shall be required for sewer lift stations with pumps larger than 25 HP:

A. A JIB crane, boom and the electric pump hoist shall be designed by the Professional Engineer to accommodate the weight of the pump and motor assembly provided with the project to aid the removal and re-installation of the pumps for repairs. Some consideration of future upgrade may be required for sizing the crane, boom and hoist.

B. The emergency generator must be a permanently mounted generator with an automatic transfer switch and a mezzanine catwalk to access the unit for servicing and repairs. The mezzanine catwalk shall be equipped with a set of steps on two sides of the unit.

C. The emergency generator shall be provided with a rain hood to cover the generator and the mezzanine catwalk. The rain hood shall extend above the generator by at least 24 inches and over the catwalk by at least 36 inches.

D. The wet well must be provided with anti-floatation ring if installed in flood plain or wetlands.

E. A concrete pad shall be included with the sewer lift station design for a sampling station or odor control equipment to include a chemical tank and pump for delivery of odor control chemicals to the wet well.

F. A concrete basin or retaining wall shall be constructed around the generator fuel tank(s) and the odor control chemical tank to contain any potential spill. The containment area shall be equipped with a drain and plug to allow for easy removal of the spilled fuel or chemical.

G. Lightning protection must be designed for the sewer lift station electrical equipment where the pumps will exceed 50 HP in size.

H. The sewer lift station shall have three pumps with one of them being a diesel driven pump connected to the fuel supply of the emergency generator or provided with a separate fuel storage container on site designed to be large enough so the emergency diesel driven pump can run at least 24 hours.

7.2.3 Structures

A. Equipment Removal

Provisions shall be made to facilitate removal of pumps, motors, and other mechanical and electrical equipment. Guide rails and chain falls shall be provided in submersible stations to aid in the removal of pumps. The guide rails shall be supported properly and evenly by attaching the guide rails to the wet well wall every 3-4 feet. The guide rails, support brackets and hardware shall be constructed with stainless steel material.

B. Access

Suitable and safe means of access shall be provided to the wet wells and pits containing either bar screens or mechanical equipment requiring inspection or maintenance. Steps shall be provided in the concrete structures for adequate means of ingress and egress.

C. Construction Materials

Due consideration shall be given to the selection of materials because of the presence of hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in sewage. The HRW prefers the use of stainless steel bolts, nuts, washers, fittings and appurtenances.

7.2.4 Pumps

A. Protection Against Clogging

Pumps handling separate sanitary sewage from 30" (76 cm) or larger diameter sewers shall be protected by automatic bar racks or bar screen with sludge press. Appropriate protection from

clogging shall also be considered for all sewage pump stations. Manual bar screens are not the preferred option.

B. Pump Openings

Pumps shall be capable of passing solid spheres of at least 3 inches (7.6 cm) in diameter, and pump suction and discharge piping shall be a minimum of 4 inches (10. 2 cm) in diameter.

C. Priming

The pump shall be so placed that under normal operating conditions it will operate under a positive suction head.

D. Electrical Equipment

Electrical systems and components (e.g. motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class 1, Group D, Division I locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible) cable shall be provided with watertight seal and separate strain relief A fused disconnect switch located above ground shall be provided for all pumping stations. The wires and cables entering the wet well shall pass through a cable tray with an appropriate vent or removable top that can be vented by the HRW staff. The first point of connection shall be a terminal strip inside a junction box that can be sealed off from the main control panel. The junction box shall be installed within close proximity to the wet well to keep the connections to pump floats, motor "hog heads" and level measuring devices as short as possible.

E. Electrical Enclosures

When such equipment is exposed to weather, an appropriate housing shall be supplied as follows:

1. Electronics, alarms, automatic switch gear, electro-mechanical devices, telemetry or any other such moisture sensitive devices shall be housed in a NEMA 4X stainless steel enclosure.

2. Fuse boxes, main disconnects, manual switch gear or any device not critically moisture sensitive may be housed in a NEMA 3R or NEMA 4 enclosure or better.

3. No holes will be allowed in the top of NEMA 4X enclosures. Holes in other sides of that enclosure will be kept to a minimum in number and size utilizing approved waterproofing technicalities.

4. The primary control enclosure may be required to provide space for future telemetry in critical areas as specified by HRW staff.

F. Intake

Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake. Intake piping shall be as straight and short as possible.

G. OEM Manuals

Each sewer lift station or sewage pumping station shall be provided with the operating and maintenance manuals as written by the Original Equipment Manufacturer (OEM). The contractor shall provide the OEM manuals (in good condition) for each pumping station or sewer lift station

to the HRW Engineer. The one year warranty on the pumps cannot begin until the OEM manuals have been delivered to the HRW Engineer and all testing and inspections have been completed with satisfactory results.

H. Pump Curves

The Professional Engineer (P.E.) shall obtain the pump curve for each pump application from the pump manufacturer and place of copy of the pump curve on the plans for the sewer lift station. The plans shall identify the recommended pumps by manufacturer, model number, pump motor voltage, pump motor amperage, pump motor HP, pump motor RPM, and pump motor frequency.

7.2.5 Controls

A. Type

Control systems shall be of the encapsulated float type. The electrical equipment shall comply with the National Electrical Code requirements for Class 1, Group D, Division I locations. Over and under voltage monitoring equipment with a three minute timer is required (motor saver).

B. Location

The control floats shall be located away from the turbulence of incoming flow and pump suction. The above ground control panel shall be so located to prevent accessibility to the panel and wet well simultaneously.

C. Alternation

In small sewer lift stations, provisions should be made to automatically alternate the pumps in use.

D. Wiring

Control wiring should be so designed as to fully utilize the dual pump aspect of the station. Wiring layouts should avoid contacts in series that promote total pump station failure by one float failure. All wiring shall be color coded to conform to the National Electrical Code (NEC), latest edition. All grounds shall be made using green colored wire.

E. Grounding

Each sewer lift station shall be provide with a ground rod at least ten (10") feet in length and driven in the ground to be covered when connected. The ground rod shall be aluminum or copper. The main control panels shall be properly grounded so the resistance to ground is less than 5 ohms.

7.2.6 Valves

A. Suction Line

Suitable shutoff valves shall be placed on the suction line of each pump except on submersible and vacuum primed pumps.

B. Discharge Line

Each pump discharge line shall have a weighted arm check valve, a plug valve and a mechanical joint fitting. Ball valves may be used at the discretion of Harnett Regional Water. Check valves shall not be placed on the vertical portion of discharge piping. Valves shall be capable of withstanding normal pressure and water hammer.

C. Location

Valves shall be located in a separate valve pit. Valves shall not be located in the wet well. Flow meters shall be located in a separate flow meter pit. Flow meters shall not be located in the valve pit.

D. Drainage

Accumulated water from the valve pit and flow meter pit shall be drained to the wet well or to the surrounding soil at least ten (10ft.) feet from the station perimeter. If the valve pit is drained to the wet well, an effective method shall be provided to prevent sewage from entering the pit during surcharged wet well conditions such as the use of a flapper type check valve on the drain line located inside the wet well.

E. Routine Maintenance

Each pump station shall be provided with a 3/4" water tap for routine maintenance with appropriate cross connection protection provided (only when water service is within 500 feet of the station).

7.2.7 Wet Wells

A. Size

Minimum wet well diameter shall be 6 feet. However, the wet well and control setting shall be appropriate to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention time.

B. Steps

Steps shall be properly located for accessibility and shall be of a non-corrosive material as approved by the Harnett Regional Water.

C. Hatches

All access covets shall be aluminum (Bilco, Halliday, or US Foundry), appropriately sized for accessibility and large enough to provide a clear access to all appurtenances.

D. Rust Proofing

All bolts, nuts, washers, hangers, rails, and related hardware within the wet well shall be stainless steel.

E. Floor Slope

The wet well floor shall have a minimum slope of one to one to the hopper bottom. The horizontal area of the hopper bottom shall be not greater than necessary for proper installation and function of the inlet.

F. Flood Proofing & Floatation

The top of the slab for the wet well shall be at least two (2") feet above the 100 foot flood elevation or so designed to prevent flooding and floatation on the wet well (i.e. water tight hatch covers increased base slab, etc.).

G. Ventilation

Adequate ventilation shall be provided for all pump stations. The vent pipe shall be rust resistant (PVC or stainless steel) and shall contain a 1/8" bug stainless steel screen.

Where wet wells, dry wells, and pump stations are installed, special ventilation design considerations shall be given to provide continuous or intermittent ventilation. Ventilation rate, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wet well rather than exhausted from the wet well.

H. Influent Pipe

Developments that would require more than one influent pipe reaching the wet well site should incorporate them into a control manhole prior to entering the wet well to allow for future bypassing of the wet well for maintenance purposes.

I. Coating

All wet wells may be required to have an atmospheric and moisture resistant coating as approved by the HRW to prevent degradation of the concrete surface by hydrogen sulfide.

J. Odor Control

Odor control devices approved by the Harnett Regional Water shall be provided at pump stations located in critical areas (i.e. high flow/high density areas) as determined by the HRW. Such devices may include air scrubbers or odor depressant injector systems. 105

7.2.8 Flow Measurement

Suitable devices for measuring sewage flow shall be installed at all sanitary sewer lift stations and sewer pumping stations. At a minimum, a flow meter shall be installed on the force main and run time meters shall be installed for each pump. Run time meters shall be so designed as to operate only when voltage is supplied to the primary pump wiring. A third run time meter shall be installed that runs when both pumps are operating to indicate a combined run time.

An EMCO ultrasonic flow meter or approved equal shall be attached to the force main to measure the flow leaving the station. The EMCO ultrasonic flow meter shall be strapped on using stainless steel bands with wire lead extending to the digital readout mounted under the hood for the control panel. The flow meter shall be calibrated for wastewater flow once the station has been inspected, tested and certified for operation. The flow meter shall be equipped with a 4-20 mA external output to provide a signal to the SCADA system. The flow meter shall be placed on the force main inside the flow meter vault so that there is sufficient length of unobstructed pipe for the ultrasonic flow meter to work properly in accordance with the manufacturer"s recommendations.

7.2.9 Water Supply

There shall be no physical connection between any potable water supply and a sewage pumping station which under any conditions might cause contamination of the potable water supply. When a potable water supply is brought to the station, it should comply with conditions stipulated elsewhere in this policy including the proper backflow protection. The water service shall be installed to a yard hydrant that is installed to proper depth to avoid freezing.

7.2.10 Alarm Systems

Alarm systems shall be provided for all pumping stations. The alarm shall be activated in case of power failure, pump failure, or any cause of pump station malfunction. The HRW shall require all sewer lift stations and sewer pumping stations to have alarms with the 4-20 mA external outputs that can be connected to the SCADA system. The HRW does not use auto dialers for transmission of operating parameters and alarm telemetry. The HRW has connected all sewer lift stations to a independent System Control and Data Acquisition (SCADA) computers at the North Harnett Regional Wastewater Treatment Plant and the Collections office in Lillington, NC where the HRW staff can monitor the SCADA system 24 hours a day. Audiovisual alarm systems with a self-contained power supply

may be acceptable in addition to the SCADA equipment outlined above, depending upon location, station holding capacity and inspection frequency. Generally, all sewer lift stations shall have a SCADA system to monitor the station operating parameters and the SCADA equipment will be installed by the HRW and the owner/developer shall pay the HRW a SCADA fee to cover the expense of the equipment installation at each sewer lift station. Pump seal failure lights are required for all pump stations. Strobe lights with power pack alarm system shall be installed on all pump station control systems. The alarm system shall be programmable at the station site. The control panel shall include dry terminal contact strips for the external output of all alarm signals to connect the System Control and Data Acquisition (SCADA) equipment to transmit the signals to a remote location that is manned and monitored 24 hours a day.

7.2.11 Overflow Prevention Methods

A satisfactory method shall be provided to prevent or minimize overflows. The following methods should be evaluated on an individual basis. The choice should be based on least cost and least operational problems for the HRW. The method selected shall provide an acceptable degree of reliability with the following considerations:

A. Storage capacity, including trunk sewers, for retention of wet weather flows (storage basins must be designed to drain back into the wet well or collection system after the flow receded); and

B. A permanently mounted pump or a portable pump, driven by an internal combustion engine, capable of pumping from the wet well to the discharge side of the station.

C. A portable standby generator with manual transfer switch will be required if the station flow rate is less than 15,000 gallons per day. A pad mounted, permanent standby generator with an automatic transfer switch will be required if the station flow rate is greater than or equal to 15,000 gallons per day.

D. HRW requires a pump bypass line to be designed from the wet well to the force main with the emergency connections to be set up beside the valve vault or the wet well. The temporary pump connections shall be designed with valves to be normally closed when the bypass line is not in operation. The pump bypass lines shall be equipped with quick-connect style fittings that allow the HRW staff to make the hose connections between the bypass line and the backup emergency pump quickly.

7.2.12 Instructions and Equipment

The HRW sanitary sewer lift stations and pumping stations shall be supplied with a complete set of Original Equipment Manufacturer (OEM) Manuals with the operational instructions, including emergency procedures, maintenance schedules, special tools, and such spare parts as may be necessary for each sewage pumping station. At least two additional copies shall be provided to the HRW Engineer.

Section 7.3 Site Construction

7.3.1 Fencing of the Pump Station Site - Chain Link Fence and Gates

All sewer lift station and pump station site areas shall be fenced covering at least a 50 ft. x 50 ft. area minimum. The entire site shall be covered with weed blocking material and at least six (6") inches of ABC washed stone or clean #57 stone or suitable granular material approved by the HRW. The fence shall include a personnel gate at least three (3 ft.) feet wide and a double vehicular gate twelve (12 ft.) feet wide comprised of two (2) - six (6 ft.) feet wide sections. Both the personnel gate and the vehicle gate shall be equipped with locking hasp that will accommodate a pad lock for security.

Fence Materials (All materials shall be Class I Galvanized Coated).

A. Fabric shall be 6 feet high, ends barbed, commercial grade 9 gauge.
Two (2) inch mesh with galvanized coating.

B. End, comer and pull posts to be 2-7/8" O.D. galvanized coated.

C. Top and line posts to be 1-7/8" O.D. galvanized coated.

D. Bottom tension wire shall be 7 gauge spring coil wire with galvanized coating.

E. Barb wire shall be 14 gauge galvanized barbs; font, point pattern on 5 inch centers, three (3) rows of outward facing barbed wire shall be used.

F. Gate posts shall be 4" O.D. galvanized coated.

G. A personnel gate shall be provided at least three (3 ft.) feet long by six (6 ft.) feet high. A vehicle gate shall be provided as a pair of eight (8ft.) feet long by six (6 ft.) feet high sections constructed of 2 inch O.D. pipe. Gate shall be equipped with a prop post center latch and hasp assembly. A ground anchor cast in concrete shall be provided. Gates shall be factory fabricated and equipped with gate holders.

7.3.2 Ground Cover

The entire site shall be covered with 8 mils thick black polyethylene plastic or other weed blocking material and then covered with at least 6 inches of clean #57 stone or suitable granular material to promote proper drainage. The site should be graded to eliminate erosion and sedimentation concerns. Berms or swales may be required to eliminate site flooding during heavy rain events. The site conditions shall be approved by the Harnett Regional Water. This covering shall extend one (1 ft.) foot outside the fence line.

7.3.3 Power Pole

The power pole shall be located within the fenced area and shall be located in such a manner so the electric meter can be easily read from outside the fenced area. The power supplier"s electric mater shall be placed on the power pole or the outside of the control panel hood. 107

7.3.4 Power Lines

All power lines within the site shall be underground (encased in Schedule 40 PVC conduit, not less than 2" I.D.). No overhead power line or other utility line shall be allowed to cross the site. Each sewer lift station shall be provided with three phase power of at least 480/277 volts unless approved by the HRW Engineer in writing.

7.3.5 Electrical Light

An exterior mercury vapor light (1200 watt minimum), automatically activated via photo-cell switch shall be mounted above ground on the power pole. The light shall be so located to provide adequate lighting for night maintenance. A fluorescent light fixture with a zero (0°) degree ballast controlled by a manual single throw switch shall be mounted under the control panel hood to provide better lighting to the controls at night.

7.3.6 Access Road

All pump station sites shall be serviced by an all weather road with top of road above the twenty-five (25) year flood elevation. Road and site drainage shall be included and approved by the appropriate agency. The pump station access road shall be paved if deemed necessary by the HRW Engineer or the HRW Utility Construction Inspector. The access road shall be at least 20 feet wide with adequate grade for drainage. Access roads with steep grade must be paved with asphalt or concrete.

Section 7.4 Suction Lift Pumps

Suction lift pumps shall be of the self-priming type (Gorman Rupp, Smith & Loveless, or approved equal) pumps and shall meet the applicable requirements of these specifications. Suction lift pump stations using dynamic suction

lifts exceeding the limits outlined may be approved by the HRW upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction lift as measured from "lead pump off' elevation to center line or pump suction, friction and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 6 feet (1.8 m).

The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent the humidity and corrosive sewer atmosphere from entering the equipment compartment. Valves shall not be located in the wet well.

7.4.1 Self Priming Pumps

Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 25 feet (7.6 m) in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 4 feet (1.2 m) from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction lift at the "pump off' elevation and required net positive suction head at design operating conditions shall not exceed 22 feet (6.7 m).

Section 7.5 Submersible Pump Stations

Submersible pump stations shall meet the applicable requirements stated herein. All submersible pump stations shall be non-clog style (ABS, F.E. Meyers, Homa, Zoeller or approved equal) pumps to suit flow conditions. Grinder style pumps are not preferred by the HRW but may be allowed on an individual case basis.

7.5.1 Construction

Submersible pumps and motors shall be designed, specifically, for raw sewage use, including totally submerged operation during a portion of each priming cycle. An effective method to detect shaft seal failure or potential seal failure shall be provided. The motor shall be of squirrel cage type design without brushes or other arc producing mechanisms.

7.5.2 Pump Removal

Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well by use of guide rails. The guide rails shall be secured to the wall of the wet well at least every three feet to secure the guide rails. Pumps and motors shall have adequate sized aluminum or stainless lifting chain. Lengths shall extend from the bottom of the wet well and reach top of station plus an additional 6' of chain.

7.5.3 Electrical

A. Power Supply and Control

Three (3Φ) phase power with at least 480 /277 volts shall be required at all submersible pump stations when three phase power is available as determined by the Harnett Regional Water. No add-a-phase is allowed to create a simulated three (3Φ) phase power supply. Single (1Φ) phase power will only be approved in rare instances when the distance to bring in the three (3Φ) phase power is cost prohibitive. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside of wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well or through use of watertight seals. If located outside, weatherproof equipment shall be used. Lightning arresters shall be required for all services located on the power meter base. Unbalanced voltage on motors shall not exceed 1%.

B. Controls

The motor control center shall be located outside the wet well and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code (NEC), to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal. Over and under (110+ %) voltage variance protection equipment shall be required. Each pump shall be equipped with thermal overload protection meeting the requirements of the pump manufacturer and the National Electrical Code (NEC).

C. Power Service Outlet

The control panel shall be provided with two (2) individual 110-120 volt power service outlets located on each end of the weatherproof panel. Each outlet shall be provided with a "while-in-use" type cover.

D. Concrete Pad

A concrete pad shall be provided for by the electrical control panel and extend a minimum of 3' measured from the face of the panel.

E. Power Cord

Pumps and motors shall be shipped with non-wicking electrical power cable, over heat cable, and seal failure cable, factory installed and tested cut ends and shall be sealed and tagged at the factory for shipping.

Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage and shall meet the requirements of the Mine Safety and Health Administration for trailing cables. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances, and shall be designed to facilitate field connecting.

Section 7.6 Force Main Design

7.6.1 Velocity

At design, average flow velocity of at least 2 feet per second (0.61 *m/x)* shall be maintained. A complete hydraulic analysis is required in determining force main sizes.

7.6.2 Air Relief Valve

An automatic air relief valve shall be placed at high points in the force main to prevent air locking.
Caution should be taken to design and construct force mains to a uniform slope to prevent air locking.
Air relief valves shall be located in shallow 4' manholes to allow for maintenance. Air relief valves shall be Crispin combination type air release valves or approved equal.

7.6.3 Termination

Force mains should enter the gravity sewer system at a point not more than 2 feet (3 0 cm) above the flow line of the receiving manhole. Terminus of force main shall be designed by a smooth transition of gravity flow of force main pipe into gravity pipe. Receiving manhole shall be adequately protected with a HRW approved coating to prevent hydrogen sulfide damage.

7.6.4 Design Pressure

The force main and fittings, including reaction blocking, shall be designed to withstand normal pressure and pressure surges (water hammer). Force main manifolding shall be avoided.

7.6.5 Special Construction

Force main construction near streams or used for aerial crossings shall meet applicable requirements previously addressed herein.

7.6.6 Design Friction Losses

Friction losses through force mains shall be based on the Hazen and Williams formula. When the Hazen and Williams formula is used, the following values for "C" shall be used for design.
PVC 120 unlined iron or steel.
When initially installed, force mains shall have a significantly higher factor. The higher "C" factor should be considered only in calculating maximum power requirements.

7.6.7 Separation from Water Mains

There shall be at least a 10 foot (3.0 m) horizontal separation between water mains and sanitary sewer force mains. Force mains crossing water mains shall be laid to provide a minimum vertical distance of 24 inches below the outside of the water main or ferrous pipe materials shall be used and a minimum of 18" separation shall be maintained between the water main and the force main.

7.6.8 Materials

The following pipe materials will be accepted by the HRW for force mains: PVC AWWA C900 Pressure Class 100 DR25, PVC SDR 21,200 psi and ductile iron ANSI A21.51 Class 50 with bituminous casting and Protecto 401 costing or approved equal.

7.6.9 Testing

All force mains shall be required to withstand a low pressure test in accordance with ASTM C 828.

7.6.10 Location

In both public and private road right-of-ways, force mains shall be located in accordance with Harnett Regional Water for Coordinating Utility Services.
A minimum permanent easement of 20 feet shall be provided where it is necessary to install force mains outside of a public highway right-of-way such as planned unit developments, private road right-of-way and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels. Force mains shall be located within road right-of-ways or public access areas (PUD's, private road right-of-ways). The same location requirements for public road right-of-ways shall apply.

Any change of direction greater than a 22 degree bend shall require a marker denoting change of direction.

7.6.11 Locator Wire

An insulated, solid conductor, #12 AWG copper wire THHM shall be provided for all water lines and sanitary sewer force mains as directed by the Harnett Regional Water for location of pipe line. The tracer wire should be taped to the top of the pipe using duct tape or similar adhesive tape until the backfill operation can be completed. The tracer wire shall not be spliced underground and it shall extend up to the surface on the outside of valve boxes and manholes per the HRW Standard Details. The locator tape is not sufficient to meet current HRW Standards.

7.6.12 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the North Carolina Department of Transportation. In no event shall open cuts in the roadway remain unpaved or patched, in keeping with highway standards, for more than 15 days. Failure on the part of the contractor to take adequate action on patching will force the HRW to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs.

7.6.13 Force Mains

- Air reliefs and detail.
- Provide a pigging access to force main in 1000" intervals on force mains less than 5000" and access and flush ports every 2500" on force mains greater than 5000".

Please see Chapter 12, General and Special Conditions, Section Special Construction Technical Specifications for additional information and requirements for construction.

CHAPTER 7

DESIGN OF SEWAGE PUMPING STATIONS

REQUIREMENTS

Chapter 7 DESIGN OF SEWAGE PUMPING STATIONS- REQUIREMENTS

Section 7.1 Design and Minimum Requirements for Sanitary Sewer Lift Stations

7.1.1 Sanitary Sewer Lift Station Design Standards

All engineering plans and profiles of public sanitary sewer lift stations and any associated or proposed system improvements to Harnett Regional Water's sanitary sewer collection systems shall be designed by a Professional Engineer (P.E.) in accordance with industry recognized standards to conform with all applicable rules and regulations established by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR –DWQ) under the Administrative Code Section 15A NCAC 2T - Waste Not Discharged to Surface Waters (EFFECTIVE September 1, 2006) , the standard specifications and details of the HRW as outlined herein this section. All engineering plans and profiles of proposed public and/or private projects, that involve improvements to the Harnett Regional Water's sanitary sewer system, shall be permitted by the NCDENR – DWQ prior to any construction of the proposed improvements. The Professional Engineer (P.E.) shall submit the design plans and profiles of the sanitary sewer system improvements to the HRW Engineer for review and approval prior to the submission of any permit application to the NCDENR – DWQ. The design plans and profiles shall include the following information:

A. pump model number, pump size (HP), pump operating speed (RPM) and pump head rating (feet) for each pump to be installed with any sewer lift station,

B. the pump curve for each pump to be installed with any sewer lift station,

C. the station power requirements showing the voltage and amperage rating for each pump to be installed with any sewer lift station (Note HRW prefers each pump station to be supplied with 480/277 volts unless otherwise approved in writing by the HRW Engineer),

D. wet well diameter (feet) and depth (feet),

E. the electric pump hoist rating (HP) and JIB crane with a boom sized long enough to reach across the wet well to remove and re-install the pumps,

F. the overall sewer lift station layout including the control panel, SCADA panel, the wet well, the generator, valve vault, meter vault, station fencing, odor control and sampling equipment.

G. the topographic lines, existing grade and the proposed finished grade upon project completion,

H. the HRW sanitary sewer details in accordance with these specifications,

I. the erosion control plans and associated details.

7.1.2 Sewer Lift Station Design Capacity

In general, a Professional Engineer (P.E.) shall design any and all sanitary sewer lift stations in accordance with industry recognized standards and conform to the state minimum design rules indicated above and these specifications. The sanitary sewer lift station capacities shall be designed for the estimated ultimate tributary population, except in considering parts of the systems that can be readily increased in capacity. Similarly, consideration shall be given to the maximum anticipated capacity of institutions, industrial parks, shopping centers, other nearby subdivisions and completed build out of the project where the sewer lift station is to be located as determined by Harnett Regional Water's Master Sewer Plan. In determining the required capacities of sanitary sewer lift station(s), the following factors should be considered:

A. Maximum hourly domestic sewage flow;

B. Pump station capacities and interceptor sewers from point of discharge to the treatment works;

C. Inflow and groundwater infiltration;

D. Topography of area;

E. Location of sewage treatment plant;

F. Depth of excavation; and

G. Pumping requirements.

The basis of design for all projects that include a sanitary sewer lift station shall incorporate the size and site of any such sewer lift station necessary to convey wastewater to the nearest publicly-owned treatment works (POTW) facility owned and operated by the HRW. The Professional Engineer (P.E.) shall provide the HRW Engineer with a set of detailed computations and calculations to demonstrate how the pumps and associated wet well for any sanitary sewer lift station have been sized and specified for any project which requires as sewer lift station. The HRW Master Sewer Plan shall be the guiding document for all sanitary sewer improvements and the developer/owner shall abide by the pipe sizes, grades, locations and capacities as determined by the HRW and outlined in the HRW Master Sewer Plan.

7.1.3 Sewer Lift Station Minimum Requirements

The basis of design for all projects that include a sanitary sewer lift station shall incorporate the size and site of any such sewer lift station necessary to convey wastewater to the nearest publicly-owned treatment works (POTW) facility owned and operated by the HRW. The Professional Engineer (P.E.) shall provide the HRW Engineer with a set of detailed computations and calculations to demonstrate how the pumps and associated wet well for any sanitary sewer lift station have been sized and specified for any project which requires as sewer lift station. The HRW Master Sewer Plan shall be the guiding document for all sanitary sewer improvements and the developer/owner shall abide by the pipe sizes, grades, locations and capacities as determined by the HRW and outlined in the HRW Master Sewer Plan.

