MASTER SPECIFICATIONS

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DEFINITION OF TERMS

Whenever in these specifications and contract documents the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

"City" . . . . . The City of Fayetteville, North Carolina

"City Attorney" . . . . The legal counsel employed by the City

"City Council" . . . . The Mayor - City Council of the City of Fayetteville, North Carolina

"Contractor" . . . . . The individual, partnership, firm or corporation with whom a contract is made for the prosecution of the work. Also referred to as Prime Contractor or General Contractor.

"Defective" . . . . . Work that is unsatisfactory, faulty or deficient or does not conform to the Contract Documents or does not meet the requirements of any inspection test or approval referred to in the Contract Documents or has been damaged prior to Engineer's recommendation of final payment.

"Engineer" . . . . . The Representative Engineering Company. Also may be known as the Design Professional.

"Laboratory" . . . . . The official testing laboratory or laboratories employed by the Engineer with the approval of the Owner.

"Owner" . . . . . The City of Fayetteville, North Carolina acting through the Public Works Commission of the City of Fayetteville, NC.

"Plans" . . . . . All drawings, or reproductions of drawings, that pertains to the construction of the work contemplated and its appurtenances.

"Specifications" . . . The description, provisions, and requirements contained herein, together with all written agreements made or to be made pertaining to the method and manner of performing the work, or to the quantities and qualities of materials to be furnished under the contract.

"Superintendent" . . . The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the Engineer or his designer, and who shall supervise and direct the construction.

"Warranty" . . . . . The words "warranty" and "guarantee" shall mean "an agreement by which the maker, installer or both insures the Owner the integrity of a product or system for a stipulated period of time after final acceptance by the Owner".

"Work" . . . . . Includes materials, labor, and workmanship of the appropriate contractor.

Intention of Terms: Whenever in these specifications or on the plans, the words "directed", "required", "ordered", "permitted", "prescribed", or words of the like import are used, it shall be understood that the requirement of the Engineer is intended; and similarly, the words "approved", "acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable to the Engineer, subject in each case to the final determination of the Owner.

ABBREVIATIONS

Whenever in these Contract Documents abbreviations occur, the meaning shall be interpreted as follows:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
AGC	-	Associated General Contractors of America
ANSI	-	American National Standard Institute
ASTM -	American Society for Testing Materials	
ASSE	-	American Society of Sanitary Engineering
AWWA	-	American Water Works Association
DI	-	Ductile Iron Pipe
GS	-	General Statutes of North Carolina
MUTCD	-	Manual on Uniform Traffic Control Devices
NCAC	-	North Carolina Administrative Code
NCDOT	-	North Carolina Department of Transportation
NCDENR	-	North Carolina Department of Environment and Natural Resources
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturer's Association

NIC	-	Not in Contract
OSHA	-	Occupational Safety and Health Standards
PVC	-	Polyvinyl chloride
PWC	-	Public Works Commission of the City of Fayetteville
RCP	-	Reinforced Concrete Pipe
UL	-	Underwriter's Laboratories, Inc.
VC	-	Vitrified Clay Pipe

GENERAL CONDITIONS

INTENT OF PLANS AND SPECIFICATIONS:

The intent and purpose of the plans, specifications, and supplementary documents to provide for satisfactory completion in all details of the work contemplated, and the Contractor shall do all work necessary thereto in full compliance with the plans and specifications. The drawings and specifications are mutually explanatory and complimentary, one to the other. Therefore, work shown in one and not shown in the other, shall have the same effect and intent as if shown in both and shall be fully executed. The Contractor shall furnish all material, equipment, tools, and labor necessary to the full completion of the work contemplated unless specifically otherwise provided in these specifications. Any work that may reasonably be inferred from the Specifications or Drawings as being required to produce the intended result shall be supplied whether or not the work is specifically called for.

The Contractor acknowledges and warrants that he has closely examined all Plans and Specifications and examined existing conditions and that they are suitable and sufficient to enable the Contractor to complete the work in a timely manner and that they include all work, which may be reasonably inferred to be required or necessary for the completion of the work in full compliance with all applicable codes, laws, ordinances and regulations.