A. The following minimum requirements, standards, and specifications established by the HRW shall apply to all sewer lift stations constructed after August 2009 and these minimum requirements shall be included with the Utility Notes on all plans:

1. Three (3) phase (480 volts) power must be provided for each sewer lift station. Exceptions must be approved in writing by the HRW Engineer or the HRW Director in advance of the installation of any equipment at any new sewer lift station.

2. Multiple pumps (minimum of 2) each capable of pumping at a rate 2.5 times the average daily flow rate with any one pump out of service. Pump-On/Pump-Off elevations shall be set such that 2-8 pumping cycles per hour may be achieved in the sewer lift station under the average flow rate condition.

3. At least two (2) ground fault circuit interrupter (GFCI) receptacles rated for 110-120VAC shall be installed near the main control panel for each sewer lift station. One GFCI receptacle shall be located on each end of the control panel hood assembly and each one shall be provide with a while-in-use cover.

4. One (1) NEMA 4/4X stainless steel electrical control cabinet with minimum cabinet dimensions of thirty (30") inches width x of thirty (30") inches length x ten (10") inches depth shall be provided for the station pumps. Space should be left under the control panel hood assembly to add another NEMA 4/4X stainless steel electrical control cabinet with minimum cabinet dimensions of thirty (30") inches width x of thirty (30") inches length x ten (10") inches depth shall be provided for the SCADA system to be installed

by HRW. The power (voltage and amps) rating for each control panel shall be labeled on the outside of the station pump control panel, the generator panel, automatic transfer switch (ATS) and disconnect panels with block letters and numbers at least three (3") inches tall. The block letters and numbers should be permanently mounted to the electrical panels and the use of adhesive type (peel & stick) letters and numbers will not be approved by HRW.

5. Gas/liquid barrier junction box or cable support for all cabling that enters the wet well with cord grip type unions. The junction box should be mounted near the top of the wet well with and open raceway providing an air gap above the wet well penetration to the junction box allowing methane and sewer gases to escape between the wet well and the junction box such that all sewer gases from the wet well are prevented from entering the control panel(s).

6. Spare one (1") inch (minimum) conduit with an air gap from the RTU cabinet area to the liquid tight junction box of low voltage signal wire entry into the wet well.

7. Dry contact terminal strip shall be installed to provide SCADA connections for:

a. Pump run indication – Auxiliary contacts from pump motor starters.
b. High level alarm
c. Pump HOA (Hand or Automatic) switch in auto position (contacts on the HOA switches)
d. Pump seal failure and/or priming failure
e. Motor over temperatures
f. Motor overloads
g. Lag pump start
h. Three phase power failure or "single phasing"
i. Circuit breaker tripped or control power failure

8. For totally enclosed lift stations (i.e. Gorman Rupp and Smith & Loveless), provisions must be provided to connect RTU conduit to the motor control cabinet. One (1¼") NPT hole and one (1") inch hole will suffice. Totally enclosed sewer lift stations shall be provided with forced air ventilation and damper vents to reduce heat during the summer months and a heat source (light, heat strip, heat tape, etc.) to avoid freezing during the winter months.

9. Inline control circuit phase failure relays with spare contacts for SCADA monitoring.

10. 100-watt heat strip for moisture and temperature control of the cabinet environment.

11. Each pump installed in conjunction with the sewer lift station shall be equipped with run time meters or hour meters.

12. Each sewer lift station shall have a visible alarm light and an audible alarm horn to signal high level warnings.

13. A stainless steel or aluminum hooded control station must be provided. See the HRW Standard Sewer Details or contact the HRW Engineer for a fabrication guide.

14. All materials and construction shall comply with Standards and Specifications of Harnett Regional Water.

15. The sanitary sewer force main leaving the sewer lift station shall be installed with 12 gauge, insulated, solid copper conductor, tracer wire from the gate valves and/or check valves to the point of discharge manhole. The gate valves and check valves shall be

located in a concrete valve vault with minimum dimensions of four (4") feet width x three (3") feet depth x six (6") feet length near the wet well to meet minimum requirements of the HRW Standards and Specifications. The valve vault shall remain accessible for maintenance and repairs with a positive head for drainage having an aluminum, locking type (Bilco) hatch or approved equal at least thirty (30") inches width x forty-eight (48) inches length.

16. Each sewer lift station must have an approved flow meter rated for sewer service (SCADA ready) installed in a separate concrete vault beside the valve vault with minimum dimensions of four (4") feet width x three (3") feet depth x six (6") feet length. The flow meter should be an EMCO ultrasonic flow meter or approved equal with external transducers clamped onto the outside of the force main. The EMCO ultrasonic flow meter should be equipped with SCADA-Ready 4-20 mA I/O ports and have a cable extended to a remote readout display mounted near the control panel. The flow meter vault shall remain accessible for maintenance and repairs with a positive head for drainage and an aluminum, locking type (Bilco) hatch or approved equal at least thirty (30") inches width x forty-eight (48) inches length.

17. Each sewer lift station shall have potable water service on site consisting of at least one (1) yard hydrant installed during the construction of the project. The yard hydrant shall meet minimum requirements of the HRW Standards and Specifications and this water service should be equipped with an above ground RPZ installed inside a weatherproof housing.

18. Each lift station and pump station shall have an emergency pump connection on the force main with an associated shut-off valve to meet minimum requirements of the HRW Standards and Specifications. The force main(s) shall be at least four (4") inches in diameter unless otherwise approved by the HRW.

19. The wet well for each sewer lift station must be constructed of concrete lined with a protective coating and equipped with a maintenance manhole and/or associated bar screen to meet minimum requirements of the HRW Standards and Specifications. The joints between the prefabricated wet well sections shall be sealed externally with sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal as outlined in Section 5.5.6 of these specifications.

20. Each sewer lift station shall have an emergency generator sized to handle at least 2.5 times the rated electrical load for the entire sewer lift station that shall be mounted upon a concrete pad. In addition the emergency generator should be provided with an automatic transfer switch. An external connector plug sized to handle the output of an emergency generator as outlined above as a minimum requirement on all temporary sewer lift stations as pre-approved by the HRW. An alternative would be to provide HRW with a diesel driven emergency pump rated to handle at least 2.5 times the rated peak flow for the entire sewer lift station.

21. The emergency standby generator shall include a dry contact terminal strip for SCADA connections to monitor:

a. Generator in Automatic Mode
b. Generator Running
c. Common Engine Failure
d. Low Fuel Level and Fuel leak Detection
e. Low and High Water Temperature
f. Low Oil Pressure

22. Each sewer lift station shall be surrounded by security fencing at least six (6") high with twelve (16") feet wide double swinging gate comprised of two - eight (8 ft.) feet wide sections for vehicular traffic and one - three (3 ft.) wide single swinging gate for a personnel entrance. The security fencing installed around the sewer lift station shall be 50 ft. x 50 ft. as a standard area unless the station has pumps greater than 50 hp then the station shall have a 60 ft. x 60 ft. area unless otherwise approved by the HRW Engineer.

23. Each sewer lift station shall be provided with a SCADA pole, a SCADA antenna and associated telemetry to meet minimum requirements of the HRW Standards and Specifications. HRW will install the SCADA system and invoice the developer for the SCADA Fees to cover the equipment and installation costs.

24. Each sewer lift station shall be provided an area security light (mercury vapor bulb) with photocell control. The weather hood over the control panel should include the installation of a fluorescent light fixture with a zero (0°) degree ballast above the control panel mounted far enough from the control panel to allow for full opening of the panel door without obstruction.

25. Each sewer lift station shall have an access road that is properly graded for adequate storm water run-off and at least twenty (20ft.) feet wide. The access road must be paved if the grade is more than 10 % but, it shall have at least six (6") inches of # 57 (crush and run) stone. The developer must provide the HRW a permanent easement for the sewer lift station and associated access road.

26. All bolts, mounting brackets, pump lift chains, etc., shall be stainless steel or manufactured of an approved material with proper corrosion resistance and properly sized and mounted to provide proper support for the applicable loads.

27. All wiring and electrical work shall conform to the latest revised National Electrical Code (NEC) and local guidelines. All wiring shall be identified at each termination on both ends.

28. New installations are required to meet the latest revised OSHA standards at the time of final acceptance. The contractor shall provide and install all site specific OSHA required labels and signs for the sewer lift station equipment. The hatch opening of the wet well shall be provided with a webbing or net to provide fall protection. The webbing or net shall be secured by hooks and reinforced grommets in the webbing or net.

29. The sewer lift station shall be located two (2") feet above the 100-year flood elevation and the 100-year flood elevations should be shown on the plans and As-Built record Drawings. The site for the sewer lift station must be provided with adequate means for drainage of storm water runoff whereby the station site will not be flooded during significant rain events of more than 2" inches of rainfall. The entire site shall be provided with weed blocking material below gravel for adequate drainage inside the station. The gravel shall be ABC washed stone installed at least six (6") inches thick on top of the weed block material.

30. Site visits by the HRW Utility Construction Inspector will be required and scheduled for the following actions:

a. Before final plan approval,
b. Pressure testing the force main
c. When pumps are set,
d. Pump draw down testing,
e. Generator startup testing,
f. Final Inspection of all sewer lift station equipment and when flow is applied.

Final start up testing shall be coordinated with the Design Engineer, the HRW Engineer, the OEM Pump Manufacturer Representative, OEM Generator Manufacturer Representative, the HRW SCADA Supervisor and the HRW Collections System Supervisor. Final start up testing shall include Items D & E above at a minimum. The flow meter shall be calibrated prior to the HRW final acceptance of the sewer lift station.

31The manufacturer is to furnish all recommended spare parts including, at a minimum, two sets of mechanical seals, o-rings, gaskets, and wear rings. Each pump shall be provided with an extra full size impeller in addition to other spare parts recommended by the pump manufacturer. The spare parts shall be provided by start-up date. Spare parts shall be provided in original packaging in factory new condition. In addition to the spare pump assembly, the contractor shall furnish to the HRW one complete set of spare parts for the electric generator including: an air filter, an oil filter, and a fuel filter along with one spare set of accessory belts if applicable. An emergency pump connection shall be designed with a tee, a gate valve and quick connect nozzle for the emergency pump connection between the valve vault and the flow meter vault.

32. The contractor shall provide HRW with at least three (3) sets of OEM operating and maintenance manuals for all equipment. The manuals must be original as provided by the manufacturer and bound. Spare parts as required by HRW shall be boxed for long term storage with part numbers and identification labels. Items subject to handling damage will not be accepted if the factory packaging has been opened. All manuals and spare parts are to be turned over to HRW at final inspection and acceptance of the pump station.

33. The generator must have a mezzanine or catwalk around it to provide adequate access to service, inspect and test the unit. If the doors on the enclosure cannot be opened and removed to service the unit without a ladder or lift then the contractor must construct a mezzanine or catwalk around it to provide adequate access. Generally, when the access door panels are more than two (2') feet above finish grade or the concrete pad then a mezzanine or catwalk will be required by the HRW.

34. The sewer lift station must be provided with a JIB crane, boom and electric hoist to remove and replace the pumps when the pumps are larger than 25 hp. The boom must extend at least twelve (12') feet from the edge of the wet well and be able to lift the pump at least six (6') feet off the ground in order to allow a pump to be loaded into the bed of a service truck. A JIB crane that rotates 360° will be required for pumps greater than 60 hp.

35. The sewer lift station must be provided with a tee and two valves between the flow meter vault and the valve vault in order to accommodate the quick connection of a diesel driven pump. Diesel driven pumps may be used to replace the emergency generator if approved by the HRW in advance and permitted with NCDENR-DWQ before installation.

36. The 911 address for the sewer lift station cannot be assigned until the map for the subdivision has been provided to the Harnett County E-911 Department. Once the 911 address has been assigned for the sewer lift station, each sewer lift station shall have a placard mounted at the gate which clearly identifies the HRW station number and assigned E-911 address for the station per item # 37 below. The Contractor shall be responsible to install the placard sign or pay for the installation thereof.

37. Each sewer lift station shall be provided a standard sign (32" wide x 16" tall) designating the facility as the property of **Harnett Regional Water**. The station sign should have large red letters on a white background denoting the **Sewer Lift Station #** (to be assigned by HRW Collections Department), the **911 address** (to be assigned by

E911) and **In Case Of Emergency call telephone number (910) 893-2424.** The sign shall be permanently mounted on the security fencing of the main gate at eye level. The signs currently posted by Harnett Regional Water (HRW) have been ordered from Advanced Signs of Angier and their telephone number is (919) 639-0794. All questions concerning the station sign should be directed to the HRW Collections Systems Supervisor at (910) 893-7575 extension 3243.

38. The Developer must provide HRW with a map and deed which describes all metes and bounds for the easements for the sewer lift station, the associated force main and the access road. If the project includes a utility easement, then the deed and all pertinent utilities easement(s) must be assigned to HRW and recorded with the Harnett County Register of Deeds office. The Developer or Registered Land Surveyor (RLS) should coordinate all recording of deed(s) and utility easement plat(s) with the HRW Right-of-Way Agent at (910) 893-7575 extension 3277.

7.1.4 Flooding

Sewage pumping station structures and electrical and mechanical equipment for sewer lift stations shall be protected from physical damage by the one hundred (100) year flood by having all structures within the sewage pumping stations to be at least 2 feet above the one hundred (100) year flood stage. Sewage pumping stations should remain fully operational and accessible during the twenty-five (25) year flood.

7.1.5 Accessibility

The pumping station shall be readily accessible by maintenance vehicles during all weather conditions. The facility should be located off the traffic way of streets and alleys. Each sewer lift station shall be provided with an all-weather access road at least 20 feet wide. The entire sewer lift station and the associated access road shall be dedicated to Harnett Regional Water (HRW) as a permanent easement or deeded to the County fee simple.

7.1.6 Grit/Solids

Where it is necessary to pump sewage prior to grit/solids removal, the design of the wet well and pump station piping shall receive special consideration to avoid operational problems from the accumulation of grit/solids. A grit removal chamber may be required by the HRW Engineer if the sewer lift station will serve a significant coverage area.

Section 7.2 Types of Sewer Lift Stations

7.2.1 Sewer pumping stations shall be of the following types:

A. self-priming lift pump type (Gorman Rupp "T" series, Smith & Loveless or equal) above ground stations where the wet well is less than 20 feet deep or

B. submersible pumping stations with non-clog (ABS, F.E. Myers, Homa, Zoeller or approved equal) pumps when the wet well must be deeper than 20 feet. Submersible stations shall not be designed for major transmission facilities as determined by the HRW. All sewer lift stations must be designed to conform the minimum requirements set forth in Section 7.1.3 above.

7.2.2 The following additional requirements shall be required for sewer lift stations with pumps larger than 25 HP:

A. A JIB crane, boom and the electric pump hoist shall be designed by the Professional Engineer to accommodate the weight of the pump and motor assembly provided with the project to aid the removal and re-installation of the pumps for repairs. Some consideration of future upgrade may be required for sizing the crane, boom and hoist.

B. The emergency generator must be a permanently mounted generator with an automatic transfer switch and a mezzanine catwalk to access the unit for servicing and repairs. The mezzanine catwalk shall be equipped with a set of steps on two sides of the unit.

C. The emergency generator shall be provided with a rain hood to cover the generator and the mezzanine catwalk. The rain hood shall extend above the generator by at least 24 inches and over the catwalk by at least 36 inches.

D. The wet well must be provided with anti-floatation ring if installed in flood plain or wetlands.

E. A concrete pad shall be included with the sewer lift station design for a sampling station or odor control equipment to include a chemical tank and pump for delivery of odor control chemicals to the wet well.

F. A concrete basin or retaining wall shall be constructed around the generator fuel tank(s) and the odor control chemical tank to contain any potential spill. The containment area shall be equipped with a drain and plug to allow for easy removal of the spilled fuel or chemical.

G. Lightning protection must be designed for the sewer lift station electrical equipment where the pumps will exceed 50 HP in size.

H. The sewer lift station shall have three pumps with one of them being a diesel driven pump connected to the fuel supply of the emergency generator or provided with a separate fuel storage container on site designed to be large enough so the emergency diesel driven pump can run at least 24 hours.

7.2.3 Structures

A. Equipment Removal

Provisions shall be made to facilitate removal of pumps, motors, and other mechanical and electrical equipment. Guide rails and chain falls shall be provided in submersible stations to aid in the removal of pumps. The guide rails shall be supported properly and evenly by attaching the guide rails to the wet well wall every 3-4 feet. The guide rails, support brackets and hardware shall be constructed with stainless steel material.

B. Access

Suitable and safe means of access shall be provided to the wet wells and pits containing either bar screens or mechanical equipment requiring inspection or maintenance. Steps shall be provided in the concrete structures for adequate means of ingress and egress.

C. Construction Materials

Due consideration shall be given to the selection of materials because of the presence of hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in sewage. The HRW prefers the use of stainless steel bolts, nuts, washers, fittings and appurtenances.

7.2.4 Pumps

A. Protection Against Clogging

Pumps handling separate sanitary sewage from 30" (76 cm) or larger diameter sewers shall be protected by automatic bar racks or bar screen with sludge press. Appropriate protection from

clogging shall also be considered for all sewage pump stations. Manual bar screens are not the preferred option.

B. Pump Openings

Pumps shall be capable of passing solid spheres of at least 3 inches (7.6 cm) in diameter, and pump suction and discharge piping shall be a minimum of 4 inches (10. 2 cm) in diameter.

C. Priming

The pump shall be so placed that under normal operating conditions it will operate under a positive suction head.

D. Electrical Equipment

Electrical systems and components (e.g. motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class 1, Group D, Division I locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible) cable shall be provided with watertight seal and separate strain relief A fused disconnect switch located above ground shall be provided for all pumping stations. The wires and cables entering the wet well shall pass through a cable tray with an appropriate vent or removable top that can be vented by the HRW staff. The first point of connection shall be a terminal strip inside a junction box that can be sealed off from the main control panel. The junction box shall be installed within close proximity to the wet well to keep the connections to pump floats, motor "hog heads" and level measuring devices as short as possible.

E. Electrical Enclosures

When such equipment is exposed to weather, an appropriate housing shall be supplied as follows:

1. Electronics, alarms, automatic switch gear, electro-mechanical devices, telemetry or any other such moisture sensitive devices shall be housed in a NEMA 4X stainless steel enclosure.

2. Fuse boxes, main disconnects, manual switch gear or any device not critically moisture sensitive may be housed in a NEMA 3R or NEMA 4 enclosure or better.

3. No holes will be allowed in the top of NEMA 4X enclosures. Holes in other sides of that enclosure will be kept to a minimum in number and size utilizing approved waterproofing technicalities.

4. The primary control enclosure may be required to provide space for future telemetry in critical areas as specified by HRW staff.

F. Intake

Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake. Intake piping shall be as straight and short as possible.

G. OEM Manuals

Each sewer lift station or sewage pumping station shall be provided with the operating and maintenance manuals as written by the Original Equipment Manufacturer (OEM). The contractor shall provide the OEM manuals (in good condition) for each pumping station or sewer lift station

to the HRW Engineer. The one year warranty on the pumps cannot begin until the OEM manuals have been delivered to the HRW Engineer and all testing and inspections have been completed with satisfactory results.

H. Pump Curves

The Professional Engineer (P.E.) shall obtain the pump curve for each pump application from the pump manufacturer and place of copy of the pump curve on the plans for the sewer lift station. The plans shall identify the recommended pumps by manufacturer, model number, pump motor voltage, pump motor amperage, pump motor HP, pump motor RPM, and pump motor frequency.

7.2.5 Controls

A. Type

Control systems shall be of the encapsulated float type. The electrical equipment shall comply with the National Electrical Code requirements for Class 1, Group D, Division I locations. Over and under voltage monitoring equipment with a three minute timer is required (motor saver).

B. Location

The control floats shall be located away from the turbulence of incoming flow and pump suction. The above ground control panel shall be so located to prevent accessibility to the panel and wet well simultaneously.

C. Alternation

In small sewer lift stations, provisions should be made to automatically alternate the pumps in use.

D. Wiring

Control wiring should be so designed as to fully utilize the dual pump aspect of the station. Wiring layouts should avoid contacts in series that promote total pump station failure by one float failure. All wiring shall be color coded to conform to the National Electrical Code (NEC), latest edition. All grounds shall be made using green colored wire.

E. Grounding

Each sewer lift station shall be provide with a ground rod at least ten (10") feet in length and driven in the ground to be covered when connected. The ground rod shall be aluminum or copper. The main control panels shall be properly grounded so the resistance to ground is less than 5 ohms.

7.2.6 Valves

A. Suction Line

Suitable shutoff valves shall be placed on the suction line of each pump except on submersible and vacuum primed pumps.

B. Discharge Line

Each pump discharge line shall have a weighted arm check valve, a plug valve and a mechanical joint fitting. Ball valves may be used at the discretion of Harnett Regional Water. Check valves shall not be placed on the vertical portion of discharge piping. Valves shall be capable of withstanding normal pressure and water hammer.

C. Location

Valves shall be located in a separate valve pit. Valves shall not be located in the wet well. Flow meters shall be located in a separate flow meter pit. Flow meters shall not be located in the valve pit.

D. Drainage

Accumulated water from the valve pit and flow meter pit shall be drained to the wet well or to the surrounding soil at least ten (10ft.) feet from the station perimeter. If the valve pit is drained to the wet well, an effective method shall be provided to prevent sewage from entering the pit during surcharged wet well conditions such as the use of a flapper type check valve on the drain line located inside the wet well.

E. Routine Maintenance

Each pump station shall be provided with a 3/4" water tap for routine maintenance with appropriate cross connection protection provided (only when water service is within 500 feet of the station).

7.2.7 Wet Wells

A. Size

Minimum wet well diameter shall be 6 feet. However, the wet well and control setting shall be appropriate to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention time.

B. Steps

Steps shall be properly located for accessibility and shall be of a non-corrosive material as approved by the Harnett Regional Water.

C. Hatches

All access covets shall be aluminum (Bilco, Halliday, or US Foundry), appropriately sized for accessibility and large enough to provide a clear access to all appurtenances.

D. Rust Proofing

All bolts, nuts, washers, hangers, rails, and related hardware within the wet well shall be stainless steel.

E. Floor Slope

The wet well floor shall have a minimum slope of one to one to the hopper bottom. The horizontal area of the hopper bottom shall be not greater than necessary for proper installation and function of the inlet.

F. Flood Proofing & Floatation

The top of the slab for the wet well shall be at least two (2") feet above the 100 foot flood elevation or so designed to prevent flooding and floatation on the wet well (i.e. water tight hatch covers increased base slab, etc.).

G. Ventilation

Adequate ventilation shall be provided for all pump stations. The vent pipe shall be rust resistant (PVC or stainless steel) and shall contain a 1/8" bug stainless steel screen.

Where wet wells, dry wells, and pump stations are installed, special ventilation design considerations shall be given to provide continuous or intermittent ventilation. Ventilation rate, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wet well rather than exhausted from the wet well.

H. Influent Pipe

Developments that would require more than one influent pipe reaching the wet well site should incorporate them into a control manhole prior to entering the wet well to allow for future bypassing of the wet well for maintenance purposes.

I. Coating

All wet wells may be required to have an atmospheric and moisture resistant coating as approved by the HRW to prevent degradation of the concrete surface by hydrogen sulfide.

J. Odor Control

Odor control devices approved by the Harnett Regional Water shall be provided at pump stations located in critical areas (i.e. high flow/high density areas) as determined by the HRW. Such devices may include air scrubbers or odor depressant injector systems. 105

7.2.8 Flow Measurement

Suitable devices for measuring sewage flow shall be installed at all sanitary sewer lift stations and sewer pumping stations. At a minimum, a flow meter shall be installed on the force main and run time meters shall be installed for each pump. Run time meters shall be so designed as to operate only when voltage is supplied to the primary pump wiring. A third run time meter shall be installed that runs when both pumps are operating to indicate a combined run time.

An EMCO ultrasonic flow meter or approved equal shall be attached to the force main to measure the flow leaving the station. The EMCO ultrasonic flow meter shall be strapped on using stainless steel bands with wire lead extending to the digital readout mounted under the hood for the control panel. The flow meter shall be calibrated for wastewater flow once the station has been inspected, tested and certified for operation. The flow meter shall be equipped with a 4-20 mA external output to provide a signal to the SCADA system. The flow meter shall be placed on the force main inside the flow meter vault so that there is sufficient length of unobstructed pipe for the ultrasonic flow meter to work properly in accordance with the manufacturer"s recommendations.

7.2.9 Water Supply

There shall be no physical connection between any potable water supply and a sewage pumping station which under any conditions might cause contamination of the potable water supply. When a potable water supply is brought to the station, it should comply with conditions stipulated elsewhere in this policy including the proper backflow protection. The water service shall be installed to a yard hydrant that is installed to proper depth to avoid freezing.

7.2.10 Alarm Systems

Alarm systems shall be provided for all pumping stations. The alarm shall be activated in case of power failure, pump failure, or any cause of pump station malfunction. The HRW shall require all sewer lift stations and sewer pumping stations to have alarms with the 4-20 mA external outputs that can be connected to the SCADA system. The HRW does not use auto dialers for transmission of operating parameters and alarm telemetry. The HRW has connected all sewer lift stations to a independent System Control and Data Acquisition (SCADA) computers at the North Harnett Regional Wastewater Treatment Plant and the Collections office in Lillington, NC where the HRW staff can monitor the SCADA system 24 hours a day. Audiovisual alarm systems with a self-contained power supply

may be acceptable in addition to the SCADA equipment outlined above, depending upon location, station holding capacity and inspection frequency. Generally, all sewer lift stations shall have a SCADA system to monitor the station operating parameters and the SCADA equipment will be installed by the HRW and the owner/developer shall pay the HRW a SCADA fee to cover the expense of the equipment installation at each sewer lift station. Pump seal failure lights are required for all pump stations. Strobe lights with power pack alarm system shall be installed on all pump station control systems. The alarm system shall be programmable at the station site. The control panel shall include dry terminal contact strips for the external output of all alarm signals to connect the System Control and Data Acquisition (SCADA) equipment to transmit the signals to a remote location that is manned and monitored 24 hours a day.

7.2.11 Overflow Prevention Methods

A satisfactory method shall be provided to prevent or minimize overflows. The following methods should be evaluated on an individual basis. The choice should be based on least cost and least operational problems for the HRW. The method selected shall provide an acceptable degree of reliability with the following considerations:

A. Storage capacity, including trunk sewers, for retention of wet weather flows (storage basins must be designed to drain back into the wet well or collection system after the flow receded); and

B. A permanently mounted pump or a portable pump, driven by an internal combustion engine, capable of pumping from the wet well to the discharge side of the station.

C. A portable standby generator with manual transfer switch will be required if the station flow rate is less than 15,000 gallons per day. A pad mounted, permanent standby generator with an automatic transfer switch will be required if the station flow rate is greater than or equal to 15,000 gallons per day.

D. HRW requires a pump bypass line to be designed from the wet well to the force main with the emergency connections to be set up beside the valve vault or the wet well. The temporary pump connections shall be designed with valves to be normally closed when the bypass line is not in operation. The pump bypass lines shall be equipped with quick-connect style fittings that allow the HRW staff to make the hose connections between the bypass line and the backup emergency pump quickly.