SHOP DRAWING, PRODUCT DATA AND SAMPLE REVIEW:

The Contractor shall not perform any portion of the Work requiring submittal and review until the respective submittal has been returned with the appropriate action. Work performed prior to review and acceptance shall be at the Contractor’s risk.

Minimums of six (6) copies are required for each material submittal to PWC. Each submittal must clearly indicate the Project name and the material to be submitted for review (i.e. highlight the correct class, size, dimensions, type, etc.) If the material is not clear to PWC or properly marked, all unchecked submittals will be returned to the Contractor without further review.

The Contractor shall submit to PWC for approval a list of proposed materials, equipment, or products to be incorporated in the work for review. If requested by PWC, the manufacturer of materials, equipment or product shall submit evidence of having consistently produced materials of satisfactory quality and performance for a period of at least 2 years.

The Contractor shall submit to PWC, the manufacturer's recommendations for each material and procedure to the utilized which is required to be in accordance with such recommendations. The Contractor shall have a copy of the manufacturer's instructions/recommendations available at the construction site at all times and shall follow these instructions.

The Contractor shall be responsible at his own expense to provide certification to the PWC by the manufacturer that all piping, manholes, concrete and accessories meet project specifications and are in complete compliance with referenced American Society of Testing and Materials (ASTM) Standards. Materials or material suppliers shall not be changed after submittal or certification. A Schedule of Shop Drawings Submittals is included at the end of these General Conditions.

RESPONSIBILITY FOR MATERIAL:

All pipe, fittings, manholes, and other materials shall be inspected upon arrival at the job site by a competent superintendent before unloading to insure that the quality of the materials conform to the specifications. If a pipe is damaged during delivery or unloading, the pipe shall be set aside. Before installing, the Contractor shall notify PWC so that the materials can be inspected for defects. Materials found to be defective shall be clearly marked to assure the necessary repairs are made, if approved by PWC before the pipe is incorporated in the work or replaced with sound material. All PVC or other plastic pipe, fittings and materials shall be covered for protection from UV rays.

The interior of all pipe fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Satisfactory protection from damage shall be provided. Solvents, gaskets, lubricants and any other similar material shall be stored in accordance with the manufacturer's recommendations. Any stockpiling of pipe shall be as near as possible to where the pipe will be installed. Small diameter pipe shall be layered in the same manner, as they were loaded on the truck. The bottom layer shall be placed on a flat bottom and adequately blocked to prevent shifting as more layers are added. Each layer of bell and spigot pipe shall be arranged so that all bells are at the same end. The bells in the next layer shall be at the opposite end and projecting beyond the spigots of the pipe sections in the lower layer. Where only one layer is being stockpiled, the bell and spigots shall alternate between adjacent pipe sections. All pipes shall be supported by the pipe barrel so that the joint ends are free of load concentrations. No other pipe or material of any kind shall be placed inside a pipe or fittings as to damage protective coatings. The materials shall be stored as to be protected from traffic and construction equipment, damage of interior lining and/or freezing.

FAMILIARITY WITH LAWS, ETC.:

The Contractor at all times shall observe, conform to and comply with all laws, regulations, codes, rules, charters and ordinances of the United States, the State of North Carolina, County of Cumberland, the City of Fayetteville, and Public Works Commission including, but not limited to laws concerned with labor safety, minimum wages, and the environment. The Contractor shall indemnify and save harmless PWC and the Engineer and all of its officers, agents, and employees against any and all claims, fines, penalties, judgments,

damages, or liability including reasonable attorney's fees arising from or based on the violation of any such law or regulation, order, or decree, whether by himself or his employees.

If the Contractor observes that the drawings and specifications are not in compliance, the Contractor shall promptly notify the Engineer. If the Contractor knowingly performs any work in violation to such laws, codes, ordinances, rules, and regulations, the Contractor shall bear the costs arising there from.