7.2.12 Instructions and Equipment

The HRW sanitary sewer lift stations and pumping stations shall be supplied with a complete set of Original Equipment Manufacturer (OEM) Manuals with the operational instructions, including emergency procedures, maintenance schedules, special tools, and such spare parts as may be necessary for each sewage pumping station. At least two additional copies shall be provided to the HRW Engineer.

Section 7.3 Site Construction

7.3.1 Fencing of the Pump Station Site - Chain Link Fence and Gates

All sewer lift station and pump station site areas shall be fenced covering at least a 50 ft. x 50 ft. area minimum. The entire site shall be covered with weed blocking material and at least six (6") inches of ABC washed stone or clean #57 stone or suitable granular material approved by the HRW. The fence shall include a personnel gate at least three (3 ft.) feet wide and a double vehicular gate twelve (12 ft.) feet wide comprised of two (2) - six (6 ft.) feet wide sections. Both the personnel gate and the vehicle gate shall be equipped with locking hasp that will accommodate a pad lock for security.

Fence Materials (All materials shall be Class I Galvanized Coated).

A. Fabric shall be 6 feet high, ends barbed, commercial grade 9 gauge.
Two (2) inch mesh with galvanized coating.

B. End, comer and pull posts to be 2-7/8" O.D. galvanized coated.

C. Top and line posts to be 1-7/8" O.D. galvanized coated.

D. Bottom tension wire shall be 7 gauge spring coil wire with galvanized coating.

E. Barb wire shall be 14 gauge galvanized barbs; font, point pattern on 5 inch centers, three (3) rows of outward facing barbed wire shall be used.

F. Gate posts shall be 4" O.D. galvanized coated.

G. A personnel gate shall be provided at least three (3 ft.) feet long by six (6 ft.) feet high. A vehicle gate shall be provided as a pair of eight (8ft.) feet long by six (6 ft.) feet high sections constructed of 2 inch O.D. pipe. Gate shall be equipped with a prop post center latch and hasp assembly. A ground anchor cast in concrete shall be provided. Gates shall be factory fabricated and equipped with gate holders.

7.3.2 Ground Cover

The entire site shall be covered with 8 mils thick black polyethylene plastic or other weed blocking material and then covered with at least 6 inches of clean #57 stone or suitable granular material to promote proper drainage. The site should be graded to eliminate erosion and sedimentation concerns. Berms or swales may be required to eliminate site flooding during heavy rain events. The site conditions shall be approved by the Harnett Regional Water. This covering shall extend one (1 ft.) foot outside the fence line.

7.3.3 Power Pole

The power pole shall be located within the fenced area and shall be located in such a manner so the electric meter can be easily read from outside the fenced area. The power supplier"s electric mater shall be placed on the power pole or the outside of the control panel hood. 107

7.3.4 Power Lines

All power lines within the site shall be underground (encased in Schedule 40 PVC conduit, not less than 2" I.D.). No overhead power line or other utility line shall be allowed to cross the site. Each sewer lift station shall be provided with three phase power of at least 480/277 volts unless approved by the HRW Engineer in writing.

7.3.5 Electrical Light

An exterior mercury vapor light (1200 watt minimum), automatically activated via photo-cell switch shall be mounted above ground on the power pole. The light shall be so located to provide adequate lighting for night maintenance. A fluorescent light fixture with a zero (0°) degree ballast controlled by a manual single throw switch shall be mounted under the control panel hood to provide better lighting to the controls at night.

7.3.6 Access Road

All pump station sites shall be serviced by an all weather road with top of road above the twenty-five (25) year flood elevation. Road and site drainage shall be included and approved by the appropriate agency. The pump station access road shall be paved if deemed necessary by the HRW Engineer or the HRW Utility Construction Inspector. The access road shall be at least 20 feet wide with adequate grade for drainage. Access roads with steep grade must be paved with asphalt or concrete.

Section 7.4 Suction Lift Pumps

Suction lift pumps shall be of the self-priming type (Gorman Rupp, Smith & Loveless, or approved equal) pumps and shall meet the applicable requirements of these specifications. Suction lift pump stations using dynamic suction

lifts exceeding the limits outlined may be approved by the HRW upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction lift as measured from "lead pump off' elevation to center line or pump suction, friction and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 6 feet (1.8 m).

The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent the humidity and corrosive sewer atmosphere from entering the equipment compartment. Valves shall not be located in the wet well.

7.4.1 Self Priming Pumps

Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 25 feet (7.6 m) in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 4 feet (1.2 m) from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction lift at the "pump off' elevation and required net positive suction head at design operating conditions shall not exceed 22 feet (6.7 m).

Section 7.5 Submersible Pump Stations

Submersible pump stations shall meet the applicable requirements stated herein. All submersible pump stations shall be non-clog style (ABS, F.E. Meyers, Homa, Zoeller or approved equal) pumps to suit flow conditions. Grinder style pumps are not preferred by the HRW but may be allowed on an individual case basis.

7.5.1 Construction

Submersible pumps and motors shall be designed, specifically, for raw sewage use, including totally submerged operation during a portion of each priming cycle. An effective method to detect shaft seal failure or potential seal failure shall be provided. The motor shall be of squirrel cage type design without brushes or other arc producing mechanisms.

7.5.2 Pump Removal

Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well by use of guide rails. The guide rails shall be secured to the wall of the wet well at least every three feet to secure the guide rails. Pumps and motors shall have adequate sized aluminum or stainless lifting chain. Lengths shall extend from the bottom of the wet well and reach top of station plus an additional 6' of chain.

7.5.3 Electrical

A. Power Supply and Control

Three (3Φ) phase power with at least 480 /277 volts shall be required at all submersible pump stations when three phase power is available as determined by the Harnett Regional Water. No add-a-phase is allowed to create a simulated three (3Φ) phase power supply. Single (1Φ) phase power will only be approved in rare instances when the distance to bring in the three (3Φ) phase power is cost prohibitive. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside of wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well or through use of watertight seals. If located outside, weatherproof equipment shall be used. Lightning arresters shall be required for all services located on the power meter base. Unbalanced voltage on motors shall not exceed 1%.

B. Controls

The motor control center shall be located outside the wet well and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code (NEC), to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal. Over and under (110+ %) voltage variance protection equipment shall be required. Each pump shall be equipped with thermal overload protection meeting the requirements of the pump manufacturer and the National Electrical Code (NEC).

C. Power Service Outlet

The control panel shall be provided with two (2) individual 110-120 volt power service outlets located on each end of the weatherproof panel. Each outlet shall be provided with a "while-in-use" type cover.

D. Concrete Pad

A concrete pad shall be provided for by the electrical control panel and extend a minimum of 3' measured from the face of the panel.

E. Power Cord

Pumps and motors shall be shipped with non-wicking electrical power cable, over heat cable, and seal failure cable, factory installed and tested cut ends and shall be sealed and tagged at the factory for shipping.

Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage and shall meet the requirements of the Mine Safety and Health Administration for trailing cables. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances, and shall be designed to facilitate field connecting.

Section 7.6 Force Main Design

7.6.1 Velocity

At design, average flow velocity of at least 2 feet per second (0.61 *m/x)* shall be maintained. A complete hydraulic analysis is required in determining force main sizes.

7.6.2 Air Relief Valve

An automatic air relief valve shall be placed at high points in the force main to prevent air locking.
Caution should be taken to design and construct force mains to a uniform slope to prevent air locking.
Air relief valves shall be located in shallow 4' manholes to allow for maintenance. Air relief valves shall be Crispin combination type air release valves or approved equal.

7.6.3 Termination

Force mains should enter the gravity sewer system at a point not more than 2 feet (3 0 cm) above the flow line of the receiving manhole. Terminus of force main shall be designed by a smooth transition of gravity flow of force main pipe into gravity pipe. Receiving manhole shall be adequately protected with a HRW approved coating to prevent hydrogen sulfide damage.

7.6.4 Design Pressure

The force main and fittings, including reaction blocking, shall be designed to withstand normal pressure and pressure surges (water hammer). Force main manifolding shall be avoided.

7.6.5 Special Construction

Force main construction near streams or used for aerial crossings shall meet applicable requirements previously addressed herein.

7.6.6 Design Friction Losses

Friction losses through force mains shall be based on the Hazen and Williams formula. When the Hazen and Williams formula is used, the following values for "C" shall be used for design.
PVC 120 unlined iron or steel.
When initially installed, force mains shall have a significantly higher factor. The higher "C" factor should be considered only in calculating maximum power requirements.

7.6.7 Separation from Water Mains

There shall be at least a 10 foot (3.0 m) horizontal separation between water mains and sanitary sewer force mains. Force mains crossing water mains shall be laid to provide a minimum vertical distance of 24 inches below the outside of the water main or ferrous pipe materials shall be used and a minimum of 18" separation shall be maintained between the water main and the force main.

7.6.8 Materials

The following pipe materials will be accepted by the HRW for force mains: PVC AWWA C900 Pressure Class 100 DR25, PVC SDR 21,200 psi and ductile iron ANSI A21.51 Class 50 with bituminous casting and Protecto 401 costing or approved equal.

7.6.9 Testing

All force mains shall be required to withstand a low pressure test in accordance with ASTM C 828.

7.6.10 Location

In both public and private road right-of-ways, force mains shall be located in accordance with Harnett Regional Water for Coordinating Utility Services.
A minimum permanent easement of 20 feet shall be provided where it is necessary to install force mains outside of a public highway right-of-way such as planned unit developments, private road right-of-way and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels. Force mains shall be located within road right-of-ways or public access areas (PUD's, private road right-of-ways). The same location requirements for public road right-of-ways shall apply.

Any change of direction greater than a 22 degree bend shall require a marker denoting change of direction.

7.6.11 Locator Wire

An insulated, solid conductor, #12 AWG copper wire THHM shall be provided for all water lines and sanitary sewer force mains as directed by the Harnett Regional Water for location of pipe line. The tracer wire should be taped to the top of the pipe using duct tape or similar adhesive tape until the backfill operation can be completed. The tracer wire shall not be spliced underground and it shall extend up to the surface on the outside of valve boxes and manholes per the HRW Standard Details. The locator tape is not sufficient to meet current HRW Standards.

7.6.12 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the North Carolina Department of Transportation. In no event shall open cuts in the roadway remain unpaved or patched, in keeping with highway standards, for more than 15 days. Failure on the part of the contractor to take adequate action on patching will force the HRW to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs.

7.6.13 Force Mains

- Air reliefs and detail.
- Provide a pigging access to force main in 1000" intervals on force mains less than 5000" and access and flush ports every 2500" on force mains greater than 5000".

Please see Chapter 12, General and Special Conditions, Section Special Construction Technical Specifications for additional information and requirements for construction.

CHAPTER 8

CONSTRUCTION OF SEWAGE PUMPING STATIONS

REQUIREMENTS

Chapter 8 CONSTRUCTION OF SEWAGE PUMPING STATIONS

Section 8.1 Construction of Sanitary Sewer Lift Stations

The Contractor shall install the sewer lift station(s) in accordance with the engineer"s design as approved by HRW and permitted by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR-DWQ) unless the existing site conditions preclude such installation or significantly impact the project. Should site conditions warrant plan revisions then follow the procedures outlined in Section 4.1 above. All materials used in the construction of the sewer lift station(s) shall meet the requirements specified in the sections below unless otherwise approved by the HRW Engineer.

Once each project has been approved by the HRW and permitted by the state, the approved plans will be issued to the contractor by the HRW Engineer. Copies of the approved plans will be stamped by the HRW Engineer as "Released For Construction," signed and dated to verify all plan changes requested by the state and the HRW have been addressed by the design engineer. During the pre-construction conference, the HRW Engineer will provide a copy of the state approved plans stamped as "Released For Construction" to the contractor and the HRW Utility Construction Inspector along with a copy of the permit. Only the state approved plans stamped by the HRW Engineer as "Released For Construction" shall be used for construction of any sanitary sewer lift station. The preliminary plans or other plans not marked as "Released For Construction" by the HRW shall cause an immediate work stoppage until the approved plans marked as "Released For Construction" shall be issued and maintained on site by the Contractor. The Contractor shall post the permit issued by NCDENR-DWQ on the site for the sewer lift station prior to the start of construction.

Section 8.2 Material Submittals and Shop Drawings

All materials to be used in the extension the construction of the sewer lift station(s) must be approved by HRW before they are purchased and delivered on any project site. Submit six (6) copies of the following material specification sheets and all associated shop drawings for the material to be used in the in accordance proposed project shall be furnished to the HRW Engineer or the HRW Utility Construction Inspector to demonstrate compliance with the stipulated requirements as set forth herein these specifications under the "General Conditions." The utility contractor shall furnish all types of pipe and other incidentals required for the construction of a complete sanitary sewer lift station as shown on the drawings and as specified herein. Unless otherwise noted, the materials listed below are acceptable to the HRW for use in the construction of any extension of Harnett Regional Water's sanitary sewer collection system. Should the contractor desire to use materials not listed in these specifications, written permission must be obtained from both the Professional Engineer (P.E.) of record and the HRW Engineer or designated personnel as approved by the HRW Director.

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purposes specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail. Connect to existing sanitary sewer mains and manholes as indicated by the project plans and under the direct supervision of the HRW Utility Construction Inspector or equivalent engineering representative of the HRW. Provide sanitary sewer main pipe, manholes, fittings, seals, combination air valves, air/vacuum valves, rubber seals, check valves, sanitary sewer service laterals, valve boxes, concrete valve box protective rings (donuts) and other system appurtenances as specified and where indicated per project utility plans approved by the HRW and permitted by the North Carolina Department of Environment and Natural Resources – Division of Water Quality (NCDENR- DWQ).

Section 8.3 Concrete Structures

8.3.1 Concrete Wet Wells

Wet wells shall be pre-engineered and constructed using pre-cast base sections, extended base sections, riser sections, and top slab sections with access hatches to simplify field installation for the concrete wet wells installed in Harnett County. All wet wells shall meet or exceed the ASTM standards and these specifications herein for the concrete, structural design, polypropylene reinforced steps, butyl-rubber mastic seal and wraps for water tightness. Wet wells shall be of precast concrete or poured-in-place concrete type. All wet wells shall be waterproofed. The

inlet and outlet pipes shall be joined to the wet well with a cast in place booted gasket and secured with stainless steel clamps.

Wet wells may be formed and poured on site if the completed concrete structure meets or exceeds the structural integrity of the manholes assembled using the pre-fabricated, pre-formed concrete manhole barrel, cone and riser sections and conforming to the following applicable ASTM standards:

A36/A36M Specification for Carbon Structural Steel
A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
C33 Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Standard]
C76M Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]
C150 Specification for Portland Cement
C260 Specification for Air-Entraining Admixtures for Concrete
C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
and Section 5.4.1 d above for reinforced concrete pipe (RCP).

Any work to construct wet wells by forming and pouring on site shall be directly supervised by the Professional Engineer (P.E.).

8.3.2 Concrete Valve Vault and Flow Meter Vault

Separate concrete vaults shall be ordered and installed to house the valves and flow meter for each submersible type sewer lift station. The concrete vaults shall be equipped with drains to keep them from retaining water. The drains shall be piped to the wet well with a flapper type check valve to assure the water flows one direction. The concrete vaults shall be sized by the Professional Engineer (P.E.) to house the check valves, gate valves and flow meter with adequate clearances. The contractor shall install the concrete vaults square and plumb according to the project plans and profiles. Concrete vaults shall be reinforced and manufactured to the same ASTM standards for the wet wells as outlined above in Section 8.3.1 and these specifications herein for the concrete, structural design, polypropylene reinforced steps, butyl-rubber mastic seal and wraps for water tightness. All concrete vaults shall be waterproofed. The inlet and outlet pipes shall be joined to the concrete vault with a cast in place booted gasket and secured with stainless steel clamps.

8.3.3 Water-Tightness

Each joint between every concrete section of the wet well shall be sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal. The seal shall be made of a stretchable, self-shrinking, intra-curing halogenated based rubber with a minimum thickness of 30 mils. The back side of each unit shall be coated with a cross-linked re-enforced butyl adhesive. The butyl adhesive shall be non-hardening sealant, with a minimum thickness of 30 mils. The seal shall be designed to stretch around the substrate then overlapped creating a cross-link and fused bond between the rubber and butyl adhesive. The

application shall form a continuous rubber seal that applies inward pressure on the protected area for the life of the application. The butyl adhesive and the inward pressure exerted on the substrate will prevent the intrusion of water and soil through the joint sections of a manhole, catch basin or concrete pipe. External rubber sleeve shall be UV and Ozone resistant and it shall meet or exceed the following:

Sheer Strength shall be 20 psi minimum per ASTM test method D816
Tensile Strength shall be 50 psi minimum per ASTM test method D412
Elongation % shall be 500 % per ASTM test method D412
Penetration shall be 60/140 MM minimum per ASTM test method D217
Low temperature shall be -49° F flexibility per ASTM test method D746
Heat aging, the material shall be able to withstand 90°C for 7 days and be able to reach 300% elongation at break and have a minimum tensile strength of at least 100 psi.

Section 8.4 Sewer Lift Station Minimum Requirements

8.4.1 Minimum Requirements

All projects that include a sanitary sewer lift station shall incorporate the entire sewer lift station as a complete pumping station to include but not limited to all pumps, generators, pipes, fittings, panels, wiring, controls, relays, alarms, hoists, fencing and concrete structures, ground cover as such sewer lift station is necessary to convey wastewater to the nearest sanitary sewer collection system or publicly-owned treatment works (POTW) facility owned and operated by the HRW. The Professional Engineer (P.E.) shall design the sewer lift station in accordance with the HRW Master Sewer Plan.

A. The following minimum requirements, standards, and specifications established by the HRW shall apply to all sewer lift stations constructed after August 20012 and these minimum requirements shall be satisfied by the contractor during the site construction:

1. Three (3) phase (480 volts) power must be provided for each sewer lift station. Exceptions must be approved in writing by the Engineer or the HRW Director in advance of the installation of any equipment at any new sewer lift station.

2. Multiple pumps (minimum of 2) each capable of pumping at a rate 2.5 times the average daily flow rate with any one pump out of service. Pump-On/Pump-Off elevations shall be set such that 2-8 pumping cycles per hour may be achieved in the sewer lift station under the average flow rate condition.

3. At least two (2) ground fault circuit interrupter (GFCI) receptacles rated for 110-120VAC shall be installed near the main control panel for each sewer lift station. One GFCI receptacle shall be located on each end of the control panel hood assembly and each one shall be provide with a while-in-use cover.

4. One (1) NEMA 4/4X stainless steel electrical control cabinet with minimum cabinet dimensions of thirty (30") inches width x of thirty (30") inches length x ten (10") inches depth shall be provided for the station pumps. Space should be left under the control panel hood assembly to add another NEMA 4/4X stainless steel electrical control cabinet with minimum cabinet dimensions of thirty (30") inches width x of thirty (30") inches length x ten (10") inches depth shall be provided for the SCADA system to be installed by HRW. The power (voltage and amps) rating for each control panel shall be labeled on the outside of the station pump control panel, the generator panel, automatic transfer switch (ATS) and disconnect panels with block letters and numbers at least three (3") inches tall. The block letters and numbers should be permanently mounted to the electrical panels and the use of adhesive type (peel & stick) letters and numbers will not be approved by HRW.

5. Gas/liquid barrier junction box or cable support for all cabling that enters the wet well with cord grip type unions. The junction box should be mounted near the top of the wet

well with and open raceway providing an air gap above the wet well penetration to the junction box allowing methane and sewer gases to escape between the wet well and the junction box such that all sewer gases from the wet well are prevented from entering the control panel(s).

6. Spare one (1") inch (minimum) conduit with an air gap from the RTU cabinet area to the liquid tight junction box of low voltage signal wire entry into the wet well.

7. Dry contact terminal strip shall be installed to provide SCADA connections for:

a. Pump run indication – Auxiliary contacts from pump motor starters.
b. High level alarm
c. Pump HOA (Hand or Automatic) switch in auto position (contacts on the HOA switches)
d. Pump seal failure and/or priming failure
e. Motor over temperatures
f. Motor overloads
g. Lag pump start
h. Three phase power failure or "single phasing"
i. Circuit breaker tripped or control power failure

8. For totally enclosed lift stations (i.e. Gorman Rupp and Smith & Loveless), provisions must be provided to connect RTU conduit to the motor control cabinet. One (1¼") NPT hole and one (1") inch hole will suffice. Totally enclosed sewer lift stations shall be provided with forced air ventilation and damper vents to reduce heat during the summer months and a heat source (light, heat strip, heat tape, etc.) to avoid freezing during the winter months.

9. Inline control circuit phase failure relays with spare contacts for SCADA monitoring.

10. 100-watt heat strip for moisture and temperature control of the cabinet environment.

11. Each pump installed in conjunction with the sewer lift station shall be equipped with run time meters or hour meters.

12. Each sewer lift station shall have a visible alarm light and an audible alarm horn to signal high level warnings.

13. A stainless steel or aluminum hooded control station must be provided. See the HRW Standard Sewer Details or contact the HRW Engineer for a fabrication guide.

14. All materials and construction shall comply with Standards and Specifications of Harnett Regional Water.

15. The sanitary sewer force main leaving the sewer lift station shall be installed with 12 gauge, insulated, solid copper conductor, tracer wire from the gate valves and/or check valves to the point of discharge manhole. The gate valves and check valves shall be located in a concrete valve vault with minimum dimensions of four (4") feet width x three (3") feet depth x six (6") feet length near the wet well to meet minimum requirements of the HRW Standards and Specifications. The valve vault shall remain accessible for maintenance and repairs with a positive head for drainage having an aluminum, locking type (Bilco) hatch or approved equal at least thirty (30") inches width x forty-eight (48) inches length.

16. Each sewer lift station must have an approved flow meter rated for sewer service (SCADA ready) installed in a separate concrete vault beside the valve vault with

minimum dimensions of four (4") feet width x three (3") feet depth x six (6") feet length. The flow meter should be an EMCO ultrasonic flow meter or approved equal with external transducers clamped onto the outside of the force main. The EMCO ultrasonic flow meter should be equipped with SCADA-Ready 4-20 mA I/O ports and have a cable extended to a remote readout display mounted near the control panel. The flow meter vault shall remain accessible for maintenance and repairs with a positive head for drainage and an aluminum, locking type (Bilco) hatch or approved equal at least thirty (30") inches width x forty-eight (48) inches length.

17. Each sewer lift station shall have potable water service on site consisting of at least one (1) yard hydrant installed during the construction of the project. The yard hydrant shall meet minimum requirements of the HRW Standards and Specifications and this water service should be equipped with an above ground RPZ installed inside a weatherproof housing.

18. Each lift station and pump station shall have an emergency pump connection on the force main with an associated shut-off valve to meet minimum requirements of the HRW Standards and Specifications. The force main(s) shall be at least four (4") inches in diameter unless otherwise approved by the HRW.

19. The wet well for each sewer lift station must be constructed of concrete lined with a protective coating and equipped with a maintenance manhole and/or associated bar screen to meet minimum requirements of the HRW Standards and Specifications. The joints between the prefabricated wet well sections shall be sealed externally with sealed with an external rubber sleeve (similar to Mac-Wrap, Infi-Shield Gator Wrap as manufactured by Sealing Systems, Inc) or approved equal as outlined in Section 5.5.6 of these specifications.

20. Each sewer lift station shall have an emergency generator sized to handle at least 2.5 times the rated electrical load for the entire sewer lift station that shall be mounted upon a concrete pad. In addition the emergency generator should be provided with an automatic transfer switch. An external connector plug sized to handle the output of an emergency generator as outlined above as a minimum requirement on all temporary sewer lift stations as pre-approved by the HRW. An alternative would be to provide HRW with a diesel driven emergency pump rated to handle at least 2.5 times the rated peak flow for the entire sewer lift station.

21. The emergency standby generator shall include a dry contact terminal strip for SCADA connections to monitor:

a. Generator in Automatic Mode
b. Generator Running
c. Common Engine Failure
d. Low Fuel Level and Fuel leak Detection
e. Low and High Water Temperature
f. Low Oil Pressure

22. Each sewer lift station shall be surrounded by security fencing at least six (6") high with twelve (16") feet wide double swinging gate comprised of two - eight (8 ft.) feet wide sections for vehicular traffic and one - three (3 ft.) wide single swinging gate for a personnel entrance. The security fencing installed around the sewer lift station shall be 50 ft. x 50 ft. as a standard area unless the station has pumps greater than 50 hp then the station shall have a 60 ft. x 60 ft. area unless otherwise approved by the HRW Engineer.

23. Each sewer lift station shall be provided with a SCADA pole, a SCADA antenna and associated telemetry to meet minimum requirements of the HRW Standards and

Specifications. HRW will install the SCADA system and invoice the developer for the SCADA Fees to cover the equipment and installation costs.

24. Each sewer lift station shall be provided an area security light (mercury vapor bulb) with photocell control. The weather hood over the control panel should include the installation of a fluorescent light fixture with a zero (0°) degree ballast above the control panel mounted far enough from the control panel to allow for full opening of the panel door without obstruction.

25. Each sewer lift station shall have an access road that is properly graded for adequate storm water run-off and at least twenty (20ft.) feet wide. The access road must be paved if the grade is more than 10 % but, it shall have at least six (6") inches of # 57 (crush and run) stone. The developer must provide the HRW a permanent easement for the sewer lift station and associated access road.

26. All bolts, mounting brackets, pump lift chains, etc., shall be stainless steel or manufactured of an approved material with proper corrosion resistance and properly sized and mounted to provide proper support for the applicable loads.

27. All wiring and electrical work shall conform to the latest revised National Electrical Code (NEC) and local guidelines. All wiring shall be identified at each termination on both ends.

28. New installations are required to meet the latest revised OSHA standards at the time of final acceptance. The contractor shall provide and install all site specific OSHA required labels and signs for the sewer lift station equipment. The hatch opening of the wet well shall be provided with a webbing or net to provide fall protection. The webbing or net shall be secured by hooks and reinforced grommets in the webbing or net.

29. The sewer lift station shall be located two (2") feet above the 100-year flood elevation and the 100-year flood elevations should be shown on the plans and As-Built record Drawings. The site for the sewer lift station must be provided with adequate means for drainage of storm water runoff whereby the station site will not be flooded during significant rain events of more than 2" inches of rainfall. The entire site shall be provided with weed blocking material below gravel for adequate drainage inside the station. The gravel shall be ABC washed stone installed at least six (6") inches thick on top of the weed block material.

30. Site visits by the HRW Utility Construction Inspector will be required and scheduled for the following actions:

a. Before final plan approval,
b. Pressure testing the force main
c. When pumps are set,
d. Pump draw down testing,
e. Generator startup testing,
f. Final Inspection of all sewer lift station equipment and when flow is applied.

Final start up testing shall be coordinated with the Design Engineer, the HRW Engineer, the OEM Pump Manufacturer Representative, OEM Generator Manufacturer Representative, the HRW SCADA Supervisor and the HRW Collections System Supervisor. Final start up testing shall include Items D & E above at a minimum. The flow meter shall be calibrated prior to the HRW final acceptance of the sewer lift station.

31. A spare pump and motor assembly shall be provided to the HRW for each sewer lift station. One spare pump and electric motor or one diesel driven pump and diesel motor shall be provided to HRW for each sewer lift station. In addition to the spare pump

assembly, the contractor shall furnish to the HRW one complete set of spare parts for the electric generator including: an air filter, an oil filter, and a fuel filter along with one spare set of accessory belts if applicable. An emergency pump connection shall be constructed with a tee, a gate valve and quick connect nozzle for the emergency pump connection between the valve vault and the flow meter vault.

32. The contractor shall provide HRW with at least three (3) sets of OEM operating and maintenance manuals for all equipment. The manuals must be original as provided by the manufacturer and bound. Spare parts as required by HRW shall be boxed for long term storage with part numbers and identification labels. Items subject to handling damage will not be accepted if the factory packaging has been opened. All manuals and spare parts are to be turned over to HRW at final inspection and acceptance of the pump station.

33. The generator must have a mezzanine or catwalk around it to provide adequate access to service, inspect and test the unit. If the doors on the enclosure cannot be opened and removed to service, the unit without a ladder or lift then the contractor must construct a mezzanine or catwalk around it to provide adequate access. Generally, when the access door panels are more than two (2") feet above finish grade or the concrete pad then a mezzanine or catwalk will be required by the HRW.

34. The sewer lift station must be provided with a JIB crane, boom and electric hoist to remove and replace the pumps when the pumps are larger than 25 hp. The boom must extend at least twelve (12") feet from the edge of the wet well and be able to lift the pump at least six (6") feet off the ground in order to allow a pump to be loaded into the bed of a service truck. A JIB crane that rotates 360° will be required for pumps greater than 60 hp.

35. The sewer lift station must be provided with a tee and two valves between the flow meter vault and the valve vault in order to accommodate the quick connection of a diesel driven pump. Diesel driven pumps may be used to replace the emergency generator if approved by the HRW in advance and permitted with NCDENR-DWQ before installation.

36. The 911 address for the sewer lift station cannot be assigned until the map for the subdivision has been provided to the Harnett County E-911 Department. Once the 911 address has been assigned for the sewer lift station, each sewer lift station shall have a placard mounted at the gate which clearly identifies the HRW station number and assigned E-911 address for the station per item # 37 below. The Contractor shall be responsible to install the placard sign or pay for the installation thereof.

37. Each sewer lift station shall be provided a standard sign (32" wide x 16" tall) designating the facility as the property of **Harnett Regional Water**. The station sign should have large red letters on a white background denoting the **Sewer Lift Station #** (to be assigned by HRW Collections Department), the **911 address** (to be assigned by E911) and **In Case Of Emergency call telephone number (910) 893-2424**. The sign shall be permanently mounted on the security fencing of the main gate at eye level. The signs currently posted by Harnett Regional Water (HRW) have been ordered from Advanced Signs of Angier and their telephone number is (919) 639-0794. All questions concerning the station sign should be directed to the HRW Collections Systems Supervisor at (910) 893-7575 extension 3243.

38. The Developer must provide HRW with a map and deed which describes all metes and bounds for the easements for the sewer lift station, the associated force main and the access road. If the project includes a utility easement, then the deed and all pertinent utilities easement(s) must be assigned to HRW and recorded with the Harnett County

Register of Deeds office. The Developer or Registered Land Surveyor (RLS) should coordinate all recording of deed(s) and utility easement plat(s) with the HRW Right-of-Way Agent at (910) 893-7575 extension 3277.

Section 8.5 Site Construction

All pump station site areas to be fenced shall be 50' x 50' minimum. The entire site shall be covered with weed blocking material and at least six (6") inches of ABC washed stone or clean #57 stone or suitable material approved by Harnett Regional Water.

8.5.1 Fencing of the Pump Station Site - Chain Link Fence and Gates

A. General: This section covers furnishing of all labor, materials, tools, equipment, and performing all work and services necessary or incidental to furnish and install complete all chain link fence and gates as shown on drawings and as specified in accordance with provisions of the Contract Documents and completely coordinated with that of all other trades.

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete and compatible installation shall be furnished and installed as part of this work. Provide each type of steel fence and gate, complete, produced by one manufacturer, including necessary erection accessories, fittings and fastenings.

B. Submittals: Show fence layout, post locations, gates, details illustrating fence height, location and sizes of posts, rails, braces, footings, hardware list and erection procedures.

Product Delivery, Storage and Handling: Store fence fabric, posts and other items off ground and protected from damage.

C. Job Conditions: Verify suitability of substrate to accept installation. Installation assumes responsibility for performance.

D. Materials-General: Use only new materials. Pipe sizes indicated are commercial pipe sizes. Tube sizes indicated specified are nominal flange dimensions. Roll form section sizes are nominal outside dimensions. Open seam material not allowed.

Hot-dip galvanized iron or steel components after fabrication. Use finish complying with the following minimum requirements unless otherwise noted:

- Pipe: ASTM A120, 1.8 oz. zinc/sf.
- Square Tubing: ASTM A123, 2.0 oz. zinc/sf.
- H-sections: ASTM A123, 2.0 oz. zinc/sf.
- Hardware and Accessories: ASTM A153
- Fabric: ASTM A392, Class I, 1.2 oz. zinc/sf.
- Misc. Items: ASTM A120, 1.8 oz. zinc/sf.

Provide one-piece wire fabric 6 feet width, unless otherwise noted on the drawings, No. 9 wire gauge woven into 2-inch mesh. Furnish selvages (top and bottom) with twisting and barbing. Provide steel line posts 2-1/2 inch o.d. pipe weighing 3.65 lbs. per lineal foot or 2-1/2-inch square tubing weighing 4.1 lbs. per lineal foot, or 2-1/4-inch H-section weighing 4.1 lbs. per lineal foot. Provide steel top rails 1-5/8 inch o.d. pipe weighing 2.27 lbs. per lineal foot. Fit rails with expansion couplings of outside sleeve type. Rails shall be continuous outside sleeve type for full length of fence. Steel terminal shall be end, corner and pull posts, referred to herein as terminal posts 3 inches o.d. pipe weighing not less than 5.79 lbs. per lineal foot, or 2-1/2-inch square tube weighing 5.79 per lineal foot. Provide posts of sufficient length to permit bottom 36 inches to be

set in concrete. Bracing for use between terminal, end, corner, gate and pull posts, and first adjacent line posts shall be 1-5/8 inch o.d. pipe weighing not less than 2.27 lbs. per lineal foot.

Provide gate posts of round steel pipe not less than the size and weight given below: Single gate up to 6 feet wide: 3 inches o.d. weighing not less than 5.79 lbs. per lineal foot. Single gate 6 feet wide up to 13 feet wide: 4 inches o.d. weighing 9.11 lbs. per lineal foot. Square tube of same or greater weight may be used in lieu of round pipe. Provide posts of sufficient length to permit bottom 36 inches to be set in concrete.

Tension bars shall be 3/16 inches' x 3/4 inches' minimum steel, one piece for full height of fabric. Stretcher bar bands shall be steel, wrought iron, or malleable iron to secure stretcher bars to terminal, end, pull, corner and gate posts. Space not over 12 inches o.c.

Fabric bands shall be either No. 9-gauge aluminum wire or aluminum straps for securing fabric to line posts and rails. Fabric bands shall be either No. 9-gauge aluminum wire or aluminum straps for securing fabric to terminal posts, aluminum straps. Space bands not greater than 24 inches o.c. Gate frames shall be not less than 2 inches o.d. steel pipe weighing not less than 2.72 lbs. per lineal foot, or 2-inch square tubing weighing not less than 3.65 lbs. per lineal foot. Barbed wire shall be galvanized two strand 12-1/2-gauge wire with 14 gauge 4 point barbs spaced 5 inch o.c.

E. Gate Hardware: Hinges shall be pressed or forged steel or malleable iron to suit gate size, or non-lift-off, heavy-duty type, offset to permit 180-degree gate opening. Provide 1-1/2 pair for each leaf over 6 feet nominal height.

Latches for single gates shall be heavy-duty automatically engaging type arranged to permit operation from either side of gate. Provide latching devices lockable, with padlock, from either side, latches for double gates with automatic engaging latch on one leaf and drop rod type latch on other leaf. Furnish drop rod complete with suitable casting set in concrete to hold gate leaf in place when drop rod is engaged. Provide keepers for all gates to automatically engage gate leaf and hold it in open position until manually released. Provide a padlock with two keys and heavy-duty, straight-link machine chain for each gate. The Contractor shall provide concrete foundations for all posts. Concrete shall consist of cement aggregate and clean water mixed to obtain 2,500 psi strength in 28 days. Combination post top cap and barbed wire supporting arms shall be steel, wrought, or malleable iron complete with provisions for anchorage to posts and attaching 3 rows of barbed wire. Provide one cap and angled arm for each post where barbed wire is required.

F. Erection: The term "main post" used herein refers to terminal, gate or pull posts, as case may be. Use terminal, gate or pull post material and size as described herein under Materials. Employ only experienced and skilled mechanics to erect fence. Do not start fence installation before final grading is complete and finish elevations are established. Install fence in true and correct alignment with posts vertical. Drill holes in firm, undisturbed or compacted soil. Size holes to extend not less than 4 inches below bottoms of posts.

Set all posts in concrete foundations with crowned, steel troweled, tops of following minimum diameters:

- Ten (10) inch dia. for line posts.
- Twelve (12) inch diameter for all posts, except line posts, to 6 inches in dia.
- Eighteen (18) inches dia. for posts between 6 inches & 9 inches diameter.

Install fence tight, free of sags and bulges. Place fence with bottom edge of fabric 2 inches above grade. Correct minor irregularities in earth to maintain 2-inch clearance.
Space line posts at equal intervals not exceeding 10 feet o.c. Install main posts at gates, ends of runs, changes in alignment, or at other points of strain. Fit terminal posts with bracing assemblies between terminal posts and line posts adjacent to terminal posts.

Provide top rails with expansion couplings at not more than 20 feet intervals. Use couplings which provide rigid connection and allow for expansion and contraction. Anchor top rails to main posts with appropriate wrought or malleable fittings.

Install bracing assemblies at all main posts and at both sides of corner and pull posts. Locate compression members at mid-height of fabric. Extend diagonal tension members from compression members to bases of main posts. Use tension members not less than 3/8-inch diameter and fitted with tension take-up device. Install braces so that posts are plumb when diagonal rod is under correct tension.

Pull fabric taut and secure to posts and rails. Install fabric on security side of fence and secure to framework so that fabric remains in tension after pulling force is released. Secure fabric to posts at not greater than 12 inches o.c., and to top rails at not greater than 24 inches o.c. Use U-shaped wire conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend ends of wire to minimize hazards to persons or clothing. Thread stretcher bars through fabric and secure to posts with metal bands spaced not greater than 15 inches o.c.

Construct gate frames with heavy wrought or malleable fittings at joints, or by welding at joints, to produce rigid and weatherproof joints. Bracing and details of construction to provide a rigid, non-sagging, non-twisting gate. Use fabric same as fence fabric and similarly attached. Do not weld fabric to frame. Furnish frames with provision for 3 rows of barbed wire at top.

Provide center rails only where shown. Install in one piece between posts and flush with posts on fabric side using special offset fittings where required.

Remove and replace all damaged or improperly installed fencing components to satisfaction of the Engineer at no additional expense to the Owner.

8.5.2 Additional Requirements

The following additional requirements shall be required for sewer lift stations with pumps larger than 50 HP or as determined by HRW:

A. A JIB crane, boom and the electric pump hoist shall be designed by the Professional Engineer to accommodate the weight of the pump and motor assembly provided with the project to aid the removal and re-installation of the pumps for repairs. Some consideration of future upgrade may be required for sizing the crane, boom and hoist.

B. The emergency generator must be a permanently mounted generator with an automatic transfer switch and a mezzanine catwalk to access the unit for servicing and repairs. The mezzanine catwalk shall be equipped with a set of steps on two sides of the unit.

C. The emergency generator shall be provided with a rain hood to cover the generator and the mezzanine catwalk. The rain hood shall extend above the generator by at least 24 inches and over the catwalk by at least 36 inches.

D. The wet well must be provided with anti-floatation ring if installed in flood plain or wetlands.

E. A concrete pad shall be included with the sewer lift station design for a sampling station or odor control equipment to include a chemical tank and pump for delivery of odor control chemicals to the wet well.

F. A concrete basin or retaining wall shall be constructed around the generator fuel tank(s) and the odor control chemical tank to contain any potential spill. The containment area shall be equipped with a drain and plug to allow for easy removal of the spilled fuel or chemical.

G. Lightning protection must be designed for the sewer lift station electrical equipment where the pumps will exceed 50 HP in size.

H. The sewer lift station shall have three pumps with one of them being a diesel driven pump connected to the fuel supply of the emergency generator or provided with a separate fuel storage container on site designed to be large enough so the emergency diesel driven pump can run at least 24 hours.

8.5.3 Structures

A. Equipment Removal

Provisions shall be made to facilitate removal of pumps, motors, and other mechanical and electrical equipment. Guide rails and chain falls shall be provided in submersible stations to aid in the removal of pumps. The guide rails shall be supported properly and evenly by attaching the guide rails to the wet well wall every 3-4 feet. The guide rails, support brackets and hardware shall be constructed with stainless steel material.

B. Access

Suitable and safe means of access shall be provided to the wet wells and pits containing either bar screens or mechanical equipment requiring inspection or maintenance. Steps shall be provided in the concrete structures for adequate means of ingress and egress.

C. Construction Materials

Due consideration shall be given to the selection of materials because of the presence of hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in sewage. The HRW prefers the use of stainless steel bolts, nuts, washers, fittings and appurtenances.

8.5.4 Pumps

A. Installation

Pumps shall be installed by a qualified pump mechanic with care to avoid damage to the pump motor, pump impeller and housing. The pumps shall not be started or operated by the pump mechanic without the pump manufacturer's representative on site. The pumps must be in good condition when installed and any damages to the pump or motor shall be the responsibility of the contractor to repair or correct at no additional expense to the HRW. The pump mechanic should pay close attention to the proper alignment of the pump when it is installed and check the proper rotation of rotating assembly. The electrician should make certain the pump is wired correctly to achieve the correct rotation in accordance with the manufacturer's recommendations. 122

B. Warranty

The contractor shall take every precaution to install the pump correctly so as not to void the manufacturer's warranty. The contractor shall warranty the pump(s) for a period of one year after the acceptance by the HRW.

C. Pump Openings

Pumps shall be capable of passing solid spheres of at least 3 inches (7.6 cm) in diameter, and pump suction and discharge piping shall be a minimum of 4 inches (10. 2 cm) in diameter.

D. Priming

The pump shall be so placed that under normal operating conditions it will operate under a positive suction head.

E. Electrical Equipment

Electrical systems and components (e.g. motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code (NEC) requirements for Class 1, Group D, Division I locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. The wires and cables entering the wet well shall pass through a cable tray with an appropriate vent or removable top that can be vented by the HRW staff to create an air gap between the junction box and the wet well so that sewer gases will not pass into the electrical control panel. The first point of connection shall be a terminal strip inside a junction box that can be sealed off from the main control panel. The junction box shall be installed within close proximity to the wet well to keep the leads and connections to pump controls, motor "hog heads" and level measuring devices as short as possible as depicted in the Harnett Regional Water's Standard Details found at the end of these specifications.

All work to install wiring and make up terminal connections shall be performed by a qualified licensed electrician or mechanic under his direct supervision. All electrical panels and disconnects shall be labeled with the system voltage. Peel off sticker type letters are not approved for labels. The labels shall be made with white letters engraved into black acrylic to be permanently mounted on the electrical panels and fused disconnects. The electrical equipment shall be properly grounded and labeled as indicated herein these specifications.

F. Electrical Enclosures

When such equipment is exposed to weather, an appropriate housing shall be supplied as follows:

1. Electronics, alarms, automatic switch gear, electro-mechanical devices, telemetry or any other such moisture sensitive devices shall be housed in a NEMA 4X stainless steel enclosure.

2. Fuse boxes, main disconnects, manual switch gear or any device not critically moisture sensitive may be housed in a NEMA 3R or NEMA 4 enclosure or better.

3. No holes will be allowed in the top of NEMA 4X enclosures. Holes in other sides of that enclosure will be kept to a minimum in number and size utilizing approved waterproofing technicalities.

4. The primary control enclosure may be required to provide space for future telemetry in critical areas as specified by HRW staff. 123

G. Intake

Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake. Intake piping shall be as straight and short as possible.

H. OEM Manuals

Each pumping station or sewer lift station shall be provided with the operating and maintenance manuals as written by the Original Equipment Manufacturer (OEM). The contractor shall provide the OEM manuals (in good condition) for each pumping station or sewer lift station to the HRW Engineer. The one-year warranty on the pumps cannot begin until the OEM manuals have been delivered to the HRW Engineer and all testing and inspections have been completed with satisfactory results.

8.5.5 Controls

A. Type

Control systems shall be of the encapsulated float type. The electrical equipment shall comply with the National Electrical Code requirements for Class 1, Group D, Division I locations. Over and under voltage monitoring equipment with a three-minute timer is required (motor saver).

B. Location

The control floats shall be located away from the turbulence of incoming flow and pump suction. The above ground control panel shall be so located to prevent accessibility to the panel and wet well simultaneously.

C. Alternation

In small sewer lift stations, provisions should be made to automatically alternate the pumps in use.

D. Wiring

Control wiring should be designed to fully utilize the dual pump aspect of the station. Wiring layouts should avoid contacts in series that promote total pump station failure by one float failure. All wiring shall be color coded to conform to the National Electrical Code (NEC), latest edition. All grounds shall be made using green colored wire. All future SCADA connections must have appropriate conduit supplied to each piece of equipment sized appropriately by the Engineer of Record.

E. Grounding

Each sewer lift station shall be provided with at least two copper clad aluminum ground rods at least ten (10") feet in length and driven in the ground to be covered when connected. The ground rods shall be placed near the base of the area light pole and near the location for the service meter from the power supplier. The main control panels shall be properly grounded so the resistance to ground is less than 5 ohms.

8.5.6 Valves

A. Suction Line

Suitable shutoff valves shall be placed on the suction line of each pump except on submersible and vacuum primed pumps.

B. Discharge Line

Each pump discharge line shall have a weighted arm check valve, a plug valve and a mechanical joint fitting. Ball valves may be used at the discretion of Harnett Regional Water. Check valves shall not be placed on the vertical portion of discharge piping. Valves shall be capable of withstanding normal pressure and water hammer.

C. Location

Valves shall be located in a separate valve pit. Valves shall not be located in the wet well. Flow meters shall be located in a separate flow meter pit. Flow meters shall not be located in the valve pit.

D. Drainage

Accumulated water from the valve pit and flow meter pit shall be drained to the wet well or to the surrounding soil at least ten (10ft.) feet from the station perimeter. If the valve pit is drained to the wet well, an effective method shall be provided to prevent sewage from entering the pit during surcharged wet well conditions such as the use of a flapper type check valve on the drain line located inside the wet well. A check valve must be installed on the drain line between the wet well and valve vault to prevent sewer backups into the valve vault.

E. Routine Maintenance

Each pump station shall be provided with a 3/4" water tap for routine maintenance with appropriate cross connection protection provided (only when water service is within 500 feet of the station).

8.5.7 Wet Wells

A. Size

Minimum wet well diameter shall be 6 feet. However, the wet well and control setting shall be appropriate to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention time.

B. Steps

Steps shall be properly located for accessibility and shall be of a non-corrosive material as approved by Harnett Regional Water. Steps shall be excluded from the wet well unless otherwise noted.

C. Hatches

All access covets shall be aluminum (Bilco, Halliday, or US Foundry), appropriately sized for accessibility and large enough to provide a clear access to all appurtenances.

D. Rust Proofing

All bolts, nuts, washers, hangers, rails, and related hardware within the wet well shall be stainless steel.

E. Floor Slope

The wet well floor shall have a minimum slope of one to one to the hopper bottom. The horizontal area of the hopper bottom shall not be greater than necessary for proper installation and function of the inlet.

F. Flood Proofing & Floatation

The top of the slab for the wet well shall be at least two (2') feet above the 100-foot flood elevation or so designed to prevent flooding and floatation on the wet well (i.e. water tight hatch covers increased base slab, etc.).

G. Ventilation

Adequate ventilation shall be provided for all pump stations. The vent pipe shall be rust resistant (PVC or stainless steel) and shall contain a 1/8" bug stainless steel screen.

Where wet wells, dry wells, and pump stations are installed, special ventilation design considerations shall be given to provide continuous or intermittent ventilation. Ventilation rate, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wet well rather than exhausted from the wet well. 125

H. Influent Pipe

Developments that would require more than one influent pipe reaching the wet well site should incorporate them into a control manhole prior to entering the wet well to allow for future bypassing of the wet well for maintenance purposes.

I. Coating

All wet wells may be required to have an atmospheric and moisture resistant coating as approved by the HRW to prevent degradation of the concrete surface by hydrogen sulfide.

J. Odor Control

Odor control devices approved by Harnett Regional Water shall be provided at pump stations located in critical areas (i.e. high flow/high density areas) as determined by the HRW. Such devices may include air scrubbers or odor depressant injector systems. A concrete pad with the 6ftx6ft 4inches thick with 300psi concrete must be supplied for future Odor Control. The Pad must have 1inch conduit from the pad to the wet well. There must be a dedicated 120v circuit beside the pad.

8.5.8 Flow Measurement

Suitable devices for measuring sewage flow shall be installed at all sanitary sewer lift stations and sewer pumping stations. At a minimum, a flow meter shall be installed on the force main and run time meters shall be installed for each pump. Run time meters shall be so designed as to operate only when voltage is supplied to the primary pump wiring. A third run time meter shall be installed that runs when both pumps are operating to indicate a combined run time.

An EMCO ultrasonic flow meter or approved equal shall be attached to the force main to measure the flow leaving the station. The EMCO ultrasonic flow meter shall be strapped on using stainless steel bands with wire lead extending to the digital readout mounted under the hood for the control panel. The flow meter shall be calibrated for wastewater flow once the station has been inspected, tested and certified for operation. The flow meter shall be equipped with a 4-20 mA external output to provide a signal to the SCADA system. The flow meter shall be placed on the force main inside the flow meter vault so that there is sufficient length of unobstructed pipe for the ultrasonic flow meter to work properly in accordance with the manufacturer's recommended guidelines for proper installation.

8.5.9 Water Supply

There shall be no physical connection between any potable water supply and a sewage pumping station which under any conditions might cause contamination of the potable water supply. When a potable water supply is brought to the station, it should comply with conditions stipulated elsewhere in this policy including the proper backflow protection. The water service shall be installed to a yard hydrant that is installed to proper depth to avoid freezing. The water service line for the yard hydrant shall be provided with a RPZ for adequate backflow protection. The RPZ shall be installed in an above ground weather proof enclosure with a positive head for drainage.

8.5.10 Alarm Systems

Alarm systems shall be provided for all pumping stations. The alarm shall be activated in case of power failure, pump failure, or any cause of pump station malfunction. The HRW shall require all sewer lift stations and sewer pumping stations to have alarms with the 4-20 mA external outputs that can be connected to the SCADA system. The HRW does not use auto dialers for transmission of operating parameters and alarm telemetry. The HRW has connected all sewer lift stations to an independent System Control and Data Acquisition (SCADA) computers at the North Harnett Regional Wastewater Treatment Plant and the Collections office in Lillington, NC where the HRW staff can monitor the SCADA system 24 hours a day. Audiovisual alarm systems with a self-contained power supply may be acceptable in addition to the SCADA equipment outlined above, depending upon location, station holding capacity and inspection frequency. Generally, all sewer lift stations shall have a SCADA system to monitor the station operating parameters and the SCADA equipment will be installed by the HRW and the owner/developer shall pay the HRW a SCADA fee to cover the expense of the equipment installation at each sewer lift station. Pump seal failure lights are required for all pump stations. Strobe lights with power pack alarm system shall be installed on all pump station control systems. The alarm system shall be programmable at the station site. The control panel shall include dry terminal contact strips for the external output of all alarm signals to connect the System Control and Data Acquisition (SCADA) equipment to transmit the signals to a remote location that is manned and monitored 24 hours a day. 126

8.5.11 Overflow Prevention Methods

A satisfactory method shall be provided to prevent or minimize overflows. The following method should be evaluated on an individual basis. The choice should be based on least cost and least operational problems for the HRW. The method selected shall provide an acceptable degree of reliability with the following considerations:

A. Storage capacity, including trunk sewers, for retention of wet weather flows (storage basins must be designed to drain back into the wet well or collection system after the flow receded); and

B. An in place or portable pump, driven by an internal combustion engine, capable of pumping from the wet well to the discharge side of the station.

C. A portable standby generator with manual transfer switch will be required if the station flow rate is less than 15,000 gallons per day. A pad mounted, permanent standby generator with an automatic transfer switch will be required if the station flow rate is greater than 15,000 gallons per day.

D. HRW requires a pump bypass line to be designed from the wet well to the force main with the emergency connections to be set up beside the valve vault or the wet well. The temporary pump connections shall be designed with valves to be normally closed when the bypass line is not in operation. The pump bypass lines shall be equipped with quick-connect style fittings that allow the HRW staff to make the hose connections between the bypass line and the backup emergency pump quickly.

8.5.12 Instructions and Equipment

The HRW sanitary sewer lift stations and pumping stations shall be supplied with a complete set of Original Equipment Manufacturer (OEM) Manuals with the operational instructions, including emergency procedures, maintenance schedules, special tools, and such spare parts as may be necessary for each pump and emergency

generator at every sewer lift station or sewage pumping station. At least two additional copies shall be provided to the HRW Engineer before or during the draw down test. The final inspection and testing of any sewer lift station or sewage pumping station shall not be approved until the OEM Manuals have been provided to HRW.

8.5.13 Ground Cover

The entire site shall be covered with 8 mils thick black polyethylene plastic or other weed blocking material and then covered with at least 6 inches of clean #57 stone or suitable granular material to promote proper drainage. The site should be graded to eliminate erosion and sedimentation concerns. Berms or swales may be required to eliminate site flooding during heavy rain events. The site conditions shall be approved by the Harnett Regional Water. This covering shall extend one (1 ft.) foot outside the fence line.

8.5.14 Power Pole

The power pole shall be located within the fenced area and shall be located in such a manner so the electric meter can be easily read from outside the fenced area. The power supplier's electric mater shall be placed on the power pole or the outside of the control panel hood.

8.5.15 Power Lines

All power lines within the site shall be underground (encased in Schedule 40 PVC conduit, not less than 2" I.D.). No overhead power line or other utility line shall be allowed to cross the site. Each sewer lift station shall be provided with three phase power of at least 480/277 volts unless approved by the HRW Engineer in writing.

8.5.16 Electrical Light

An exterior mercury vapor light or high pressure sodium light (1200 watt minimum), automatically activated via photo-cell switch shall be mounted above ground on the power pole. The light shall be so located to provide adequate lighting for night maintenance. In addition to the area light, a fluorescent light fixture with a zero (0°) degree ballast controlled by a manual single throw switch shall be mounted under the control panel hood to provide better lighting to the control panels under the hood at night.

8.5.17 Access Road

All pump station sites shall be serviced by an all-weather road with top of road above the twenty-five (25) year flood elevation. Road and site drainage shall be included and approved by the appropriate agency. The pump station access road shall be paved if deemed necessary by the Engineer and the HRW Utility Construction Inspector. The access road shall be at least 20 feet wide with adequate grade for drainage. Access roads with steep grade must be paved with asphalt or concrete.