PERMITS AND LICENSES:

The Contractor shall obtain all construction permits and licenses. The Owner shall pay all permit charges and fees. The Contractor shall give all notices necessary and incident to the due and lawful prosecution of the work. Contractor shall pay all charges for temporary utilities and all utility connection fees and charges.

"OR EQUAL" CLAUSE:

The intent of the Contract Documents is to comply with NCGS 133-3 and to encourage free and open competition. The name of a certain brand, make manufacture, or definite Specification is to denote the quality standard, but does not restrict or limit the Specific brand, make manufacture, or Specification names; the intent is to set forth and convey to the style, type, character, and quality of the article desired. Wherever the words "or equal" appear in the Specifications, they shall be interpreted to mean an item of material or equipment similar and of equal quality to that named and which is equally suited to the same use and capable of performing the same function as that named. PWC shall be the sole judge as to the acceptability of any other equipment or material. Where the Specifications list fewer than three names of product or material, such products are the only products known to PWC that comply with the required style, type, character, appearance and quality necessary, although "or equal" substitutions will be evaluated if requested in writing.

JOB SITE SAFETY:

Safety in, on, or about the site is the sole and exclusive responsibility of the Contractor. The Contractor's method of work performance, superintendent of the Contractor's employees, sequencing of construction are also sole and exclusive responsibilities of the Contractor.

Contractor shall be responsible for the safety of any person, including but not limited to, any worker, PWC employee or representative, Design Engineer, citizen, etc. on the site of the work at all times during the prosecution of the work, regardless of whether the individual is an employee of the Contractor or a Sub-Contractor. The Contractor is required to comply with the rules, regulations and interpretations of the North Carolina Department of Labor relating to "North Carolina Occupational Safety and Health Standards (OSHA) for the

Construction Industry" (Title 29 CFR Part 1926 and 29 CFR Part 1919 as adopted by 13 NCAC 7C.0101) and revisions as adopted by GS 95-126 through 155 and additionally with normal industry safety practices or standards.

Neither the professional activities of the Engineer nor the presence of PWC, their employees and sub-consultants at a construction site, shall relieve the Contractor or any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, schedule, sequences, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the Plans and Specifications and any health or safety precautions required by any regulatory agencies.

The Contractor shall indemnify, defend, and hold harmless the PWC, Engineer, their employees, representatives, and sub-consultants harmless from any claim or liability for injury or loss arising from the Engineer or PWC, the employees, representatives, and sub-consultants alleged failure to exercise site safety responsibility or from any claim or liability for injury or loss that allegedly arises from the Contractor's performance of the work.

NCDOT RIGHT OF WAYS:

The Contractor shall not begin work on any property of the State Highway Department until he has secured necessary permits. He shall conform to all requirements of the State Highway Department, or its authorized representatives in the prosecution of this portion of the work. Prior to any construction (minimum one week advance notice), the Contractor shall notify the District Engineer's Office in Fayetteville, telephone 486-1496. Excess soil on pavement shall be broomed daily. A copy of the approved encroachment agreement/permit shall be kept on the job-site at all times and made readily available if requested. The Manager of Rights-of-Way and Division Engineer, or their representative reserves the right to stop any work for noncompliance.

TRAFFIC CONTROL:

The Contractor working in public rights-of-way on streets open to vehicular traffic, shall be required to temporarily maintain traffic control devices to reduce unnecessary congestion and unsafe traffic conditions thru out the entire project area to include any connecting streets affected by construction activities. These devices shall be placed and maintained in accordance with the following:

AMERICAN TRAFFIC SAFETY SERVICES ASSOCIATED, "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, PART VI (LATEST EDITION)" and the North Carolina Supplement.

The Contractor shall be liable for any damages resulting from his negligence in using adequate work zoned traffic control. Furthermore, the Owner's Representative(s) reserve the right to stop any work for non-compliance.