Section 8.6 Pumps

8.6.1 Suction Lift Pumps

Suction lift pumps shall be of the self-priming type (Gorman Rupp, Smith & Loveless, or approved equal) pumps and shall meet the applicable requirements of these specifications. Suction lift pump stations using dynamic suction lifts exceeding the limits outlined may be approved by the HRW upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction lift as measured from "lead pump off' elevation to center line or pump suction, friction and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 6 feet (1.8 m).
The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent the humidity and corrosive gases of the sewer atmosphere from entering the equipment compartment. Valves shall not be located in the wet well. The pump enclosure shall be vented to keep pumps and motors cool

during summer months. The pump enclosure shall be equipped with source of heat to protect the pumps and lines from freezing in the winter months. The manufacturer's requirements for proper installation must be followed by the contractor so as not void the manufacturer's warranty.

8.6.2 Self Priming Pumps

Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 25 feet (7.6 m) in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 4 feet (1.2 m) from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction lift at the "pump off' elevation and required net positive suction head at design operating conditions shall not exceed 22 feet (6.7 m).

8.6.3 Submersible Pump Stations

Submersible pump stations shall meet the applicable requirements stated herein. All submersible pump stations shall be non-clog style (ABS, F.E. Meyers, Homa, Zoeller or approved equal) pumps to suit flow conditions. Grinder style pumps are not preferred by the HRW but may be allowed on an individual basis. The manufacturer's requirements for proper installation must be followed by the contractor so as not void the manufacturer's warranty.

8.6.4 Construction

Submersible pumps and motors shall be designed, specifically, for raw sewage use, including totally submerged operation during a portion of each priming cycle. An effective method to detect shaft seal failure or potential seal failure shall be provided. The motor shall be of squirrel cage type design without brushes or other arc producing mechanisms.

8.6.5 Pump Removal

Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well by use of guide rails. The guide rails shall be secured to the wall of the wet well at least every three feet to secure the guide rails. Pumps and motors shall have adequate sized aluminum or stainless lifting chain. Lengths shall extend from the bottom of the wet well and reach top of station plus an additional 6' of chain.

8.6.6 Electrical

A. Power Supply and Control

Three (3Φ) phase power with at least 480 /277 volts shall be required at all submersible pump stations when three phase power is available as determined by the Harnett Regional WaterNo add-a-phase is allowed to create a simulated three (3Φ) phase power supply. Single (1Φ) phase power will only be approved in rare instances when the distance to bring in the three (3Φ) phase power is cost prohibitive. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside of wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well or through use of watertight seals. If located outside, weatherproof equipment shall be used. Lightning arresters shall be required for all services located on the power meter base. Unbalanced voltage on motors shall not exceed 1%.

B. Controls

The motor control center shall be located outside the wet well and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code (NEC), to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be

so located that the motor may be removed and electrically disconnected without disturbing the seal. Over and under (110+ %) voltage variance protection equipment shall be required. Each pump shall be equipped with thermal overload protection meeting the requirements of the pump manufacturer and the National Electrical Code (NEC).

C. Power Service Outlet

The control panel shall be provided with two (2) dedicated 110-120-volt power service outlets located on each end of the weatherproof panel. Each outlet shall be provided with a "while-in-use" type cover.

D. Concrete Pad

A concrete pad shall be provided for the electrical control panel and extend a minimum of three (3 ft.) feet as measured from the face of the panel. The emergency generator or emergency pump shall be provided with a concrete pad that extends at least two (2 ft.) feet outside the unit on all four sides.

E. Power Cord

Pumps and motors shall be shipped with non-wicking electrical power cable, over heat cable, and seal failure cable, factory installed and tested cut ends and shall be sealed and tagged at the factory for shipping.

Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage and shall meet the requirements of the Mine Safety and Health Administration for trailing cables. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances, and shall be designed to facilitate field connecting.

Section 8.7 Force Main Construction

8.7.1 Location

The force main for any sewer lift station shall be installed in accordance with the Engineer's design to the proper depth unless existing utilities or other obstruction prevents such an installation. Any existing utilities or other obstructions that limit or prevent the proper installation of the force main shall be identified prior to start of construction where practical and identified for the Engineer. If the force main location must be changed than the contractor shall construct the force main in accordance with approved change order from the Engineer and HRW. In both public and private road right-of-ways, force mains shall be located in accordance with Harnett Regional Water for Coordinating Utility Services. A minimum permanent easement of 20 feet shall be provided where it is necessary to install force mains outside of a public highway right-of-way such as planned unit developments, private road right-of-way and commercial areas, etc. or a combination of 15' common property easement and 15' building setback for lines installed between adjacent parcels. Force mains shall be located within road right-of-ways or public access areas (PUD's, private road right-of-ways). The same location requirements for public road right-of-ways shall apply. Any change of direction greater than a 22-degree bend shall require a marker denoting change of direction.

8.7.2 Locator Wire

An insulated, solid conductor, #12 AWG copper wire THHM shall be provided for all water lines and sanitary sewer force mains as directed by Harnett Regional Water for location of pipe line. The tracer wire should be taped to the top of the pipe using duct tape or similar adhesive tape until the backfill operation can be completed. The tracer wire shall not be spliced underground and it shall extend up to the surface of the finished grade on the outside of valve boxes and manholes per the HRW Standard Details. The locator tape is not sufficient to meet current HRW Standards. The location of the force main shall be identified by the use of tracer wire taped to the top of the pipe

during the installation prior to backfilling. The tracer wire shall be brought up to the surface of the finished grade inside valve boxes at least every 500 feet. The valve boxes will have cast iron lids marked "sewer."

8.7.3 Air Relief Valve

An automatic air relief valve shall be placed at high points in the force main to prevent air locking. Caution should be taken to design and construct force mains to a uniform slope to prevent air locking. Air relief valves shall be located in shallow 4' manholes to allow for maintenance. Air relief valves shall be Crispin combination type air release valves or approved equal.

8.7.4 Termination

Force mains should enter the gravity sewer system at a point not more than 2 feet (3 0 cm) above the flow line of the receiving manhole. Terminus of force main shall be designed by a smooth transition of gravity flow of force main pipe into gravity pipe. Receiving manhole shall be adequately protected with a HRW approved coating to prevent hydrogen sulfide damage.

8.7.5 Design Pressure

The force main and fittings, including reaction blocking, shall be constructed to withstand normal test pressure and pressure surges (water hammer) up to 200 psi. The force main shall be constructed with ductile iron pipe inside the sewer lift station fence and then converted to PVC pipe beyond the station fence. The pipe transition must be made at a valve using mechanical joints with grip rings.

8.7.6 Special Construction

Force main construction near streams or used for aerial crossings shall be installed with ductile iron pipe and meet applicable requirements previously addressed herein.

8.7.7 Separation from Water Mains

There shall be at least a 10 foot (3.0 m) horizontal separation between water mains and sanitary sewer force mains. Force mains crossing water mains shall be laid to provide a minimum vertical distance of 24 inches below the outside of the water main or ferrous pipe materials shall be used and a minimum of 18" separation shall be maintained between the water main and the force main. The force main shall be installed under the existing water mains to provide the proper separations as stipulated herein.

8.7.8 Materials

The following pipe materials will be accepted by the HRW for force mains: PVC AWWA C900 Pressure Class 100 DR25, PVC SDR 21,200 psi and ductile iron ANSI A21.51 Class 50 with bituminous casting. See Chapter 6 of these specifications for the minimum specifications of the pipe material for the construction of a sanitary sewer force main.

8.7.9 Testing

All force mains shall be required to withstand a low pressure test in accordance with ASTM C 828. The HRW Utility Construction Inspector must witness the pressure testing of the force main in sections not to exceed 1,000 feet. The pressure test shall be performed using water not air at a pressure not to exceed 200 psi for at least 2 hours. Any leakage during the testing of a sanitary sewer force main is not acceptable and the contractor shall repair any force main that cannot hold the pressure for at least 2 hours.

8.7.10 Patching and Paving

Roadway patching and paving shall be in keeping with the latest edition of the North Carolina Department of Transportation. In no event shall open cuts in the roadway remain unpaved or patched, in keeping with highway standards, for more than 2 days. Failure on the part of the contractor to take adequate action on patching will force

the HRW to sublease a paving contractor for the repairs. The contractor will be billed for such work and project acceptance will be subject to payment for repairs.

8.7.11 Force Mains

All force mains shall be installed and constructed to meet or exceed these specifications including the following requirements per NCDENR and HRW approved plans:

- Air reliefs and detail.
- Provide a pigging access to force main in 1000" intervals on force mains less than 5000" and access and flush ports every 2500" on force mains greater than 5000".

Please see Chapter 12, General and Special Conditions, Section Special Construction Technical Specifications for additional information and requirements for construction.

CHAPTER 9

WATER SYSTEM STANDARDS AND SPECIFICATIONS

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CHAPTER 9 WATER SYSTEM STANDARDS AND SPECIFICATIONS

Section 9.1 Design of Water System Improvements

All line extensions and improvements to the Harnett Regional Water's existing water distribution system shall be designed by a Professional Engineer (P.E.). The Engineer's plans and details shall be approved by HRW and permitted by the North Carolina Department of Environment and Natural Resources – Division of Water Resources, Public Water Supply Section (NCDENR-DWR, PWSS) before any construction may begin on proposed water system improvements. The Professional Engineer must follow the Plan and General Requirements described in Chapters 2-4.The Contractor shall notify the Engineer if site conditions prevent the construction of the water system improvements as planned by the Engineer, approved by the HRW and permitted by the NCDENR-DWR, PWSS. Should site conditions warrant plan revisions then follow the procedures outlined in Chapter 4 under Section 4. 1. 11 above for plan approval of all system improvements. All materials used in the water system improvements shall meet the requirements specified in the specifications unless otherwise approved by the HRW Engineering Representative or the HRW Director in writing.

Once each project has been approved and permitted by the state, the approved plans will be returned to the HRW and then copies will be made for the contractor and the HRW Utility Construction Inspector. Copies of the state approved plans will be stamped by the HRW Engineering Representative as "Released For Construction," signed and dated to verify all plan changes requested by the state and the HRW have been addressed by the design engineer. During the pre-construction conference, the HRW Engineering Representative will provide a copy of the state approved plans stamped as "Released for Construction" to the contractor/developer and the HRW Utility Construction Inspector. Only the HRW approved plans as permitted by the NCDENR-DWR, PWSS stamped by the HRW Engineering Representative as "Released for Construction" shall be used for construction of any water system improvements to the existing Harnett Regional Water's water treatment plant or the water distribution system.

Section 9.2 Materials & Design Requirements

The Professional Engineer (P.E.) shall design the water system improvements using only materials approved under Rules Governing Public Water Systems NCAC Title 15A DENR Subchapter 18C Sections .0100 through .2200 or latest edition, Harnett Regional Water's Standards and Specifications latest edition, and included herein. Unless otherwise noted, the materials listed below are acceptable to the HRW for use in the design of any line extension or system improvement of the Harnett Regional Water's water distribution system. Should the P.E. desire to use materials not listed in these specifications, written permission must be obtained from both the HRW Director and the HRW Engineering Representative or designated personnel as approved by the HRW Director.

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purposes specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail. Connection to existing water mains as indicated under the direct supervision of the HRW Utility Construction Inspector or equivalent engineering representative of HRW. Provide water main pipe, fittings, accessories, resilient seat or resilient wedge type gate valves, rubber seated butterfly valves, fire hydrants, combination air valves, air/vacuum valves, altitude control valves, check valves, cast iron valve boxes, tapping saddles, service saddles, corporation stops, polyethylene (CTS) plastic tubing, soft "K" copper tubing, meter setters, meter boxes, concrete valve box protective rings (donuts) and concrete valve markers as specified and where indicated per project utility plans approved by the HRW and permitted by the

North Carolina Department of Environment and Natural Resources – Division of Water Resources, Public Water Supply Section.

Any engineer designing project(s) to improve the Harnett Regional Water's water distribution system or to extend new water mains, water service lines or repair of the existing water distribution system shall abide the specifications herein and shall have a copy of these specifications. The specifications shall govern the design of any such system improvements and be submitted to the North Carolina Department of Environment and Natural Resources – Division of Water Resources, Public Water Supply Section (NCDENR-DWR, PWSS) along with the utility plans and an engineer's report to obtain the appropriate "Authorization to Construct" (water) DWR permit issued by the NCDENR-DWR, PWSS for the proposed project. In addition, the P.E. shall obtain an Erosion and Sedimentation Control permit issued by the North Carolina Department of Environment and Natural Resources – Division of Land Quality (NCDENR-DLQ) for any land disturbing activity that disturbs more than one (1) acre of soil. In addition, the P.E. shall obtain Wetland permit issued by the state of North Carolina and/or United States Army Corps of Engineers (USACE) for any wetland disturbance that may be caused by the project construction. The P.E. shall complete the North Carolina Department of Transportation (NCDOT) encroachment agreement to cover all work proposed within the right-of-way of any state maintained street or road. All of these permits and agreements shall be obtained by the P.E. for the Contractor to post on the project job site for any authority having jurisdiction over the project to see the appropriate permits and agreements have been issued to Harnett Regional Water or the developer as required by state law.

Section 9.3 Water Main Design

9.3.1 Pressure

All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on the flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow including domestic fire flow of 500 gpm in residential communities and 500 gpm in commercial areas. The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi. All pipe to be selected for water system improvements shall be able to withstand system pressures up to 200 psi. Water distribution mains shall be sized to provide a minimum pressure at all points within the distribution system of not less than 20 pounds per square inch (gauge) during periods of peak demand (fire flow), but in any case water mains shall not be less than two-inch standard nominal diameter. Fire hydrants shall not be installed on water mains of less than six inches diameter or on water mains or water systems not designed to carry fire protection flows. All systems shall have the capacity to maintain a pressure of at least 30 pounds per square inch (gauge) throughout the system during periods of peak domestic flow.

9.3.2 Diameter

Pipe sizes acceptable to the HRW are based upon nominal diameters of 2 inch, 4 inch, 6 inch, 8 inch, 12 inch, 16 inch, 20 inch, 24 inch, 30 inch and 36 inch. Larger pipe diameters shall be designed by the Professional Engineer (P.E.). Pipe diameters less than 2 inches are not acceptable for water mains. The minimum size of water main for providing fire protection and serving fire hydrants shall be 6 inches diameter. Larger size mains shall be required if necessary to allow for the withdrawal of the required fire flow while maintaining the minimum residual pressure specified herein.

9.3.3 Fire Protection

When fire protection is provided, system design shall be such that fire flows and facilities are in accordance with the requirements of the UDO (Chapter 7 Section 6.4.4) or latest revision, or a minimum of 500 gpm delivery in

residential areas 500 gpm in commercial areas with 20 psi residual pressure. The local Fire Marshal having jurisdictional authority over the project may require greater flow than the minimum flows listed above.

9.3.4 Small Water Mains

Any departure from minimum requirements shall be justified by hydraulic analysis and future water use, and may be considered only in special circumstances. Generally, pipe diameters of less than 4 inches are not acceptable. However, a pipe 2 inches in diameter may be acceptable by the HRW on a case by case basis (short extensions, dead ends, cul-de-sacs). All pipe under 4inches in diameter shall bear the NSF # 61 certification label.

9.3.5 Hydrants

Water mains less than six (6") inches diameter or water mains not designed to carry fire flows shall not have fire hydrants connected to them. Fire hydrants shall satisfy the requirements set forth in Section 7.4.5 below and shall
be installed on water mains six (6") inches in diameter or greater. The Harnett County Fire Marshal requires that fire hydrants shall be placed at each intersection including the entrance to each new development. The fire hydrants shall be located on the right side of the street as firefighting apparatus would travel into the development. Fire hydrants should be spaced out evenly along each new street with the spacing in between each fire hydrant not to exceed 1,000 feet.

9.3.6 Dead Ends and Reductions in Size of Water Line Pipe

Dead ends shall be minimized by looping of all mains whenever practical. The construction drawings shall include a two (2") inch blow off assembly at the end of each dead end water line in accordance with Detail W-2 to allow the HRW staff to flush the dead-end water line on a regular basis. Since the Harnett County Fire Marshal requires that each and every residential lot be within 500 feet of the nearest fire hydrant, the HRW requires the design engineer to measure the 500 feet along the centerline of the street from the rear property line of the last lot on any cul-de-sac or dead-end street to determine the point where the last fire hydrant should be placed on the dead-end street. Then the water line should be reduced down to a smaller water line of at least two (2") inches in diameter to serve the lots at the end of the street not to exceed 12 lots. The water line design shall include an in-line gate valve at each location where the water line diameter is reduced and the gate valve shall be located on the smaller side of the reducer fitting. This will enable the HRW staff to determine where the water line has been reduced in diameter.

9.3.7 Flushing

Where dead end streets will be served by water mains, there shall be provided a fire hydrant if flow and pressure are sufficient or with an approved flushing hydrant. No flushing device shall be directly connected to any sewer. Post hydrants or flushing hydrants shall be Mueller 24058 or approved equal. If the water line cannot support a flushing hydrant then the engineer shall design a two (2") inch blow off assembly to be installed at the end of the water main. The blow off assembly shall be located on the opposite corner from the last meter setter on the end of the water main. The blow off assembly shall be located at least one (1 ft.) foot within the NCDOT right-of-way at the property corner. A temporary two (2") inch blow off assembly shall be required at the end of all temporary water line terminations and the design of the blow off assembly shall include a gate valve sized equal to the main water line.

9.3.8 Size of Mains

All water mains designed to be installed within public streets and NCDOT state maintained rights-of-ways shall be sized in accordance with the HRW Water Distribution System Master Plan. Generally, all water mains installed within public streets and NCDOT state maintained rights-of-ways shall be at least eight (8") inches in diameter

unless otherwise approved by the HRW Engineer. The Professional Engineer (P.E.) designing any project to extend water mains from Harnett Regional Water's existing water distribution system shall consult with the HRW Engineering Representative to assure the requirements of the HRW Water Distribution System Master Plan will be satisfied by the design of the new project. The HRW Water Distribution System Master Plan is subject to change at any time to meet the needs of the growing population of Harnett County and the surrounding areas.

9.3.9 Materials and Locations

The Professional Engineer must design the proposed water main extensions with the materials specified herein.

Section 9.4 Materials

9.4.1 Standards

All materials used in the construction of water line extensions to be added to the Harnett Regional Water's water distribution system shall comply with the requirements of the Safe Drinking Water Act and meet the requirements established by the American Society for Testing Materials (ASTM), the American Water Works Association (AWWA), the Ductile Iron Pipe Research Association (DIPRA), the American Association of State Highway and Transportation Officials (AASHTO) and the American National Standards Institute (ANSI), American Society of Sanitary Engineering (ASSE) and all other federal, state, county and local requirements. See Section 9.15.3 for Material Submittals and Shop Drawings.

9.4.2 Water Main Materials

A. PVC PIPE – THINWALL POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

As a minimum, PVC 2 inch through 12 inch shall conform to pressure rated Class 200 PSI standard dimension ratio SDR 21 as required by AWWA Standard C-905 unless otherwise specified. All pipe less than four (4") inches in diameter shall bear the NSF # 61 certification label indicating approval for use in public water systems. All PVC pipe shall meet the requirements of ASTM Standard D-2241. Pipe supplied with gasketed joint shall meet the requirements of ASTM Standard D-3139 and the joint gasket shall conform to the requirements of ASTM Standard F-477. All PVC pipe shall meet the requirements of NSF Standard # 14, "Plastic Piping Components and Related Materials," and Standard # 61, "Drinking Water System Components-Health Effects." The PVC pipe shall display the "NSF-PW" listing mark signifying use in potable water applications. Pipe shall be installed and tested in accordance with theses specifications and the manufacturers" suggested procedures. The PVC compound material for extruding shall meet ASTM Standard D1784. The rubber coupling rings shall meet ASTM standard D2672 or ASTM D3139.

Pipe shall be furnished in factory packaged units and each pipe shall be plainly marked with the manufacturer's name, size, material (PVC), type, grade or compound pressure rating and reference to appropriate product standards each pipe length shall bear the stamped seals of approval from Underwriters Laboratory (UL) and National Sanitation Foundation (NSF).

Harnett Regional Water does not allow the use of glued pipe, joints or fittings to be installed in the Harnett County water distribution system. Pipe specimens shall be subjected to tests by an independent testing laboratory at such time as the HRW staff may direct or as specified herein. Pipe not meeting these specifications will be ordered remove from the project site by the HRW Utility Construction Inspector and such pipe shall be immediately

removed from the job site and not transported to any portion of the project being constructed or any other project to be extended from or integrally connected to the Harnett Regional Water's water distribution system.

B. DUCTILE IRON PIPE

Ductile Iron Pipe, except flange pipe, shall conform to the ANSI/AWWA C151/A21.51-02. All Ductile Iron Pipe shall be NSF # 61 certified, Pressure Class 350 for pipe 12" diameter and smaller. All larger pipes shall be Pressure Class 250. Flanged pipe shall conform to ANSI/AWWA C115/A21.15-05. The ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining per ANSI/AWWA C104/A21.4-03 standard thickness and all ductile iron shall conform to the requirements of ASTM A-536, latest revision, Grade 70-50-05.

9.4.3 Joints

A. Mechanical Joints

Packing and jointing materials used in the joints of all pressure pipe shall meet the current standards of the AWWA and the HRW. All joints on pressure pipe installed underground shall be mechanical joint ductile iron fittings with grip rings for reinforcement.

B. Slip-On or Push-On Joints

PVC pipe shall require slip on joints with rubber gaskets. Fittings for pipe 4" up to 12" shall be DI Push Joint IPS/PVC, Class 250, ASTM A-536 and F-477 or DI Mechanical Joint with Grip Rings, Class 350, AWWA C110. For pipe smaller than 4", fittings shall be PVC Push Joint 200 psi PR with elastomeric gaskets (synthetic type) must meet ASTM Standard D-1784, D-3139, and F-477.

C. Flanged Joints

The flanged joints shall be used in above ground connections or connection installed inside concrete vaults. Flanged joints cannot be approved for use in direct burial pipe. Flanged joints shall be manufactured by a domestic foundry in accordance with applicable ASME Code Section IX and ASNI B31.1 for pressure piping. The flanged fittings shall meet o9r exceed the requirements of AWWA C115/ANSI 21.15-05 for Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges and AWWA C207-01 for Steel Pipe Flanges for waterworks Service – Size 4 Inches through 144 inches.

D. Locking Joints

The locking joints shall be used in instances where the Engineer deems appropriate for the reinforcement of the joint. The locking joints shall be Griffin Field-Lok or approved equal for use with direct burial pipe. Locking joints must be assembled in compliance with the manufacturer's standards and recommended guidelines.

9.4.4 Tapping Sleeves

All tapping sleeves installed in the Harnett Regional Water's water distribution system shall be constructed with stainless steel material and meet the requirements established in AWWA Standard C223-02. Stainless steel fabricated tapping

sleeves shall be Romac model SST or approved equal made from stainless steel material that meets or exceeds the requirements of ANSI/AWWA C220. Cast Iron tapping sleeves are not permitted to be used in the Harnett Regional Water's water distribution system. Tapping flanges for stainless steel fabricated tapping sleeves shall meet or exceed the requirements of ASTM A240, ASTM A743/A743M, or ASTM A744/A744M.

The tapping sleeve shall be installed per the manufacturer's installation instructions provided with the fabricated tapping sleeve. The manufacturer's instructions must be followed regarding support of the valve and the tapping machine during the tapping procedure. The contractor shall hydrostatically test the seal between the gasket of the tapping sleeve on the pipe of the existing water main and the gate valve before the tapping machine may be set up to perform the tap. The contractor may tap into the existing water main only after the hydrostatic pressure test has been completed with satisfactory results. For personal safety reasons, do not use a compressible fluid medium (such as air) to check for water tightness.

The HRW Utility Construction Inspector must witness the hydrostatic testing on the tapping sleeve and valve assembly as well as the tapping procedure on the existing water main. The coupon removed from the existing water main when the water line is tapped shall be given to the HRW Utility Construction Inspector. The HRW Utility Construction Inspector shall return the coupon to the HRW Engineering Representative for a visual analysis. Additional non-destructive analysis may be performed by the HRW Engineering Representative on the coupon to determine the condition of the existing water main. Coupons removed from AC pipe shall be sealed in a plastic bag to reduce the potential for fraying or dispersal of asbestos material. 135

9.4.5 Gaskets

Gaskets shall be molded or extruded natural or synthetic rubber free of porous areas and visible defects. Reclaimed rubber shall not be used. Unless otherwise specified, gaskets shall be suitable for water service to 150°F (65°C). Gaskets for the body of the tapping sleeve shall meet the requirements of ASTM D2000. Gaskets needed for the body of the tapping sleeve shall have a minimum diameter of 50 and minimum tensile strength of 800 psi. Gaskets for flanges shall conform to ANSI/AWWA C207.

9.4.6 Valves

A. Gate Valves (12 inches and smaller)

Gate valves installed in the Harnett Regional Water's water distribution system shall be manufactured by Mueller, American Flow Control, M&H, Kennedy, Waterous or approved equal. Gate valves shall be cast iron conforming to AWWA standard C500 and rated for a working pressure of 200 psi for valves up to 12 inches in diameter and 150 psi for valves larger than 12 inches in diameter. Gate valves shall be mechanical joint, resilient seat type valves with non-rising stem, "0" ring seal, open left with 2-inch square operating nut. Gate valves shall be of one manufacturer. It is strongly recommended that instruction manuals supplied by the valve manufacturer be reviewed in detail before installing gate valves. The contractor should inspect the valve and accessories on the jobsite prior to installation.

Gate valves shall be resilient seated or resilient wedge type gate valves suitable for use with buried piping. All gate valves shall conform to AWWA standard C509-01 or latest version and/or AWWA standard C515-01 or latest version and they shall be NSF 61 certified. All valves smaller than 24 inches in diameter shall be configured and installed in a vertical position. Gate valve end connections shall be mechanical joint with grip rings for buried pipe or flanged joint for pipe installed above ground and for pipe installed inside an underground vault or enclosed structure as

indicated by the project drawings. Gate valves with flanged joints shall only specified for installation within an underground vault permitting personnel access and they must be equipped with hand wheels for operation. Gate valves shall have a non-rising valve stem with a 2-inch square operating nut. Gate valves shall open by counter-clockwise rotation of the operating nut. Stuffing boxes shall have "0" ring stem seals, except for those valves for which gearing is specified, in which case use conventional packing in place of the "0" ring stem seal. Stuffing boxes shall be bolted and constructed so as to permit easy removal of the parts for repair. The wedge shall be cast iron, completely encapsulated with resilient material. The resilient sealing material shall be permanently bonded to the cast iron wedge with rubber-tearing bond to meet ASTM standard D-429. The gate valve stem and stem nut shall be copper alloy. The body and bonnet shall be coated both interior and exterior with a fusion bonded heat cured thermo setting material meeting all application and performance requirements of the AWWA standard C550-05.

B. Check Valves

Check valves shall be manufactured by Mueller, American Flow Control, M&H, Kennedy or approved equal in accordance with AWWA standard C508-01 or latest version. Check valves shall be swing type check valves with iron or steel body and cover and flanged ends. Check valves shall have iron disc with bronze disc ring and seat ring. Valve to be lever and weight controlled with lever and weight on left side of valve when viewing valve in the direction of flow. All internal iron surfaces of the valve shall be coated with a minimum of 10 mils of fusion bonded or liquid epoxy, approved for potable water.

C. Butterfly Valves

Butterfly valves installed in the Harnett Regional Water's water distribution system shall be manufactured by Mueller, Kennedy, Pratt, American Flow Control, Dezurik Water Controls, Keystone or approved equal. Butterfly valves shall conform to AWWA standard C504-06 or latest version for Class 150B service and shall be NSF 61 certified. Valve bodies shall be constructed of cast iron meeting the ASTM standard A-126 Class B and conform to AWWA standard C504-06 for laying lengths and minimum body shell thickness. Butterfly valves end connections shall be mechanical joint or flanged joint as indicated by the project drawings. Butterfly valves with flanged joints shall only specified for installation within an underground vault permitting personnel access and they must be equipped with hand wheels. 136

Valve discs shall also be made of cast iron meeting the ASTM standard A-126 Class B or ASTM standard A-48 Class 40 in sizes 24" and smaller. Disc shall be furnished with 316 stainless steel seating edge to mate with rubber seat on the body. Valve seat shall be Buna-N rubber located on the valve body. Valves 20 inches in diameter and smaller shall have bonded seats that meet test pressures outlined in the ASTM standard D-429 Method B. For valve sizes 24 inches in diameter and larger, the valve seats shall be retained in the valve body by mechanical means without the use of metal retainers or other devices located in the flow stream.

Butterfly valve shafts shall be manufactured of 18-8 type 304 stainless steel conforming to ASTM standard A-276. Shaft seals shall be standard self-adjusting split V packing and shaft seals shall be of a design allowing replacement without removing the shaft. Valve bearings shall be sleeve-type, corrosion resistant and self-lubricating. The valve shaft bearings shall be heavy duty bronze, properly fitted into thee hubs which are integrally cast into the valve body.

Valve actuators shall be fully grease packed and have stops in the open position. The actuator shall have a mechanical stop which will withstand an input torque of 450 ft.-lbs against the stop. The traveling nut shall engage alignment groves in the housing. The actuator shall have a built in packing leak bypass to eliminate possible packing leakage into the actuator housing. All internal and external surfaces shall be covered with a polyamide cured epoxy coating applied over a sand blasted "new white metal surface" per SSPC-SP10 to a minimum of 6 mils in compliance with AWWA standard C-550-05 or latest version. External painting, hydrostatic testing, travel stop adjustments and crating for shipment shall be completed by the manufacturer in accordance with the AWWA standard C504-06 or latest version. It is strongly recommended that instruction manuals supplied by the valve manufacturer be reviewed in detail before installing butterfly valves. The contractor should inspect the valve and accessories on the jobsite prior to installation.

Valve actuators shall be fully grease packed and have stops in the open position. The actuator shall have a mechanical stop which will withstand an input torque of 450 ft.-lbs against the stop. The traveling nut shall engage alignment groves in the housing. The actuator shall have a built in packing leak bypass to eliminate possible packing leakage into the actuator housing. All internal and external surfaces shall be covered with a polyamide cured epoxy coating applied over a sand blasted "new white metal surface" per SSPC-SP10 to a minimum of 6 mils in compliance with AWWA standard C-550-05 or latest version. External painting, hydrostatic testing, travel stop adjustments and crating for shipment shall be completed by the manufacturer in accordance with the AWWA standard C504-06 or latest version. It is strongly recommended that instruction manuals supplied by the valve manufacturer be reviewed in detail before installing butterfly valves. The contractor should inspect the valve and accessories on the jobsite prior to installation.

D. Surge Relief and Backpressure Valves

Surge relief and backpressure valves shall be flanged iron globe body; fully bronze mounted; external pilot operated with free floating piston; operated without springs, diaphragm, or levers; single seat with seat bore equal to size of valve. Valves shall be manufactured in accordance with AWWA standard C506. All surfaces of iron castings shall be coated with a minimum of two coats of a serviceable grade of asphaltic base metal paint. The valve design shall be such that repairs and internal dismantling of the main valve may be done without removing the valve from the water main. Valve working and surge pressures will be shown on the drawings or designated in the "Special Conditions." . It is strongly recommended that instruction manuals supplied by the valve manufacturer be reviewed in detail before installing surge relief and backpressure valves. The contractor should inspect the valve and accessories on the jobsite prior to installation.

E. Air Release/Air Relief Combination Valves for Water Lines

The air release/air relief valve shall include a vacuum check unit. The air release valve shall be installed at the highest point(s) on the water main as indicated by the project plans in order to release air in the main as the water main is filling and allow air to enter when the water main is being emptied to prevent pipe collapse when subject to negative pressure or vacuum. The air release valve shall be manufactured to meet or exceed the requirements of ANSI/AWWA C512-04 or latest edition and shall be NSF 61 certified. Valves shall be iron manufactured with screwed inlet connections and rated for a working pressure of 150 psi. The air release valves shall be Crispin Universal Air Valve model U20 with 1/4" orifice, Val-Matic, A.R.I. or approved equal. The valve shall be operated through a compound level system that will seal both the pressure orifice and the air vacuum orifice simultaneously. This lever system shall permit a ¼" orifice to

release an accumulation of air from the valve body at a capacity of 98 cfm of air at 150 psig. The function lever of the valve shall permit a positive disengagement of the main valve from the large orifice. As the float drops the pressure decreases, the disengagement of the main valve from the large orifice shall be immediate and not limited to an initial draw of vacuum. The air release valve(s) shall be two (2") inches in diameter with national pipe threads (NPT) or ANSI Class 125 flanged inlet connection and shall be a cast iron body, top and inlet flange (where required), stainless steel float and trim with a BUNA-N rubber seat. Valves, which operate the pressure plunger via a single lever and fulcrum, will not be acceptable. A protect top shall be supplied to keep debris from entering the outlet of the valve. Air release valve(s) shall be two (2") inches in diameter include a two (2") inches in diameter, non-rising stem (NRS) solid disc, inside screw bonnet gate valve with a 200 WOG pressure rating and conforming to Federal Specifications MSS SP-80. Each air release valve shall be installed inside a manhole as shown in detail sheet of the project plans if included with the project. Air release valves are not required for most water line extensions.

F. Indicator Posts

Indicator Posts shall be supplied for gate valves and butterfly valves as specified in the project plans. Indicator Posts shall be FM approved and installed to meet the established requirements of the Harnett County Fire Marshal having jurisdiction over the project. Indicator posts shall have a means to lock the valve open or closed.

9.4.7 Fittings and Bends

Pipe manufacturers have a specified amount of deflection that the pipe can bend. If the design of any water line will exceed the manufacturer's tolerance for deflection then the design shall incorporate the use of bends and fittings to accomplish turns, offsets and other adjustments for water line alignment. All fittings and bends shall be installed with mechanical joints and grip rings for pipe sizes up to 12" diameter and be installed with appropriate concrete reaction blocking. All fittings and bends shall be installed with mechanical joints and Megalugs for pipe sizes over 12" diameter and be installed with appropriate concrete reaction blocking. The fittings shall conform to the following applicable AWWA standards:

C104/A21.4-03 Cement- Mortar Lining for Ductile Iron Pipe & Fittings for Water
C110/A21.10-03 Ductile Iron & Gray Iron Fittings for Water
C111/A21.11-00 Rubber Gasketed Joints for Ductile Iron Pressure Pipe &Fittings
C900-97 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4" through 12"
C901-02 Polyethylene (PE) Pressure Pipe and Tubing, ½" through 3" for Water Service
C903-05 Polyethylene-Aluminum-Polyethylene & Crossed- Linked Polyethylene-Aluminum-Cross-Linked Polyethylene Composite Pressure Pipes, ½" through 2" for Water Service
C905-97 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14" through 48", For Water Transmission and Distribution
C906-99 Polyethylene (PE) Pressure Pipe and Fittings, 4" Through 63", For Water Transmission and Distribution
C907-04 Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4" Through 12", For Water Distribution.

Section 9.5 Main Line Valves

9.5.1 Valve Location

Sufficient valves shall be provided on all new water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves shall be located at intervals not to exceed 700 feet in any commercial district and not more than 1,000 feet in residential districts. Two valves are required on each tee, one on the main line and one on the lateral line unless the water mains are looped. Three valves are required for all tees where the water mains are looped. Four valves are required for all crosses, two valves on the branches or laterals and two in-line valves. An in-line gate valve shall be included with each hydrant tee except at fire hydrants located at intersections. Each valve shall be provided with and concrete valve marker with brass insert stamped with distance and direction denoted. All valves shall require concrete valve location markers, except within interior subdivisions, where the Professional Engineer (P.E.) shall reference valves on the "As-built" Record Drawings to at least two permanent above ground structures. The concrete valve location markers should be included on the "As-built" Record Drawings.

9.5.2 Location of Bends in Water Mains

Bends and fittings shall be depicted in plans where the water mains shall turn more than the allowable deflection will be exceeded by the design. All bends greater than 22.5° degrees shall be marked in the field by setting two concrete markers at the edge of the right-of-way or easement in line with the bends. The top of the markers shall be stamped with the distance to each bend or fitting and the markers shall be turned backwards so the HRW staff will not confuse them for valve markers or blow off markers.

9.5.3 Valve Operation and Protection

All valves (gate valves, butterfly valves, plug valves, etc.) installed in the Harnett Regional Water's Water Distribution System shall meet AWWA standards and be provided with an adjustable cast iron valve box with an 18" x 18" x 6" concrete collar in accordance with the HRW Standard Details. The valves that are installed more than eight (8 ft.) feet below finished grade shall be provided with extensions on the operating nuts to raise them up to be within six (6 ft.) feet of the finished grade.

Section 9.6 Fire Hydrants

9.6.1 Location and Spacing

Hydrants shall be provided at each street intersection and at intermediate points between intersections as recommended by the Harnett County Fire Marshal. Generally, hydrant spacing may range from 500 to 1,000 feet depending on the area being served. Larger spacing increments may be allowed in very rural areas upon approval of the HRW. The fire hydrants installed to serve new residential subdivisions shall be installed on the right side of the street in which fire and rescue vehicles travel when entering the subdivision and the water main shall be installed on the same side of the street to avoid having hydrant legs installed under the paved streets. The location of the fire hydrant shall be approved by the Fire Marshal having jurisdiction over the project site.

9.6.2 Valves and Nozzles

Fire hydrants shall have a bottom valve size of at least 5-1/4 inches, one 4 1/2 inch pumper nozzle and two 2 1/2 inch hose nozzles.

9.6.3 Hydrant Leads

The hydrant lead shall be a minimum of six inches in diameter. Auxiliary valves shall be installed in all hydrant leads and bolted firmly to the hydrant tee with threaded rod. The threaded rod shall be coated to prevent corrosion.

9.6.4 Drainage

Hydrant drains shall have a gravel pocket or dry well provided unless the natural soil will provide adequate drainage. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers or storm drains.

9.6.5 Type

Fire hydrants shall conform to the latest edition of AWWA C502-05 for Dry Barrel Fire Hydrants. Fire hydrants must have main opening valves of 5¼"diameter. All fire hydrants must be installed in accordance with the requirements established by the HRW standard details and the Harnett County Fire Marshal. In order to reduce the number of different brands and models that HRW must stock parts and repair kits for and for standardization and maintenance reasons, HRW only the following fire hydrants are permitted to be installed in Harnett County:

A. Mueller - Super Centurion 250 A-423 model with a 5¼" main valve opening three way (two hose nozzles and one pumper nozzle);

B. American Darling - Mark B-84-B model with a 5¼" main valve opening three way (two hose nozzles and one pumper nozzle);

C. Waterous - Pacer B-67-250 model with a 5¼" main valve opening three way (two hose nozzles and one pumper nozzle).

Fire hydrants shall meet or exceed the AWWA C502, latest edition and have a rated working pressure of at least 250 psig. All fire hydrants shall be dry-barrel type with two – 2 ½" hose nozzles and one – 4 ½" pumper nozzle all having standard NPT threads. All fire hydrants shall carry a 10 year warranty from the date stamped on the fire hydrant. Fire hydrant(s) shall be listed by Underwriters Laboratories, Inc., as meeting their standard UL 246, latest edition and approved by the Factory Mutual Research Corporation (FMRC) and installed to meet the established requirements of the Fire Marshal having jurisdiction over the project.

9.6.6 Fire Hydrant Testing, Painting and Color Coding

Fire hydrants shall be painted solid red before installation by the manufacturer. Once the fire hydrant has been inspected, pressure tested and accepted for service by HRW, and then the utility contractor shall paint another coat of red paint on all fire hydrants and then notify the Harnett County Fire Marshal or the Fire Marshal having jurisdiction over the project to request an inspection of each fire hydrant installation. Any deficiencies noted by the Fire Marshal shall be corrected before the fire hydrant will be accepted by the HRW and allowed to be placed into operation.

The contractor shall provide the HRW with one fire hydrant wrench for each fire hydrant installed in the Harnett Regional Water's water distribution system up to a maximum of two wrenches per project. The local fire department shall be responsible to conduct any additional pressure testing and/or fire flow testing annually on the fire hydrants following acceptance by the HRW. Each fire hydrant shall be provided with chains for each nozzle cap. The fire hydrants shall be installed with a four (4 ft.) feet bury depth with three feet of cover to allow the base of the hydrant to be slightly above finished grade. Should the hydrant tee be installed at depths greater than four (4 ft.) feet then the contractor shall provide all bends, fittings, pipe and joints to raise the fire hydrant to the proper elevation so the base of the fire hydrant shall be no more than twelve (12") inches above the finished grade.

Each fire hydrant may be Color Coded as necessary by the local fire department. The top cap may be repainted by the local fire department which will designate the specific pressure and flow characteristics of each fire hydrant. The National Fire Protection Association (NFPA) standard calls for bonnets and caps to be color-coded to indicate the hydrant's available flow at 20 psi. Standard color codes stipulated by the National Fire Protection Association (NFPA) are as follows:

NFPA 291, Chap. 3

Class C	Less than 500 GPM	**Red**
Class B	500-999 GPM	**Orange**
Class A	1000-1499 GPM	**Green**
Class AA	1500 GPM & above	**Light Blue**

Section 9.7 Air Relief Valves

9.7.1 Air Relief Valves

At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

9.7.2 Air Relief Valve Piping

The open end of an air relief pipe from automatic valves shall be extended to at least one foot above finished grade and provided with a stainless steel screened, downward facing elbow. The pipe from a manually operated valve shall be extended to the top of the pit.

9.7.3 Chamber Drainage

Chambers, pits or manholes containing valves, blow offs, meters, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer, nor shall blow offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface or the ground where they are not subject to flooding by surface water or to absorption pits underground. If gravity drainage is impractical, a small sump pump with float control shall be included in the design along with the electrical service connection to provide power for the sump pump. Generally, the HRW prefers to avoid the use of sump pumps unless absolutely necessary for the proper operation of the system.

Section 9.8 Bore and Jack Method for Water Lines to Cross NCDOT Right-of-Ways

9.8.1 Bore and Jack Method

All water lines that will cross an established NCDOT maintained street shall be permitted by the North Carolina Department of Transportation (NCDOT) District Engineer in a three party NCDOT Encroachment Agreement. Any bore and jack work shall be accurately described in the three party NCDOT Encroachment Agreement between the

developer, the HRW and the NCDOT. All water lines that will cross an established NCDOT maintained street shall be designed to be installed by the bore and jack method to avoid open cuts in the existing pavement. Open cuts on established streets and roads are not allowed by the HRW unless approved by NCDOT in writing in the three- party NCDOT Encroachment Agreement.

9.8.2 Carrier Pipe

The carrier pipe for any road crossing should be sized equal to or larger than the water line being extended to accommodate future development when practical. The carrier pipe shall be the same material as the water line unless conditions will prevent the installation of the water line using the same material. Generally, the HRW prefers that all carrier pipe shall be ductile iron pipe installed inside a steel casing pipe. The use of PVC pipe material should be avoided under the paved street inside the NCDOT right-of-ways. The carrier pipe shall include a valve on each side of the street to afford the HRW staff a means to isolate the water line on both sides of the street. The valves may not be required if the water line is greater than 20 inches in diameter.

9.8.3 Casing Pipe

Where indicated on the plans and/or as required by the NCDOT, water lines shall be installed under highways by bore and jack method with the carrier pipe (water line) installed inside a spiral wound steel casing. The contractor shall be required to notify NCDOT's District Engineer and Harnett Regional Waterat least five (5) days prior to work starting. Casing shall have a minimum cover of three (3) feet of cover and extend a minimum of two (2) feet either side of pavement but preferably from ditch line to ditch line where practical as stipulated in the approved project plans. The utility contractor must verify all grades and alignment prior to set up. Contractor shall install casing in a manner not to create drainage beneath the highway. Casing shall be welded steel to conform to ASTM A-53 Grade "B", ASTM A-139 Grade "B" or better. Although the casing is not considered a pressure vessel, the welding on the casing shall be performed by a qualified welder in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. The minimum inside diameter of the casing as compared to the largest diameter outside diameter of the carrier pipe, joints or couplings shall be as follows:

Casing Pipe Nominal Size	Casing Pipe Diameter Amount Diameter O.D. Greater than Carrier Pipe
Less than 6 inches	Not less than 4 inches
6 inches and larger	Not less than 6 inches

Casing Pipe Diameter	Minimum Wall Thickness
6"-14"	1/4"
16"-18"	5/16"
20"-22"	3/8"
24"-26"	7/16"
28"-32"	1/2"
34"-42"	9/16"

Section 9.9 Separations

9.9.1 General

The following factors shall be considered in providing adequate separation:

A. Materials and type of joints for water and other non-potable water lines,

B. Soil conditions,

C. Service and branch connections into the water main and other non-potable water lines,

D. Compensating variations in the horizontal and vertical separations,

E. Space for repair and alterations of water and sewer pipes, and

F. Offsetting of pipes around manholes.

9.9.2 Vertical Separations

The following minimum vertical separations shall be provided for any water line extension of Harnett Regional Water's existing water distribution system:

Utilities or Structures Vertical Separation Distance
A. Storm sewers and other utilities not listed below; 2 feet

B. Water mains (potable water over potable water) 2 feet

C. Reclaimed water lines (potable water over reclaimed water); 2 feet

D. Final earth grade (finished grade); 3 feet

i. Crossing a Water Main Over a Sewer. Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 24 inches above the top of the sewer, unless local conditions or barriers prevent an 24 inch vertical separation--in which case both the water main and sewer shall be constructed 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.
ii. Crossing a Water Main Under a Sewer. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed 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. The design shall maintain vertical separations to satisfy state minimum requirements where the ductile iron pipe is used to satisfy the HRW requirements above.

Ductile iron pipe shall be used for any line extension of Harnett Regional Water's existing water distribution system where the above minimum vertical separations cannot be maintained, except for the edge of pavement (EOP). The design shall maintain horizontal separations to satisfy state minimum requirements where the ductile iron pipe is used to satisfy the HRW requirements above.

9.9.3 Horizontal Separations

The following minimum horizontal separations shall be provided for any water line extension of Harnett Regional Water's existing water distribution system:

Utilities or Structures Horizontal Separation Distance

A. Edge of Pavement (EOP); 3-5 feet

B. Storm sewers, power poles and other utilities not listed below; 5 feet

C. Sanitary sewers and reclaimed water mains or associated lines; 10 feet

D. Any non-permanent structures or improvements (fencing, landscape material, etc.) ; 10 feet

E. Any building foundation, basement or subsurface structure; 25 feet

F. Any swimming pool 30 feet

i. Lateral Separation of Sewers and Water Mains. Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation--in which case:

ii. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 24 inches above the top of the sewer; or

iii. The water main is laid 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 24 inches above the top of the sewer.

Ductile iron pipe shall be used for any line extension of Harnett Regional Water's existing water distribution system where the above minimum horizontal separations cannot be maintained, except for the edge of pavement (EOP). The design shall maintain horizontal separations to satisfy state minimum requirements where the ductile iron pipe is used to satisfy the HRW requirements above.

9.9.4 Sewer Manholes/Storm Drainage

No water pipe shall pass through or come in contact with any part of a sewer manhole or storm drain.

9.9.5 Exception

The HRW and the North Carolina Department of Environment & Natural Resources, Division of Environmental Health – Public Water Supply Section must specifically approve any variance from the separation requirements of Sections 9.10.2, 9.10.3 and 9.10.4 when it is impossible to obtain the specified separation distances.

Section 9.10 Surface Water Crossings

Surface water crossings or under water crossings present special problems. The HRW shall be consulted before final plans are prepared. Generally, the HRW will design and build the water lines in these areas with specific approval of the Harnett County Board of Commissioners as permitted by the state, unless a developer or land owner desires to fund the project engineering and construction costs. These water crossings will be designed and constructed in accordance with all federal, state and local requirements. An Engineer working on a project design that will include the crossing of a lake, river or stream must consult with the HRW Engineer before submitting plans to the HRW for review or approval.

9.10.1 Above Water Crossing

The pipe shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement.

9.10.2 Under Water Crossing

A minimum cover of five (5 ft.) feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided.

A. The pipe shall be of special construction, having flexible watertight joints;

B. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding; and

C. A blow off shall be provided on the side opposite the supply of service.

Section 9.11 Easements

In all cases when it is necessary to construct water mains abutting private property, an easement designated specifically for construction, operation and maintenance of water/sewer improvements shall be dedicated exclusively to the Harnett Regional Water. In no event shall the easement be allowed to be upon privately held single family lots. Dimensions of the easement shall be in keeping with the herein stated separation requirements. A minimum permanent easement width of 20' shall be provided where it is necessary to install water mains outside of public highway right-of-ways, such as planned unit developments, private road right-of-ways and commercial areas, etc. or a combination of 15' common property easement and 15" building setback for lines installed between adjacent parcels.

Section 9.12 Cross Connections and Interconnections

9.12.1 Cross Connections

There shall be no connection between the distribution system and any pipe, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system. Connections between private individual's wells shall not be allowed. This procedure is not acceptable by the North Carolina Department of Environment & Natural Resources (NCDENR) No fire protection water line, irrigation water system, commercial or industrial water system shall be allowed to connect to the Harnett Regional Water's water distribution system without the proper backflow protection. At a minimum, these connections shall have a dual check valve assembly (DCVA) or reduced pressure zone (RPZ) assembly installed between their water system and the Harnett Regional Water's water distribution system to provide adequate backflow protection. Each service connection shall be evaluated by the HRW Backflow and Cross Connection Operator in Charge (ORC) for proper compliance to this requirement. Each business owner shall be responsible to satisfy all current and future requirements with respect to the backflow and cross connection regulations as set forth in all federal, state, county, and local regulations. All connections to the Harnett Regional Water's water distribution system shall be tied into the potable water system without prior approval and in keeping with the Harnett Regional Water's Water Conservation Resolution, as amended. Whenever there is a question of cross connection the engineer shall provide reduce pressure zone backflow prevention.

9.12.2 Cooling Water

Neither steam condensation nor cooling water from engine jackets, cooling towers, heat exchangers or any other heat transfer devices shall be returned to the sanitary sewer collection system. Potable water supply shall not be connected without proper back flow prevention. 145

9.12.3 Interconnections

The approval of the HRW shall be obtained for interconnections between potable water supplies and non-potable water sources (i. e. irrigation systems). in the event the interconnections are allowed by the HRW, such connections shall be designed in keeping with the Ten States Standards, the State Primary Drinking Water Regulations and the HRW Water Conservation Resolution.

Section 9.13 Water Services and Plumbing

9.13.1 Water Services

Harnett Regional Water will be responsible for the initial installation of a water service connection for all single family lots, including a main line tap, water service from the main line to the user's property line (or within the defined public or private road right-of-way), a meter box, a meter, a check valve or backflow prevention device, and a cut off valve. It shall be the property owner's responsibility to maintain and/or install all pertinent lines, connection fittings beyond the check valve/back flow prevention device and/or gate valve to the premises or building units being served.

9.13.2 Service Lines

All 3/4", 1"and 2" water service lines shall be copper tubing size (CTS) SDR-9 polyethylene plastic tubing or approved equal conforming with ASTM D2737 with a NSF marking and Awwa Standard for polyethylene plastic tubing.

When service mains are installed under roadways or sidewalks the must be installed inside a casing. Copper water service lines shall be at „K" copper. The 3/4" water service lines shall be installed inside a schedule 40 PVC or steel casing of at least two (2") inches in diameter. The and 1" water service lines shall be installed inside a schedule 40 PVC or steel casing of at least three (3") inches in diameter. The 2" water service lines shall be installed inside a schedule 40 PVC or steel casing of at least four (4") inches in diameter. Each casing shall be installed by an open cut for new streets or by the bore and jack method for all existing paved streets. The casing shall be at a minimum of three (3 ft.) feet below surface of street and each ditch line on either side of the street.

9.13.3 Plumbing

Water services and plumbing shall conform to relevant local and/or state plumbing codes, or to the National Plumbing Code. All water service lines beyond the meter shall be inspected by the building code inspector having jurisdiction over the project. The HRW will require the plumber to install a valve (gate valve or ball valve) on the customer's side of the meter setter within 12 to 18 inches of the meter box. The HRW meter readers will not release a meter to be installed in the meter setter unless the valve has been installed by the plumber.

9.13.4 Booster Pumps

Individual home booster pumps shall not be considered or required for any individual service from the public water supply mains.

9.13.5 Fire Protection

Connections to the HRW system for the purpose of individual sprinkler systems in commercial buildings, shall provide a remote double detector check valve (double check) assembly located outside of the structure being served that can be readily accessible by HRW staff at all times for inspection. Fire lines entering private property shall be the full responsibility of the owner and must be supplied with a shut-off valve at or before the property line to delineate the responsibility of the HRW. Sprinkler systems in commercial and industrial projects must meet all requirements established by the state and local fire codes as well as the standards established by the National Fire Protection Association (NFPA). The Harnett County Fire Marshal shall review plans for all sprinkler systems and be present for a system test before the sprinkler system can be accepted and placed into operation.

Section 9.14 Service Meters

Each service connection shall be individually metered and conform to the latest AWWA standards. All brass meters shall be required. ABB, Kent, Dewey Brothers C700 meters shall be used for service connections between three-fourths (¾") inch and 1" shall be required. ABB, Kent, Dewey Brothers C3000 shall be used for service connections greater than or equal to two (2") inches shall be required. Meter boxes for the services two (2") inches or smaller shall be constructed with ABS plastic. Solid cast iron lids shall be installed for service connections of three-fourths (¾") inch. Solid ABS plastic lids with cast iron reader windows in the center shall be installed for service connections of one (1") inch up to two (2") inches. 146

All metered services greater than two (2") inches shall be installed inside a prefabricated, pre-stressed concrete vault in accordance with Harnett Regional Water's standard details. Meters two (2") inches and under shall be installed by the HRW. Metered services over two (2") inches shall be installed by the contractor and the contractor shall provide the meter for the project; however, the meter should be purchased through the HRW supplier and only released once the project has been approved by the NCDENR – DWQ, PWSS and the HRW. Concrete meter vaults shall house the bypass line, the gate valves, the meter, the strainer, flanges, couplings and have positive head for drainage or be equipped with a sump pump and a 120 volt GFCI receptacle for a light and a sump pump. The GFCI receptacle shall be installed in accordance with the NEC requirements. If the power is supplied for the sump pump then the vault shall be equipped with a fluorescent light having a zero (0°) degree ballast. 147

Please see Chapter 12, General and Special Conditions, Special Construction Technical Specifications for additional information and requirements for construction.

Section 9.15 Construction of Approved Final Drawings and Plans

9.15.1 Design Plans and Construction of Water System Improvements

Contractors shall install all water system improvements per the Professional Engineer's design as approved by HRW and permitted by the North Carolina Department of Environment and Natural Resources – Division of Water Resources, Public Water Supply Section (NCDENR-DWQ, PWSS) unless the existing site conditions preclude such installation or site conditions significantly impact the project construction. Should site conditions warrant plan revisions then the contractor shall follow the procedures outlined in Section 4. 1. 11 above. All materials used in the construction of any water system improvements to the existing Harnett Regional Water's water distribution system shall meet the requirements specified in the sections below unless otherwise approved by the HRW Engineering staff.