STREET CLOSURE - TRAFFIC CONTROL PLAN:

When deemed to be in the best interest of the motoring public, a street may be closed for work. The Contractor will request, in writing to the City of Fayetteville Traffic Owner's Representative, to have a street closed. The street closure will be requested, in writing, a minimum of five (5) working days prior to the desired closure date. The request shall state the Street Name, from and to of the individual street that is to be closed. The request shall also state the length of time the street is to be closed.

The street closure request shall also include a traffic control plan, showing the detour to thru traffic information. This traffic control plan shall be in accordance with the current edition of the Manual of Uniform Traffic Control Devices for Streets and Highways and applicable supplements. Once the street closing is approved by the City of Fayetteville Traffic Owner's Representative, in writing, the Contractor bears full responsibility for the closure. This includes the installation, maintenance and removal of all traffic control devices, as well as all implied liability.

No work on the individual streets shall start until all the traffic control devices required for the particular work activity have been installed, inspected and approved by the City Traffic Engineer.

PUBLIC CONVENIENCE AND SAFETY:

The Contractor at all times shall conduct the work in such a manner as to ensure the least obstruction to traffic practicable. The convenience of the general public and of the residents along and adjacent to the street shall be provided for in a satisfactory manner, consistent with the operation and local conditions. Fire hydrants on or adjacent to the street shall be kept accessible to the fire apparatus at all times.

The Contractor shall barricade all works, roads, etc. to keep the public away from the construction. All trenches, excavations, or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.

STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES:

The Contractor shall have a copy of the Latest North Carolina State Highway Commission Revised Standard Specification for Roads and Structures on the job site at all times during construction. These "Standards" will be considered minimum for this contract. Reference to

NCDOT "Standards" are specific to material specifications, material and installation testing, and construction procedures unless modified in the Technical Specifications or plans.

EXISTING UTILITY LINES:

The Contractor shall adhere to the provisions of 1985 Underground Damage Prevention Act North Carolina General Statutes 887 Chapter 785 Senate Bill 168 Article 3. To assist the Contractor and utility owners in meeting the requirements of this law, there is a "one call system" called "NO CUTS". Most major utilities with underground facilities in the State subscribe to this service. For calls originating within North Carolina, the number is 1-800-632-4949. For calls originating outside of North Carolina, the number is (919) 855-5760.

OWNERSHIP OF EXISTING UTILITIES:

Existing water mains, valves, fire hydrants and other accessories indicated on the Plans to be abandoned shall remain property of the Public Works Commission of the City of Fayetteville. Removal and salvageability of the materials shall be the sole responsibility of the Public Works Commission and in no way shall affect the Contractor's work. All materials supplied by the Contractor shall be new and packaged in the original containers as applicable.

PROTECTION OF SANITARY SEWER AND WATER CONNECTION:

The Contractor will be required to take every precaution to guard against any or all damage to existing structures, pipelines, and equipment of the Public Works Commission system. The Contractor shall insure that no debris from construction operations no foreign matter of any kind is allowed to enter the existing sewers. Any damage to existing structures or pipelines shall be the direct responsibility of the Contractor and such damage shall be restored, replaced, or repaired by the Contractor.

Where the new water mains are to be connected to existing mains, the existing mains shall be maintained in service to the fullest extent practicable. The Contractor shall in no case permit the introduction of water from the existing system into any new main without prior approval by PWC. The Contractor shall notify PWC in advance of commencing the connection to an existing main in order that a representative may be present to observe the progress of the work.

The Contractor shall notify PWC Water Resources Department a minimum of 48 hours in advance to receive permission to cut off water service. If main breaks occur, immediately notify the PWC Dispatcher and immediately make necessary repairs.

Existing fire hydrants shall be accessible to the fire department at all times. If fire hydrants are in need of replacement, relocation, or connection to a new water main, the Public Works

Commission and the Fire Department shall be notified and coordinated with the work. Fire hydrants shall not be taken out of service without PWC's written approval.