Once each project has been approved and permitted by the state, the approved plans will be returned to the HRW and then copies will be made for the contractor and the HRW Utility Construction Inspector. Copies of the state approved plans will be stamped by the HRW Engineering Representative as "Released for Construction," signed and dated to verify all plan changes requested by the state and the HRW have been addressed by the design engineer of record. During the pre-construction conference, the HRW Engineer or designated staff shall provide a copy of the NCDENR-DWR, PWSS (state) approved plans, marked as Final drawings by the Professional Engineer (P.E.) and stamped by the HRW as "Released for Construction" to the contractor/developer and the HRW Utility Construction Inspector. Only the state approved plans stamped by the HRW Engineer as "Released for Construction" shall be used for construction of any water system improvements to Harnett Regional Water's existing water distribution system.

9.15.2 Materials & Design Requirements

The utility contractor shall furnish all types of pipe and other incidentals required for the construction of a complete water system as shown on the plan drawings and as specified herein. Unless otherwise noted, the materials listed below are acceptable to the HRW for use in the construction of any extension of Harnett Regional Water's water distribution system. Should the contractor desire to use materials not listed in these specifications, written permission must be obtained from both the Professional Engineer (P.E.) of record and the HRW Engineering Representative or designated personnel as approved by the HRW Director. The developer's Engineer of Record will review all shop drawings for conformance with HRW specifications prior to submittal to HRW. The shop drawing submittal to HRW shall include a cover letter by the developer's Engineer of Record certifying conformance with HRW specifications and summarizing any exceptions or concerns relative to approved drawings and/or HRW standards.

9.15.3 Material Submittals and Shop Drawings

All materials to be used in the extension of or connection to the existing Harnett Regional Water's water distribution system must be approved by the Developers Engineer and HRW Engineering Representative prior to purchase and delivery to any project site. Submit three (3) copies of the material specification sheets and all associated shop drawings including a cover letter summarizing all material to be used in the in the proposed project to the Developers Engineer and HRW Engineering Representative prior to the Pre-Construction conference to demonstrate compliance with the stipulated requirements as set forth herein these specifications under the "General Conditions." The developer's Engineer of Record will review all shop drawings for conformance with HRW specifications prior to submittal to HRW. The shop drawing submittal to HRW shall include a cover letter by the developer's Engineer of Record certifying conformance with HRW specifications and summarizing any exceptions or concerns relative to approved drawings and/or HRW standards.

9.15.4 Project Specifications, Encroachments and Permits

Any utility contractor performing work to the Harnett Regional Water's water distribution system to extend new water mains, water service lines or repair of the existing water distribution system shall abide the specifications herein and shall have a copy of these specifications on the job site along with the appropriate "Authorization to Construct" (water) permit issued by the North Carolina Department of Environment and Natural Resources – Division of Water Resources, Public Water Supply Section (NCDENR-DWR, PWSS) for the proposed project. The contractor shall have a copy of the Erosion and Sedimentation Control permit issued by the North Carolina Department of Environment and Natural Resources – Division of Land Quality (NCDENR-DLQ) for any land disturbing activity that disturbs more than one (1) acre of soil. The contractor shall have a copy of any Wetland permit issued by the state of North Carolina and/or United States Army Corps of Engineers (USACE) for any wetland disturbance that

may be caused by the project construction. The contractor shall have a valid copy of the North Carolina Department of Transportation (NCDOT) encroachment agreement to cover all work proposed within the right-of-way of any state maintained street or road. Connection of new streets or driveways to the existing streets and roads shall be made by only with the approved Driveway Permits issued by the NCDOT. All of these permits, agreements, etc. shall be posted on the project site during the construction for any authority having jurisdiction over the project to see the appropriate permits and agreements have been issued to the county and/or the developer as required by state law.
Contractors shall provide the HRW Engineer with copies of any permits, encroachment agreements or other documents obtained by the Professional Engineer during the Pre-Construction Conference.

9.15.5 Material Transportation, Storage and Protection

The Contractor shall receive at least one (1) of the three (3) copies stamped as reviewed by the Engineer and HRW Utility Construction Inspector prior to ordering any material. All materials shall be transported by the supplier to the contractor at the project site and handled by both parties in a manner to avoid damage. All items damaged in transit shall be returned to the supplied for full credit and similar materials in new condition shall be provided to replace any damaged materials. The contractor shall store and protect all materials that will not be installed immediately. PVC pipe shall be provided protection against sunlight exposure. All materials shall be kept clean and free of contamination. Contaminated materials shall be removed from the project site and replaced with similar material in new condition.

Section 9.16 Site Work

9.16.1 Site Clearing

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the performance and completion of all site clearing, tree protection, and demolition as shown on drawings and as specified in accordance with provisions of the contract documents and completely coordinated with that of all other trades.

Work included within the project consists of but is not limited to the following:

- ☐ Clearing for Booster Pump Stations as needed.
- ☐ Clearing for Elevated Tank as needed.
- ☐ Clearing for all water line installation as needed.

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.

B. Quality Standards: Perform all work in accordance with OSHA requirements and requirements of Environmental Protection Agency in addition to State and Local requirements.

C. Protection of Work Area: Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements indicated to remain in place. Protect improvements on adjoining properties as well as those on Owner's property. Restore any improvements damaged by this work to their original condition, as acceptable to Owner or other parties or authorities having jurisdiction. Protect existing trees and other vegetation indicated to remain against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by

stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

D. Improvements on Adjoining Property: Authority for performing removal and alteration work on property adjoining owner's property will be obtained by Owner prior to award of contract.

E. Site Clearing: Remove trees, shrubs, grass, weeds, and other vegetation, improvements, or obstructions that interfere with new construction. Also remove such items elsewhere on site or premises as specifically indicated. Removal includes new and old stumps of trees and their roots. Carefully and cleanly cut roots and branches of trees indicated to be left standing where such roots and branches obstruct new construction.

F. Clearing and Grubbing: Clear project site of trees, shrubs, and other vegetation, except for those indicated to be left standing. Completely remove stumps, roots, and other debris protruding through ground surface. Use only hand methods for grubbing inside drip line of trees indicated to be left standing. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding 6 inches loose depth and thoroughly compact to a density equal to adjacent original ground.

G. Removal of Improvements: Remove surfacing and pavements, including bases for pavements. Remove wood headers, posts, poles, fences, and other work as specifically indicated. Removal of abandoned underground pipe(s) or conduit(s) which interferes with construction is included under this section.

H. Disposal of Waste Materials: Burning of combustible cleared and grubbed materials is permitted providing the Contractor obtains such permits and approvals required by state, county, and local authorities. Remove all waste materials and unsuitable and excess topsoil from Owner's property, and legally dispose of it.

9.16.2 Site Excavation and Grading

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation complete of all operations in connection with excavation, construction of fills, borrow, rough grading, finish site grading and disposal of excess material as shown on the drawings and as specified in accordance with provisions of the contract drawings and completely coordinate with that of all other trades.

Work included within the project consists of but is not limited to the following:

- ▪ ▪
- ▪ ▪
- ▪ ▪

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.

Unclassified Excavation: Remove and dispose of rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by the Engineer. All excavation on this project shall be considered as unclassified.

B. Site Grading: Plans indicate both existing grade and finished grade required for construction of project. The Contractor shall stake out all units, structures, piping, roads, parking areas and walks and establish their elevations and perform all other layout work required. Replace property corner markers to original location if disturbed or destroyed.

It shall be the Contractor's responsibility to maintain existing utility lines (either overhead or underground), sidewalks, and pavement designated on drawings, shown or mentioned in specifications free of damage. For any item unknown or not properly located inadvertently damaged shall be repaired to original condition. Notify the Engineer and Owner of said utility at once so that emergency repair may be made.

During construction, shape and drain embankment and excavations. Maintain ditches and excavations to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work. Reestablish elevations and slopes where settlement or washing may have occurred.

C. Construction of Embankments and Fills: Construct embankments and fills at locations shown on plans to lines of grade indicated on drawings. Completed fill shall correspond to shape of typical cross section or contour shown on plans whichever method is used to show shape, size, and extent of line and grade of completed work.

Provide only fill material which is free from roots, organic matter, trash, frozen material, and stones having a maximum dimension greater than six (6) inches. Insure that stones larger than four (4) inches, maximum dimensions, are not placed in upper six (6) inches of fill or embankment. Do not place materials in layers greater than eight (8) inches of loose thickness. Place layers in horizontally and compact each layer prior to placing additional fill.

Compact by sheep foot rollers, pneumatic rollers, vibrators or other equipment approved by Engineer. Add moisture to or dry by aeration each layer as necessary to meet requirements of compaction. Do not place materials in embankments or fills which exceed optimum moisture content by 5 percent or are 3 percent below optimum moisture content for the material.

Under structures & roadways compact to density not less than 95 percent maximum dry density as measured by AASHO Method T99.

Under other embankments and fills, compact to not less than 90 percent of maximum dry density as measured by AASHO Method T99. (ASTM D698)

In place moisture-density tests will be ordered to insure that all work complies with these specifications. Tests will be taken at locations determined by the Engineer. Compaction will be tested by the standard cone method, nuclear density test, or drive shoe method as required or approved by the Engineer. Tests shall be performed through recognized testing laboratory or by the Engineer and all costs to be paid by the Owner. Copies of test results will be furnished to Contractor and Engineer.

Materials not meeting specified moisture-density test requirements shall be re-compacted and re-tested at Contractor's expense.
Provide, at no extra cost, the necessary amount of approved borrow material compacted to a density equal to that obtained in the laboratory by vibration and inundation. Compact to 100 percent maximum density measured by AASHO T99. Borrow or fill cannot be obtained on site except when specifically permitted by Engineer.

9.16.3 Trenching, Backfilling and Compacting

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation complete of all operations in connection with excavation, trenching, and backfilling of underground utilities as shown on drawings and as specified in accordance with provisions of the contract documents and completely coordinated with that of all other trades. 152

Work included in the project consists of but is not limited to the following utility items:

- Installation of water distribution system.
- Installation of buried appurtenances.

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.

B. Protection of Existing Utilities: Verify location and existence of all underground utilities. Omission from or inclusion of located utility items does not constitute non-existence or definite location. Secure and examine local utility records for available location data.

Take necessary precautions to protect existing utilities from damage due to any construction activity. Repair all damages to utility items at sole expense. Assess no cost to Owner, Engineer, or auxiliary party for any damages.

Avoid surcharging ditch banks by placing excavated material a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such a manner to be as little inconvenience as possible to public and adjoining property owners.

Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as may be designated by the Engineer to prevent serious interruption of travel.

C. Unclassified Excavation: Remove and dispose of rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by the Engineer. All excavation on this project shall be considered as unclassified.

D. Trench Excavation: Unless given permission to do otherwise, excavate trenches by open cut method to depth shown on plans and necessary to accommodate the work. Permission may be granted for tunnel work for crossing under crosswalks, driveways or existing utility lines; however, such tunnels are limited to ten (10) feet in length.

Open only the length of trench at one time allowed by the Engineer. Do not open more than 400 lineal feet trench at one time. Failure to comply may necessitate shutdown of entire project until backfilling is performed.

Observe the following trenching criteria:

1. Trench size: Excavate only sufficient width to accommodate free working space. In no case shall trench width at the top of pipe or conduit exceed outside diameter of utility service by following dimensions:

Outside Diameter of Utility Service	Excess Dimension
33 inches and less	18 inches
more than 33 inches	24 inches

Cut trench walls vertically from bottom of trench to one (1) foot above the top of pipe, conduit, or utility service.

2. Dewatering: Keep trenches free of water. Include cost of dewatering in original bid. No additional remuneration for this item is permitted.

3. Sheeting and Bracing: Brace and sheet trenches as soil conditions dictate and in full observation of OSHA requirements. Do not remove sheeting until backfilling has progressed to a stage that no damage to piping, utility service, or conduit will result due to removal. 153

E. Preparation of Foundation For Pipe Laying: Exercise care to avoid excavations below established grade where firm earth conditions exist. If over-excavation occurs, backfill in 6-inch lifts and thoroughly compact with pneumatic tampers. In case of rock excavation, carry excavation a minimum of 12 inches below established grade and backfill to grade with suitable earth or sand. Material used shall be free of rocks, roots, sod or organic matter and shall be firmly compacted. Form bell holes in trench such that only the barrel of pipe is firmly supported by bedding material.

F. Backfilling: Use only backfill material for trenches which are free from boulders, large roots, sod, other vegetative or organic matter, and frozen material. Hand or pneumatic tamp backfill under and around pipe up to 24 inches above top of pipe in lifts not exceeding 8 inches loose thickness. Backfill and compact remainder of trench in 8-inch lifts to density specified.

Perform mechanical tamping evenly on both sides of pipe to top of excavation or to a depth such that pipe will not be injured by subsequent method of compaction used to achieve required density. Exercise extreme care in backfilling operations to avoid displacing pipe joints either horizontally or vertically and avoid breaking the pipe. Water ponding for backfill consolidation is not permitted.

G. Compaction: Compact all trench backfill in areas under roads, parking areas and sidewalks as directed by Engineer to a density of 95 percent of maximum dry density (STANDARD PROCTOR) as determined by AASHTO Method T99 (ASTM D-698). In locations where trench will not be under paved areas or roads but is inside, Department of Transportation rights-of-way, compact trench backfill to a density equal to its density before disturbance or 95 percent maximum dry density (STANDARD PROCTOR), whichever is

compact trench backfill to a density equal to its density before disturbance or minimum 90 percent of maximum dry density (STANDARD PROCTOR), as determined by AASHTO Method T99 (ASTM D-698) whichever is less.

H. Testing: Perform in-place moisture-density tests as ordered by Engineer to insure trench backfill complies with requirements. Tests shall be performed through recognized testing laboratory and all costs to be paid by the Owner. Copies of test results will be furnished to Contractor and Engineer. Where backfill compaction does not pass moisture-density test requirements and after backfill has been removed as directed by Engineer and situation corrected, additional tests will be directed until compaction meets or exceeds requirements. The Contractor shall pay the cost of any additional testing required as a result of his failure to meet minimum compaction requirements.

I. Pavement Cuts: All pavement cuts shall be made to true line by a method acceptable to the Engineer and the pavement removed just prior to the trenching operation. The Contractor will be allowed to excavate no more trench width than the pipe outside diameter plus 18 inches for pipe up to 33 inches in diameter and 24 inches for pipe over 33 inches in diameter, in all paved areas. The pavement will be trimmed an additional twelve inches (12") beyond the trench edge to give firm bearing for the patching operations.

The Contractor shall backfill all trenches to a point ten inches (10") below the existing pavement and then backfill with crushed stone flush with the existing pavement. It shall be the Contractor's responsibility to maintain all pavement cuts in good order until asphaltic patching is completed. At the time of patching, all broken down, ragged edges shall be trimmed to true line.

It shall be the contractor's responsibility to provide drag boxes, ditch jacks, sheeting, etc., as required to maintain the trench width as specified. The Owner will pay only for the width of pavement removal as specified above.

It is intended that no section of streets or road (3,000 linear feet of line) shall be left in an incomplete condition for a period in excess of thirty days. This completion shall include all phases of work on the lines to be constructed in the area of the section, including trenching, placing pipe, backfilling, setting valves, hydrants, and fittings, installing house services as required preparation for paving repair, repair of paving, grassing and clean-up for delivery of the completed section to the Owners. This requirement shall be adhered to in its entirety unless waived in writing by the Owners through the Engineers. Flushing, testing and disinfection maybe delayed until a sufficient amount of line is ready. Failure to comply with this condition for more than 30 days will result in reduction of payment to the contractor.

9.16.4 Pipe Laying – Pressure Pipe

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation complete of all pressure pipe construction as shown on drawings and as specified in accordance with provisions of the contract documents and completely coordinated with that of all other trades.

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.

B. Quality Standards: Procedures for handling, laying, protection, and use of pipe shall be in accordance with the pipe manufacturer's recommendations and these specifications.

C. Submittals: The Contractor is to submit to the Engineer the manufacturer's name and type of material for all materials used on this project. Such materials shall meet with the approval of the Engineer. If the materials submitted do not meet with the approval of the Engineer, the Contractor is to submit other types and makes that may be approved.

D. Product Delivery, Storage, and Handling: Units shall be delivered, handled, and maintained in a manner to avoid damage to the pipe.

E. Materials: Refer to the approved plans and the material specifications in Chapter 9 for the materials specified.

F. Clearing Rights-of-Ways: When piping system to be constructed under this project is outside of the streets rights-of-way, the rights-of-way are to be cleared by the Contractor to a width satisfactory for the installation and the cost of same is to be included in the price bid for the line in place. No extra allowance will be made for rights-of-way clearing.

G. Installation: The work included under this article consists of but is not limited to furnishing and installing piping systems used for the purposes of carrying fluids under pressure and shall include pressure testing. Disinfection shall be included for potable water lines.

H. Tapping Sleeves: All tapping sleeves installed in Harnett Regional Water's existing water distribution system shall be constructed with stainless steel material and meet the requirements established in AWWA Standard C223-02. Stainless steel fabricated tapping sleeves shall be Romac model SST or approved equal made from stainless steel material that meets or exceeds the requirements of ANSI/AWWA C220. Cast Iron tapping sleeves are not permitted to be used in the Harnett Regional Water's water distribution system. Tapping flanges for stainless steel fabricated tapping sleeves shall meet or exceed the requirements of ASTM A240, ASTM A743/A743M, or ASTM A744/A744M.

The tapping sleeve shall be installed per the manufacturer's installation instructions provided with the fabricated tapping sleeve. The manufacturer's instructions must be followed regarding support of the valve and the tapping machine during the tapping procedure. The contractor shall hydrostatically test the seal between the gasket of the tapping sleeve on the pipe of the existing water main and the gate valve before the tapping machine may be set up to perform the tap. The contractor may tap into the existing water main only after the hydrostatic pressure test has been completed with satisfactory results. For personal safety reasons, do not use a compressible fluid medium (such as air) to check for water tightness.

The HRW Utility Construction Inspector must witness the hydrostatic testing on the tapping sleeve and valve assembly as well as the tapping procedure on the existing water main. The coupon removed from the existing water main when the water line is tapped shall be given to the HRW Utility Construction Inspector. The HRW Utility Construction Inspector shall return the coupon to the HRW Engineer for a visual analysis. Additional non-destructive analysis may be performed by the HRW Engineer on the coupon to determine the condition of the existing water main. Coupons removed from AC pipe shall be sealed in a plastic bag to reduce the potential for fraying or dispersal of asbestos material.

I. Pipe & Fittings: Materials at all times shall be handled in such a manner as to protect them from damage. Pipe and fittings should be handled with mechanical equipment at all times that the work site will permit. At no time shall pipe and fittings be dropped or pushed into ditches. Pipe and fitting interiors shall be protected from foreign matter and shall be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it shall be removed before installation.

All pipe shall be in manufacturer's full nominal lengths and shall have a minimum of (36") thirty-inches of cover. Pipe shall be laid on true lines as directed by the Engineer. Ditches are to be dug of sufficient width to adjust the alignment. Bell holes shall be dug at each joint to permit proper making of the joints. The pipe shall be laid and adjusted so that the alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints shall be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected. In no case shall two types of pipe be used in this project, except where ductile or cast iron pipe is required. All transition joints between different types of pipe shall be made with transition couplings approved on shop drawings showing the complete assembly to scale.

J. Existing Utilities: Prior to beginning construction, the Contractor will contact local utility companies and verify the location of utilities. When existing utilities are in conflict with construction, they shall be exposed prior to beginning construction to prevent injury to the utilities.

K. Trenching Along Roadways and Unpaved Areas:

In paved areas, the Contractor shall compact the backfill as specified to a point 10" below the pavement surface and will then backfill with crushed stone, as shown on the plans.

All pavement cuts will be patched no later than two (2) days after backfilling. The unpaved areas of the rights-of-way shall be grassed as described in a later article of these specifications when disturbed by this work.

For work along highways, no more than 3,000 feet of disturbed shoulder shall be unseeded at any time. Ditches shall be maintained by the Contractor in good condition until the project is accepted by the Owners.

Any unpaved side road, dwelling entrance road, commercial entrance, or any other area presently stabilized by use of rock material shall be protected from erosion during construction and shall be stabilized by use of crusher run stone after backfilling. This stone stabilization shall be approximately four (4) inches thick unless otherwise directed by the Engineer. The Contractor shall submit his price for this stone placed as described under "Stone for Shoulder Stabilization" in the Proposal. Stone used in the repair of paved roads and streets shall be paid for separately and shall be included in the proposal under "Stone for Pavement Repairs."

The Contractor shall schedule his work to cause the least inconvenience to the public and will maintain traffic at all times. If the work shall require the existing water mains to be temporarily closed or shut off, then the contractor shall coordinate the work activity with the HRW staff and provide at least 48 hours to all existing water customers that will be affected by the outage. The

contractor will be responsible for properly safeguarding the public against accidents and shall save harmless the County or developer/owner and shall assume responsibility for any suits or actions for damages of other law suits, which may be instituted against the County or developer/owner because of any incident arising from the construction. The contractor shall follow all traffic control measures using NCDOT work Zone methods in accordance with all NCDOT requirements.

Excavated materials shall be placed on one side of the trench; and when backfilling is completed, all excess materials will be hauled off and the work shall be left in an acceptable manner. Excavated materials will never be piled beyond the centerline of the road or street. Attention is called to the fact that under no condition shall the work be accepted until completed and finished in a workmanlike manner. Barriers shall be placed and lights furnished by the Contractor as directed by the Engineers and as covered elsewhere in these specifications.

The contractor shall leave no block of streets (3,000 linear feet of line) in an incomplete condition for a period in excess of thirty days. This completion shall include all phases of work on the lines to be constructed, including trenching, placing pipe, backfilling, setting valves, hydrants and fittings, installing house services as required, testing, preparation for paving repair, repair of paving and clean-up for delivery of the completed section to the Owners. This requirement shall be adhered to in its entirety unless waived in writing by the Owners through the Engineers. The intent shall be to place the section of line into service as soon as possible. It shall be required to begin construction at the connection to the existing water system in order that water for testing, flushing and placing the line into service can be brought along with the construction. Failure to construct the project in this matter (unless otherwise impossible) will result in reduction in the amount of partial pay requests that the contractor may submit on the line section in question.

L. Pressure Testing: After installation and backfilling of the pressure mains, each section (as required by the Engineers) of the pipeline system shall be subject to a hydrostatic pressure test equal to 200 psig. Before applying the specified test pressure, all piping shall be thoroughly flushed and all air shall be expelled from the pipe. If outlets are not available at high places, the Contractor shall make the necessary taps at points of highest elevations before the test is made. The test pressure shall be maintained in the section tested for a period of three (3) hours. Allowable leakage in the three (3) hour period shall not exceed the allowable leakage using the following formula:

$$L = [S \times D \times (P)_{0.5}] / 148{,}000$$

Where:
L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

Tests may be made of isolated portions of such piping as will facilitate general progress of the installation. Any revisions made in the piping systems will subsequently necessitate retesting of such affected portions of the piping systems.

When water service is available from the Owner, reasonable amounts of water will be provided the Contractor for line flushing and testing at no cost. The availability of water for this purpose is subject to the Owner's own needs or requirements. Water loss, as the result of line breakage,

blocking movement, blow outs, or other reasons directly attributable to the Contractor's work, shall be paid for by the Contractor at the Owner's prevailing rates.

The hydrostatic test shall be conducted by the Contractor under the direct observation HRW Utility Construction Inspector and the Professional Engineer. Any defective material causing excessive leakage shall be repaired or replaced and the test repeated until satisfactory results are achieved by the pipe or pipe section holding the pressure for at least two (2) hours.

M. Disinfection:

After pressure testing, the new water lines are to be disinfected in accordance with AWWA All new, cleaned or repaired water mains shall be disinfected in accordance with AWWA C651 "section 4.4.3" and as specified herein. The water lines are to be flushed thoroughly to remove all dirt and debris which may have collected in the line. After flushing has been completed, the pipelines shall be tapped on top at a point furthest from the point that the lines are to be filled with water. The valve at the end of the line shall then be closed, and the valve between the new water line and the Municipal Water System closed.

Chlorine is then to be applied under pressure by an ejector pump (or equal) to the water entering the new pipeline. Chlorine will be added in sufficient quantities to give an overall chlorine residual to the water of at least fifty (50) parts per million. The pipeline is to be completely isolated from the system by closed valve(s) and the chlorinated water allowed to remain in the line for at least twenty-four hours. At the end of this period, the pipeline is to be thoroughly flushed until no evidence of chlorine exists as determined by the Ortho-Tolidine Test.

These specifications still include detailed procedures for the adequate flushing, disinfection, and microbiological testing of all water mains. In accordance with T15A NCAC 18C .1003 or latest NCDENR PWS version, the waterline shall be disinfected by continuous feed disinfection method.

1. Initial Flushing

All new water lines extended from Harnett Regional Water's existing water distribution system shall be thoroughly flushed to remove foreign matter, dirt and debris that may have entered the pipe during the construction process. Preliminary flushing removes light particulates from the main but not from the pipe-joint spaces. The initial flushing of any water line shall be conducted to maintain a flushing velocity of at least 2.5 feet per second. Once the initial flushing procedures have been completed and the pipe is clear of foreign matter, dirt and debris, then the contractor shall sterilize the pipe using the continuous feed method for water lines.

Flushing and cleaning shall be the responsibility of the contractor. The contractor shall pump dry and dispose of all extraneous ground water and other sand gravel and foreign objects within the water main. Such material shall not be flushed into the existing operating sewer mains, pump stations or pertinent facilities. Flushing of water main lines under construction into sewer main lines of the HRW is prohibited. Water for flushing and cleaning shall be provided by the HRW upon payment of the appropriate fees for a fire hydrant meter in keeping with HRW established standards rates and regulations. The water mains shall be flushed at the end of the blow off.

2. Chlorination Methods

Water main chlorination must be completed in accordance with AWWA C651 "section 4.4.3" for the Continuous Feed Method. The continuous-feed method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove air pockets, flushing the completed main to remove particulates, and filling the main with potable water. The potable water shall be chlorinated so that after a 24-hr holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

At the option of the contractor, calcium hypochlorite granules shall be placed in pipe sections to provide a strong chlorine concentration in the first flow of flushing water that flows down the main. In particular, this procedure is recommended when the type of pipe is such that this first flow of water will flow into annular spaces at pipe joints. Before the main is chlorinated, it shall be filled to eliminate air pockets and flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/sec (0.76 m/sec) unless the purchaser determines that conditions do not permit the required flow to be discharged to waste. Note that flushing is no substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity and pigging of the main may be required.

In accordance with T15A NCAC 18C .1003 or latest NCDENR PWS version, the waterline shall be disinfected by continuous feed disinfection method.

3. Final Flushing

After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine. Where necessary, federal, state, local, or provincial regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. Thorough consideration should be given to the impact of highly chlorinated water flushed into the waste environment. If there is any question that damage may be caused by chlorinated-waste discharge (to fish life, plant life, physical installations, or other downstream water uses of any type), then an adequate amount of reducing agent should be applied to water being disposed of in order to thoroughly neutralize the chlorine residual remaining in the water

4. Bacteria Testing of Water Samples

The purpose of chlorination is to clean and disinfect water lines, resulting in an absence of coliforms as confirmed by laboratory analysis. All water samples collected for testing must be analyzed in a state certified laboratory and for this reason all water samples will be tested by the HRW laboratory.

Water samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate and they shall be tested for bacteriological (chemical and physical) quality in accordance with *Standard Methods for the Examination of Water and Wastewater*; and shall show the absence of coliform organisms; and, if required, the presence of a chlorine residual. Turbidity, pH, and a standard heterotrophic plate count (HPC) test may be required at the option of the

county because new material does not typically contain coliforms but does typically contain HPC bacteria.

After flushing the line, the Contractor shall be responsible to furnish sample points at various points along the line under the direct observation HRW Utility Construction Inspector and the Professional Engineer. While the Contractor is responsible to furnish sterilized bottles and take water samples for testing the HRW Utility Construction Inspector will generally furnish sterilized bottles and take water samples to the HRW laboratory for testing and bacteria analysis. The HRW laboratory is a state certified laboratory and this service is free of charge at this time, but subject to change if lab fees become necessary to maintain the state certified laboratory.

A minimum of three samples shall be taken in any instance. The Contractor may send additional samples to an approved laboratory for bacteriological analysis at the contractor's expense. If the analysis reveals that no bacteria are present, the line or lines may be approved to be placed into service upon notification of the Engineer, and Final Approval by the North Carolina Department of Environment and Natural Resources – Division of Water Resources, Public Water Supply Section (NCDENR-DWR, PWSS).

At least one set of water samples shall be collected from every 1,200 ft (366 m) of the new water main, plus one set from the end of the line and at least one set from each branch. The sampling pipe must be dedicated and clean and disinfected and flushed prior to sampling. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use. The gooseneck assembly shall be stored in a clean, dry area between uses to avoid potential contamination from the assembly entering the water samples. Water samples shall have no coliforms present and the HPC is less than 500 cfu/mL.

5. Repeat Disinfection Procedures Until All Water Samples Test Negative For Coliform
If test results from the lab indicate a measured HPC greater than 500 colony-forming units (cfu) per mL for any water sample then, flushing and disinfection procedures should be resumed and continued for another 24 hour contact period. Following the second final flushing procedure, another set of water samples shall be collected and analyzed for the presence of coliform and HPC and the disinfection process shall be repeated until a set of water samples have no coliforms present and the HPC is less than 500 cfu/mL. The record of compliance shall be the bacteriological test results certifying that the water sampled from the new water main is free of coliform bacteria contamination and is equal to or better than the bacteriologic water quality in the distribution system. The HRW laboratory will forward all test results to the HRW Engineer to verify the disinfection process is complete and the results are satisfactory.

N. Protecting Open Pipelines: All water mains installed under this contract shall be thoroughly blocked against access to the pipe of any water from extraneous sources, any vermin, animals, mud, silt or other deleterious materials by installation of plugs designed for the purpose at every pipe end at all times when the pipe ending is not attended by contractor personnel.

O. Relation of Water Mains to Sewers: The Contractor shall adhere to the location of the water and sewer lines as shown on the plans (if applicable). If conditions change in the field that require relocation of either water or sewer mains, the Contractor shall insure that the water main is laid at least 10 feet laterally from existing or proposed sewers. If the 10 foot lateral separation is not

possible then the water main shall be laid in a separate trench with the bottom of the water main at least 24 inches above the top of the sewer. If neither the 10 foot lateral or 24 inch vertical separation is possible then the water and sewer lines shall both be constructed of ductile iron pipe (class 50 w/pressure tight joints) for a distance of 10 feet on each side of the point of crossing and the state minimum 18 inch vertical separation shall be maintained.

9.16.5 Boring and Jacking Under Highways

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation to complete all boring and jacking under highways as shown on drawings and as specified in accordance with provisions of the contract documents and completely coordinated with that of all other trades. The contractor shall be responsible for the work performed by a subcontractor to meet all NCDOT requirements and satisfy all requirements outlined herein these specifications. The contractor shall be responsible to repair any and all damage to existing street pavement or the right-of-way caused by the boring the jacking procedure. The areas where the contractor shall dig the bore pits shall be restored to the same condition before the bore and jacking operation started leaving the right-of-way in as good or better condition once the work is complete.

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete and compatible installation shall be furnished and installed as part of this work.

B. Quality Standards: Procedures for boring and jacking shall be in accordance with the best accepted practice of the industry and these specifications.

C. Submittals: The Contractor shall submit to the Engineer the manufacturer's name for all materials to be used in this project, along with such other information the Engineer may request.

D. Product Delivery, Storage, and Handling: Units shall be delivered, stored and handled in such a manner to avoid damage to the material.

E. Job Conditions: Verify all grade and alignment prior to setting up boring rig. Installation assumes responsibility for performance.

F. General Requirements: Lines installed under major highways shall be performed by boring under the highway or tunneling as may be required by the North Carolina Department of Transportation. Where boring under pavement is required by the Department of Transportation, the Contractor will be paid the unit price bid in the Proposal for each linear foot of pipe so placed of the type bid upon in the proposal.

In placing the pipe, any annular space exceeding one-quarter inch in width between casing and tunnel shall be fitted with 1:2 Portland cement mortar grout, pumped into the space to form a tight fit between casing and tunnel walls. Cost of grouting shall be an integral part of the price submitted in the Proposal for the type and size pipe, "Boring Under Highways" required by the installation.

The Engineer may require "Boring and Jacking" under objects or pavement not indicated on the plans but required in the best interest of the Owners, in which case the payment for each linear foot required will be made at the unit price given in the Proposal for "Boring Under Highways".

Where North Carolina Department of Transportation (NCDOT) requires casings to be installed at primary highway crossings, the Contractor shall install the casings in accordance with the following requirements:

The Contractor shall be required to notify the Department of Transportation on the contemplated construction and secure the necessary permit for performing the work.

G. Installation: All work on boring and/or casing under highways shall be under the supervision of the District Engineer of the Department of Transportation or his authorized representative who shall be notified at least five (5) days before actual work or installation begins. Pipelines shall be installed under highways by boring and jacking where shown on the plans.

H. Carrier Pipe: Carrier line pipe and joints under primary highways shall be of approved material and construction satisfactory to the District Engineer of the Department of Transportation. Pipelines operating under pressure must be of a material and type capable of withstanding the internal stresses generated in the lines. Joints may be welded, screwed or mechanical type. Pipe must be supported by a minimum of (2) two pipe carrier spacers per length of pipe.

I. Casing Pipe for Primary Highways: The inside diameter of casing pipe for carrier pipe less than 6 inches in diameter shall be not less than 2 inches greater than the largest outside diameter of the carrier pipe, joints or couplings and not less than 4 inches greater for carrier pipe 6 inches and larger in diameter. It shall, in all cases, be great enough to afford easy removal of the carrier pipe without disturbing the casing pipe or roadbed.

The casing pipe must be capable of withstanding highway loadings and must be so constructed as to prevent leakage of any matter throughout its length, except in cases where the ends are not sealed. Casing shall be installed in a manner to prevent the formation of a waterway under the highway. It must have an even bearing throughout its length, except in cases where the ends are not sealed. Casing shall be installed in a manner to prevent the formation of a waterway under the highway. It must have an even bearing throughout its length and slope to one end.

If installed by the open trench method ductile iron pipe with restrained joints may be used with approval by the NCDOT, the Professional Engineer and the HRW Engineer. Sizes 12 inches and under shall be not less than Class 50. Sizes 14 inches through 48 inches shall be not less than Class 51 or as shown on plans or directed by the Engineer.

Standard weight (Schedule 40) wrought steel or wrought iron pipe having wall thickness as listed below may be used as casing pipe in sizes 8 inches and smaller.

WROUGHT STEEL DIAMETER OF PIPE (Inches)	WROUGHT IRON WALL THICKNESS (Inches)	WALL THICKNESS (Inches)
2-1/2	.203	.208
3	.216	.221
3-1/2	.226	.231

4	.237	.242
5	.258	.263
6	.280	.286
8	.322	.329

Steel pipe in sizes 8 inches and larger manufactured from steel having minimum yield strength of 35,000 psi and having minimum permissible wall thickness as listed below may be used as casing pipe. Adjust the thickness for other grades of pipe, except that the wall thickness shall be not less than .3125 (5/16") inch:

DIAMETER OF PIPE (Inches)	MINIMUM WALL THICKNESS (Inches)
12	.188
16	.250
18	.250
DIAMETER OF PIPE (Inches)	MINIMUM WALL THICKNESS (Inches)
20	.250
24	.250
30	.312
36	.375

J. Depth of Casing Pipe: The depth from surface of roadway to top of pipe at its closest point shall be not less than 3 feet.

K. Protection at Ends of Casing Pipe: Where ends of casing are below ground, they shall be suitably sealed to protect against the entrance of foreign material.

L. Shoring of Ditches: Shoring shall be done in a neat, safe and workmanlike manner so as to prevent any cave-ins or settlement of the roadway and so as not to endanger any personnel working in the ditch. Contractor shall be required to provide shoring of pits, trenches and other excavation in accordance with the latest requirements of the North Carolina Department of Transportation and the Federal Occupational Health and Safety Act.

M. Length of Casing Pipe: Casing pipe shall be of a length as determined to be necessary by the Department of Transportation District Engineer and the Project Engineer.

N. Removal of Casing Pipe: In the event that an obstruction is encountered during the dry boring operation, the auger and spiral welded steel pipe encasement are to be withdrawn and the void is to be completely filled with grout at 25 psi pressure before moving to another boring site.

O. Payments: The Contractor shall be paid the unit price bid in the proposal for the size of casing in place complete under the primary highways, including the furnishing of all labor, tools, equipment, and materials required for the various installations. Water mains through casing will be paid for at the unit price bid in addition to the price paid for casings under the highways.

9.16.6 Horizontal Directional Boring

A. General:
Directional boring is a method of trenchless construction using a surface launched steerable drilling tool controlled from a mobile drilling frame, and includes a field power unit, mud mixing system and mobile spoils extraction system. The drilling frame is sited and aligned to bore a pilot

borehole that conforms to the planned installation of the main. The drilling frame is set back from an access pit that has been dug (typically at the location of a proposed manhole or other appurtenance) and a high-pressure fluid jet tool head that uses a mixture of bentonite clay and water is launched. Pits are normally dug at the start point and endpoint of the proposed pipe installation and are used to align the tool head, attach other equipment, and to collect and remove excess spoils. Using an electronic guidance system, the tool head is guided through the soil to create a pilot borehole. Upon reaching the endpoint joint, the tool head is removed and a reamer with the product pipe attached is joined to the drill string and pulled back through the borehole. In large diameter installations, pre-reaming of the borehole will usually be done prior to attaching the product pipe for the final pullback. A vacuum spoils extraction system removes any excess spoils generated during the installation. The connections, manholes or other appurtenances are then completed at both the start point and endpoint locations and the surface restored to its original condition. **The Contractor must follow HDPE pipe installation guidelines per AWWA Manual M55 and to provide anchorage to offset the Poisson Effect contraction.**

B. Site Conditions for Directional Borings
Drilling operations must not interfere with, interrupt or endanger surface and activity upon the surface. Contractor must comply with all applicable jurisdictional codes and OSHA requirements. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operations are encountered, the Contractor and Engineer shall review the situation and jointly determine the feasibility of continuing drilling operations.

C. Qualifications for Directional Boring Contractors
Directional boring Contractors will have actively engaged in the installation of pipe using directional boring techniques for a minimum of three years. Field supervisory personnel employed by the Directional Boring Contractor will have at least three years' experience in the performance of the work and tasks. Submit documentation indicating experience. Information must include, but not be limited to, date and duration of work, location, pipe information (i.e., length, diameter, depth of installation, pipe material, etc.), project owner information, (i.e., name, address, telephone number, contact person), and the contents handled by the pipeline (water, wastewater, etc.). Submit a list of field supervisory personnel and their experience with directional boring operations. At least one of the field supervisors listed must be at the site and be responsible for all work at all times when directional boring operations are in progress. Directional boring operations will not proceed until the resume(s) of the Contractor's field supervisory personnel have been received and reviewed by the Engineer.

D. Submittal Drawings for Directional Boring
The Directional Boring Contractor shall provide working drawings and written procedure describing in detail the proposed method of installation. This will include, but not be limited to, size, capacity and setup requirements of equipment; location of drilling and receiving pits; dewatering if applicable; method of fusion and type of equipment for joining pipe; type of cutting tool head; and method of monitoring and controlling line and depth. If the Contractor determines that modifications to the method and equipment as stated in the submittal are necessary during construction, the contractor will submit a plan describing such modifications, including the reasons for the modification.

E. Drilling Fluid:
Drilling Fluid for Directional Bores will be an inert fluid mixture of water and bentonite clay.

F. Conformance:
Directional Boring shall conform to ASTM F1962. The Contractor will furnish all labor, components, materials, tools and appurtenances necessary or proper for the performance and completion of the contract. The Engineer shall be notified immediately if any obstruction is encountered that stops the forward progress of drilling operations.

G. Preparation:
Excavate required pits in accordance with the working drawings. The drilling procedures and equipment shall provide protection of workers, particularly against electrical shock. As a minimum, grounding mats, grounded equipment, hot boots, hot gloves, safety glasses and hard hats shall be used by crewmembers. The drilling equipment shall have an audible alarm system capable of detecting electrical current. Removal of trees, landscaping, pavement or concrete shall be performed as specified.

H. Equipment:
The drilling equipment must be capable of placing the pipe within the limits indicated on the contract plans. Directional boring equipment shall consist of a surface launched steerable drilling tool controlled from a mobile drilling frame, and include a field power unit, mud mixing system and mobile spoils extraction system. The number of access pits shall be kept to a minimum and the equipment must be capable of boring the following lengths in a single bore.

I. Safety Equipment:
During drilling operations all equipment shall be effectively grounded and incorporate a system that protects operating personnel from electrical hazards. The system shall be equipped with an audible alarm that can sense if contact is made with an energized electric cable. Proper operation of the alarm system will be confirmed prior to the drilling of each tunnel. All equipment will be connected to ground with a copper conductor capable of handling the maximum anticipated fault current. Crew members operating drilling equipment and handling rods will do so while standing on grounded wire mesh mats, ensuring that all equipment is grounded, and wearing hot boots, hot gloves, safety glasses and hard hats. Crewmembers operating handheld locating equipment will wear hot boots.

J. Pilot Hole Boring / Adjustments / Restarts
The entry angle of the pilot hole and the boring process will maintain a curvature that does not exceed the allowable bending radii of the product pipe. The Contractor shall follow the pipeline alignment as shown on the Drawings, within the specifications stated. If adjustments are required, the Contractor shall notify the Engineer for approval prior to making the adjustments.

K. Product Pipe Installation:
After the pilot hole is completed, the Contractor shall install a swivel to the reamer and commence pullback operations. Pre-reaming of the tunnel may be necessary and is at the option of the Contractor.

1. Reaming diameter will not exceed 1.5 times the diameter of the product pipe being installed.

2. The product pipe being pulled into the tunnel will be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation. The drilling fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill with

s for the product pipe.

The Contractor shall allow sufficient lengths of product pipe to extend past the termination point to allow connections to the diffuser assembly. Pulled pipe will be allowed 24 hours of stabilization prior to making tie-ins. The length of extra product pipe will be at the Contractor's discretion.

The contractor shall allow at a minimum of 20 linear feet of directional-drilled pipe on each end of the installation. The additional pipe lengths shall be on a parallel plane with the existing grade at the point of connection to the Ductile Iron or PVC main.

L. Cleanup and Disposal of Drilling Fluid:

The Contractor shall maintain the work site in a neat and orderly condition throughout the period of work and after completing the work at each site, remove debris, surplus material and temporary structures erected by the Contractor. The site shall be restored to a condition equal to the existing condition prior to being disturbed. Disposal of excess drilling fluid and spoils will be the responsibility of the Contractor who must comply with all relevant regulations, right-of-way, work space, permits and encroachment agreements. Excess drilling fluid and spoils will be disposed at an approved location. The Contractor is responsible for transporting all excess drilling fluid and spoils to the disposal site and paying any disposal costs. Excess drilling fluid and spoils will be transported in a manner that prevents accidental spillage onto roadways. Excess drilling fluid and spoils will not be discharged into sanitary or storm drain systems, ditches or waterways.

Drilling fluid returns (caused by fracturing of formations) at locations other than the entry and exit points will be minimized. The Contractor will immediately clean up any drilling fluid that surfaces through fracturing. Cleanup of excess drilling fluid shall be accomplished by the means of mobile spoils removal equipment.

Mobile spoils removal equipment capable of quickly removing spoils from entry or exit pits and areas with returns caused by fracturing will be present during drilling operations to fulfill the requirements of paragraph "a" above. The Contractor shall not commence drilling operations without the presence of drilling fluid removal equipment. All excess drilling fluid shall be removed from the site(s) and disposed of properly.

The Contractor will be responsible for making provisions for a clean water supply for the mixing of drilling fluid. Water purchased from the HRW water distribution system must be metered through fire hydrant meters and paid for by the Contractor. The Contractor shall contact the HRW Administrative Office to obtain a fire hydrant meter and return the same to the HRW Administrative Office along with payment for the water used on site.

The contractor shall contain all drilling fluids from the site until such time that the excess fluid may be removed from the site by mobile spoils removal equipment. At no time shall the contractor allow excess drilling fluids to drain into water bodies such as streams, rivers, lakes, wetlands etc.

M. As-Builts

The Contractor shall provide to the Engineer a bore plan (boring log) to provide the as-built condition of the bore. This information shall include the pipe depth at intervals of 50 lf, which shall indicate the horizontal alignment with respect to a horizontal baseline.

pull back force will not exceed the allowable pulling force

9 16.7 Work Along Highways

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation to complete all work along highways construction as shown on drawings and as specified in accordance with provisions of the contract documents and completely coordinated with that of all other trades. 165

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.

B. Quality Standards: All work within the rights-of-way of the Department of Transportation shall be governed by DOT Standard Specifications.

C. Job Conditions: The Contractor shall verify all existing conditions prior to beginning work with the rights-of-way of DOT. Any unusual conditions should be brought to the attention of the Engineer.

D. Work Along Highways: The Contractor shall be responsible for notifying the North Carolina Department of Transportation of the proposed construction, shall secure necessary permits, and shall be responsible for any damage to existing roadways by reason of his work. The Contractor will be required to replace paving cut on account of this work. The Contractor shall also be entirely responsible for backfilling and maintaining the ditches cut along and across highways in accordance with the permits received from the North Carolina Department of Transportation and as is required by these specifications.

It will be absolutely necessary for the Contractor to schedule on-the-site inspection prior to beginning work at highway bridges and/or box culverts by contacting the Head of Bridge Maintenance.

Lines installed under major highways shall be performed by boring under highway or tunneling as may be required by the North Carolina Department of Transportation.

Where lines to be installed by the open-cut method pass under culverts on the Department of Transportation right-of-way, the Contractor shall fill the void from the bottom of the line to the bottom of the culvert with pea gravel (DOT No. 78M). When the Contractor tunnels under culverts, any voids shall be filled with pea gravel (DOT No. 78M) or concrete as directed by the Engineer. The Contractor shall include the cost for placing this item in the appropriate lump sum or unit price item.

The Contractor shall conduct his work in accordance with the requirements of the Department of Transportation; and in particular, he shall be required to control traffic in the vicinity of the work as required by the latest revision of the North Carolina Construction and Maintenance Operations Supplement to the Manual of Uniform Traffic Control Devices (MUTCD) for Streets and Highways. This publication may be obtained from the Traffic Engineering Branch, Division of Highways, Department of Transportation, and Highway Safety. Contractor will be required to obtain and have in his possession one copy of the above-referenced publication and to comply with the requirements therein.

The use of this supplement manual does not preclude the use of the MUTCD, and it is recommended that Part VI of the MUTCD be read before attempting any construction or maintenance signing. Any conflicts found to occur between the Supplement Manual and the MUTCD shall be resolved in favor of the MUTCD.

E. Unpaved Roadways: Any unpaved road, side road, dwelling entrance road, commercial entrance, road shoulder, or any other area presently stabilized by use of rock material shall be protected from erosion during construction and shall be stabilized by use of #57 (crusher run) stone after backfilling. This stone stabilization shall not be less than approximately four inches (4") thick unless otherwise directed by the Engineer.

F. Pavement Cuts: In pavement cuts, the Contractor shall compact the backfill as hereinbefore specified and then remove compacted earth to a point ten inches (10") below the pavement surface and will then backfill with crushed stone as shown on the plans.

The Contractor shall maintain in good condition the ditch line in pavement cuts until paving is authorized to be replaced. The Contractor, upon notification from the Engineer, shall replace any and all paving cut on this project by placing a paving of similar nature to that cut to the specifications of the North Carolina Department of Transportation. 166

The Contractor will not be reimbursed for pavement damaged on the opposite side of the roadway from the construction. The Contractor shall repair and replace such damaged pavement at his own expense.

G. Service Lines: All service lines crossing highways shall be installed by boring under highway unless special permission for open cutting is obtained by the Contractor from the Division Engineer of the Department of Transportation.

9.16.8 Asphalt Paving

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation complete of all asphalt paving construction as shown on drawings and as specified in accordance with provisions of the contract documents and completely coordinated with that of all other trades.

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.

B. Quality Standards: Contractors shall perform all work in accordance with the North Carolina Department of Transportation Standard Specifications for asphalt paving and these specifications.

C. Submittals: The Contractor shall submit the names of the suppliers of all materials to be used in this project.

D. Job Conditions: The Contractor shall verify suitability of sub grade prior to placing the stone base or asphaltic paving. Installation assumes responsibility for performance.

E. Materials: All suppliers and sources of materials shall be approved for use by the Department of Transportation of the State of North Carolina.

F. Stone Base Course: All work on this project will have six-inch minimum compacted thickness, except as is otherwise designated on the plans or as given in written instruction by the Engineer.
CABC shall consist of one or more natural materials proportioned and blended on the area to be paved and shall meet the requirements of the N. C. Department of Transportation Standard Specifications for roads and pavements.

The contractor shall utilize the stone placed in the trench after backfilling of the line in so far as possible. Additional stone may be required to bring the minimum stone thickness up to the required depth.

Prior to placing asphalt, the surface shall be thoroughly rolled for its full length and width with a power roller or vibrating tamp to thoroughly compact the stone base. Rolling and and/or tamping shall be continued alternately until the surface is smooth and the entire base is compacted.

Irregularities or depressions developed by rolling shall be corrected by loosening the material and compacting to form a uniform surface. Along curbs, headers and walls and at places not accessible to the roller the base shall be compacted thoroughly with mechanical tampers or with hand tampers. Mechanical tamping shall be done with an approved rapid hitting mechanical tamper capable for delivering 185 pounds per square foot of tamping area per blow. Hand tampers shall weigh not less than 50 pounds with a face area of not more than 100 square inches.

G. Asphaltic Concrete: The Contractor will be required to place a surface course consisting of a mixture of aggregate and liquid asphalt mixed in an approved type batch plant. Asphaltic concrete shall be placed and compacted on a prepared base course to the lines, grades, and compacted thickness called for on the plans or shown in the Bid Form.

The asphaltic wearing surface shall be N. C. Department of Transportation Asphaltic Concrete Mix Type I-2. The mix shall be prepared in a N. C. Department of Transportation approved plant and shall meet N. C. Department of Transportation Specifications Section 645 in every respect.

H. Placing: No asphaltic concrete shall be placed when temperature is less than 40° degrees F in the shade away from artificial heat.

The Contractor shall be equipped to place the mixture with approved spreading and finishing equipment, which shall spread the material to uniform density and strike a smooth finish true to cross-section and free from inequalities. Asphaltic concrete shall be placed in one course unless otherwise instructed by the Engineer.

While still hot, the mixture shall be rolled or tamped in places inaccessible to the rollers to give the required stability and density. Rolling shall be with 8- or 10-ton tandem rollers, weighing not less than 250 pounds per inch of width of roller tread. In rolling, care shall be taken not to damage structures of any type against which the mixture abuts.

Placing of the mixture shall be as nearly continuous as practicable; rollers shall not pass over unprotected end of the mixture except when laying of the course is discontinued for a length of

time that will allow the mixture to become chilled, in which case the joint shall be cut back to expose an unsealed or granular surface for the full depth and width of the joint so a bond will be formed with the fresh mixture. When laying is resumed, the exposed edge of the joint shall be painted with a thin coat of hot asphalt cement or asphalt thinned with naphtha and the fresh mixture raked against the joint thoroughly tamped with hot tamps and rolled. At the beginning of each day's work, joints shall be formed as above described and at all other times when laying of the course is interrupted for a sufficient time to allow the material to chill. Longitudinal joints shall be formed in a similar manner as that described above when longitudinal joints are required.

Newly compacted surface shall be protected from traffic until it has become properly hardened by cooling.

9.16.9 Erosion Control and Grassing

A. General: The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of all Erosion Control and Grassing construction as shown on drawings and as specified, in accordance with provisions of the contract documents and completely coordinated with that of all other trades.. 170

Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.

B. Quality Standards: The Contractor shall utilize the best materials available and shall complete all work in accordance with Department of Transportation, Sedimentation and Pollution Control Act and these specifications.

C. Submittals: The Contractor shall submit data on the suppliers of all materials to be used in this project, germination results, seed content, etc.

D. Product Delivery, Storage, and Handling: Units shall be delivered and stored in a manner to provide full protection to all materials until ready to use.

E. Job Conditions: Verify suitability and condition of all areas to receive grassing.

F. Erosion Control - General: Contractor to take all precautions to avoid excessive siltation of nearby watercourses during the construction of this project. The erosion control used shall comply with the rules and regulations set forth in the latest edition of the North Carolina Administrative Code, Title 15, Chapter 4 "Sedimentation Control". Contractor to refer to notes on plans regarding erosion control. Temporary measures will be required as shown and described on the plans. Temporary measures shall remain in place until further possibility of stream siltation has passed at which time all temporary measures will be removed by the Contractor. Permanent measures will be required as shown and described on the plans. The Contractor shall be responsible for maintenance of the permanent measures until the completion of the project.

G. Methods and Measures: The following list of methods and measures for sediment controls should be considered and implemented by the Contractor:

1. Plan buffer zone erosion control measures in advance.

2. Install preliminary controls in advance of clearing and grubbing.
3. Prohibit pumping of ditches directly into any stream or lake. Provide settling basins.
4. Require excavated materials to be piled uphill from ditch - NOT on stream side of ditch.
5. Protect backfill material against accelerated erosion.
6. Tamp, seed and mulch within 30 days after disruption or final installation of materials.
7. Maintain buffer zone protection until area is stabilized.

H. Grassing - General: All unpaved areas disturbed by cause of construction under this project shall be seeded, fertilized and mulched under this contract. Preparation of seedbed and application of fertilizer, seed and mulch shall be performed in accordance with N. C. Board of Transportation Standard Specifications and the N.C Department of Environment and Natural Resources. Type of seed, fertilizer, lime and mulch shall be as called for on the plans for the season at the time of construction.

The above requirements shall be strictly adhered to as required by the Owners through the Engineers. The Contractor shall include his charge for all required grassing in the unit price proposed for erosion control. There will be no separate payment for grassing.

Please see Chapter 12, General and Special Conditions, Special Construction Technical Specifications for additional information and requirements for construction.