CONSTRUCTION AROUND UTILITY POLES AND GUY WIRES:

The Contractor will be required to perform construction work around utility poles and guy wires which may be left in place within the construction limits of the project and where the poles remain in their present position along or within the construction limits to place fill material, pipe, etc. without disturbing the poles with construction equipment. The Contractor may be required to "tie-off", support or hire Utility Contractor to secure the poles during construction at no additional costs to the Owner.

PROTECTION OF POTABLE WATER SUPPLIES, STORM SEWERS AND OTHER UTILITIES

The Contractor is requested to assist the Engineer if these conditions/circumstances arise in advance so that proper design procedures are addressed and adhere to. All pressure tests shall be performed in accordance with the requirements specified in Hydrostatic Tests (Ductile Iron Pipe).

A. Cross Connection Prohibited

There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenances thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come into contact with any part of a sewer manhole.

B. Relation to Water Supply Source

1) A distance of 100 feet shall be maintained between any private or public water supply source, including any WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water. If this minimum separation cannot be maintained, ductile iron sewer pipe with joints equivalent to public water supply design standards and pressure tested to 150 psi to assure water tightness shall be used. The minimum separation shall however not be less than 25 feet from a private well or 50 feet from a public water supply well.

2) All existing waterworks units, such as basins, wells, or other treatment units, within 200 feet of the proposed sewer shall be shown on the engineering plans.

C. Relation of Water Mains, Sewer Mains and/or Storm Drainage

1. Lateral Separation of Sewers and Water Mains: Water mains shall be laid at least 10 feet (10') laterally from existing or proposed sewers, unless local conditions or barriers prevent a ten (10') lateral separation-in which case:

2. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

OR

3. 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 18 inches above the top of the sewer.

4. Crossing a Water Main Over a Sewer: The water main shall be laid at such a elevation that the bottom of the water main is at least 18 inches above the sewer, or both the water main and sewer main shall be constructed of ductile iron 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. The ductile iron sewer pipe shall be pressured tested to 150 psi.

5. Crossing a Water Main Under a Sewer: For a main to cross under a sewer, both the water main and the sewer shall be constructed of ductile iron materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A 20-foot section of water main pipe shall be centered at the point of crossing. The ductile iron pipe shall be pressure tested to 150 psi.

6. Crossing a Sewer and/or Water Main Over or Under a Storm Drain Line: The water and/or sewer main shall be laid with a minimum vertical separation (outside pipe diameters) of at least 12 inches or the sewer (and/or water) shall be constructed with ductile iron materials for a distance of 10 feet each side of the crossing and subjected to a 150 psi pressure test.

CROSSING EXISTING OR PROPOSED UTILITIES

1. Relation To Other Utilities

a. Underground telephone, cable TV, and gas utilities or conduit banks shall be crossed maintaining a minimum of 12-inch separation or clearance.

b. Where possible, electrical crossings shall be performed while the conductor is de-energized and at all times in the presence of the service provider. Electrical primary conductor crossings shall be as follows:

c. Crossing over a conductor, maintain a minimum of 12 inches of undisturbed soil encasing the conductor.

d. Crossing under a conductor shall be accomplished by boring maintaining 12 inches of undisturbed soil encasing the conductor.

AUTHORITY AND DUTIES OF PWC INSPECTOR:

Public Works Commission shall be authorized to observe all work performed and materials furnished. Such observation may extend to all or any parts of the work, and to preparation or manufacture of the materials to be used. PWC is to report whenever the materials furnished and the work performed by the Contractor appear to fail to fulfill the requirements of the specifications, and to call to the attention of the Contractor such failure or other default; but such observation, however, shall not relieve the Contractor of any obligation to perform all of the work strictly in accordance with the requirements of the specifications and plans. PWC may make changes in grades and quantities when necessary to keep work in progress. PWC is not responsible for the Contractor's means, methods, sequence or operation of construction as well as any construction site safety program, methods, measures, techniques, sequence, etc.

The work shall be subject to inspection during normal working hours by PWC, any duly authorized representative of the State of North Carolina and those persons required by State law or local ordinance to test special work for official approval. The Contractor shall provide proper facilities for safe access to the work at all times for each inspection. The Contractor shall give adequate notice to PWC of the time set for inspection or test.

Should any work be covered up or concealed prior to inspection and approval by PWC, such work shall be uncovered or exposed for inspection if so requested by PWC. Inspection of the work will be made promptly upon notice from the Contractor. All cost involved in uncovering, repairing, replacing, recovering, and restoring to design condition, the work that has been covered or concealed shall be paid by the Contractor.

PRE-TESTING & PRE-INSPECTION:

Where the Specifications or Plans require testing of water mains, sewer mains or sewer laterals, the Contractor shall perform all tests satisfactorily prior to scheduling the test to be observed by PWC. Pre-testing shall include sewer main and lateral flushing; mandrel pulling; air/pressure tests for water mains; air test for sewer mains, lateral and force mains. Pre-inspection shall include grouting manhole inverts, grouting manhole rings and throat, cleaning sewer mains and laterals, drop

structures and straps, water valve box protectors to grade, etc. The Contractor is expected to provide all equipment, materials, personnel, traffic control and all means necessary to perform the required testing and inspection to be witnessed by PWC. Additionally, test requiring water to be furnished shall be metered and paid for by the Contractor. If PWC observes re-occurring failing tests or if he determines pre-testing and pre-inspection is not being satisfactorily performed by the Contractor prior to scheduling the tests, the Contractor shall be charged for all costs associated with the re-testing/re-observation, to include but not limited to, PWC's actual costs to observe, report and document, mileage and all other associated costs.

The Contractor shall notify PWC to schedule all testing and inspection services. The PWC will consider such notification; either written or verbal, as the Contractors belief the tests results will be acceptable. The Contractor must notify PWC a minimum of 3 days in advance to the scheduled test.

GUARANTEE/WARRANTY:

The Contractor(s) shall guarantee and warranty all labor and material for the project against defect due to faulty material, workmanship, and/or negligence for a period of ONE YEAR from the date of final acceptance of the project by PWC. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, the manufacturer's warranty shall apply for that particular piece of equipment, material or system. The Contractor shall respond to any repair request from the Owner within ten (10) days of notice received by telephone, telegraph, or letter unless the repair request is considered an emergency threatening public health, life, safety and the response time shall be 48 hours. The Contractor shall be responsible for the material, equipment, labor and workmanship and required to repair defective product or system or remove and install a non-defective product or system without cost to the Owner within the stipulated guarantee/warranty period. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products.

GENERAL STATUTES GUIDELINES:

All prospective bidders are hereby advised to become familiar with certain provisions of the General Statutes of North Carolina. The following list is furnished for your information and is not meant to be all-inclusive. Full compliance of the Current General Statutes of North Carolina applicable to this contract shall be required from all bidders.

Chapter 44A, Article 3	Payment and Performance Bonds
Chapter 87	Contractors
Chapter 95, Article 16	Occupational Safety and Health Act of North Carolina
Chapter 113A, Article 1	Pollution Control and Environment
Chapter 130A, Article 19	Asbestos Hazard Management
Chapter 132	Public Records
Chapter 133, Article 1	Public Works - General

Chapter 133, Article 3	Public Works - Regulation of Contractors
Chapter 143, Article 8	Public Contracts
Chapter 143, Article 21	Water and Air Resources
Chapter 143, Article 21B	Air Pollution Control

"STANDARDS" REFERENCED:

Reference to standard specifications, manuals, codes of any technical society, organization or association as to the code of any governmental authority, or regulating agency, whether such reference be specific or by implication shall mean the latest standard specification, manual or code in effect at the time the work, materials, or equipment described in works which so applied have a well known technical or trade meaning shall be deemed to refer to such reorganized standard. Except where the Plans and Specifications include more stringent requirements, applicable Construction Industry Standards have the same force and effect as if bound or copied directly into the Plans and Specifications to the extent referenced.

INDEMNIFICATION:

To the fullest extent permitted by laws and regulations, the Contractor shall indemnify and save harmless PWC from all suits, actions and damages, or costs of every name and description, to which the parties may be subjected or put to by reason of injury to persons or property resulting from negligence or carelessness on the part of the Contractor, his servants or agents, in the delivery of materials and supplies, equipment and/or apparatus and installation thereof, or by or on account of any act of omission of the Contractor, his servants or agents; and the whole, or so much of the monies due or to become due the Contractor as may be considered necessary by the PWC until such suites or claims for damage shall have been settled or otherwise disposed of, and satisfactory evidence to that effect.

SCHEDULE OF SHOP DRAWING SUBMISSIONS

Project: Engineer: _____

Contractor: _____

Owner: Public Works Commission of the City of Fayetteville

Submittal ID Number	Item	Expected Submit Date	Required by Date	Submitted to Engr.	Submitted to PWC	Returned to Engr.	Returned to Contractor	Status	Remarks
02222-01	#57 Bedding Stone								
02222-02	Incidental Stone & Base, ABC								
02576-02	Type II Asphalt Mix								
02660-02	6" MJ DIP Fittings								
02660-03	6" DIP								
02660-04	6" Meg-A-Lug (If Utilized)								
02660-06	CI Valve Box								
02660-07	Concrete Protector Ring								
02660-08	Fire Hydrant								
02660-09	6" Tapping Sleeve								
02660-10	6" Tapping Valve								
02720-01	15" RCP Storm Pipe								
02720-02	Storm Drain MH								
02720-03	Storm Drain MH Grate								

SCHEDULE OF SHOP DRAWING SUBMISSIONS

Project:

Engineer: _____

Contractor: _____

Owner: Public Works Commission of the City of Fayetteville

Submittal ID Number	Item	Expected Submit Date	Required by Date	Submitted to Engr.	Submitted to PWC	Returned to Engr.	Returned to Contractor	Status	Remarks
02730-01	8" PVC SDR-26								
02730-02	4" & 6" PVC SDR-35								
02730-03	Precast Manholes								
02730-04	Butyl Sealant								
02730-05	Flexible Pipe Connector								
02730-06	External Joint Wrap								
02730-07	Manhole Step								
02730-08	MH Ring & Cover								
02730-09	PVC Sewer Fittings for SDR-35								
02730-10	PVC Sewer Fittings for SDR-26								
02730-11	PVC Sewer Fittings for Sch 40								
02730-12	4" Flexible Coupling, PVC - CII								
02730-13	4" Flexible Coupling, PVC - C/O								
02730-14	CI Comb C/O Wye								
02730-15	4" PVC C/O w/ Plug								

SCHEDULE OF SHOP DRAWING SUBMISSIONS

Project:

Engineer:

Contractor: _____

Owner: Public Works Commission of the City of Fayetteville

PCM:

Submittal ID Number	Item	Expected Submit Date	Required by Date	Submitted to PCM	Submitted to PWC	Returned to PCM	Returned to Contractor	Status	Remarks
02222-01	#57 Bedding Stone								
02222-02	Incidental Stone & Base, ABC								
02576-02	Type II Asphalt Mix								
02660-02	6" MJ DIP Fittings								
02660-03	6" DIP								
02660-04	6" Meg-A-Lug (If Utilized)								
02660-06	CI Valve Box								
02660-07	Concrete Protector Ring								
02660-08	Fire Hydrant								
02660-09	6" Tapping Sleeve								
02660-10	6" Tapping Valve								
02720-01	15" RCP Storm Pipe								
02720-02	Storm Drain MH								
02720-03	Storm Drain MH Grate								
02730-01	8" PVC SDR-26								
02730-02	4" & 6" PVC SDR-35								
02730-03	Precast Manholes								
02730-04	Butyl Sealant								
02730-05	Flexible Pipe Connector								
02730-06	External Joint Wrap								

SCHEDULE OF SHOP DRAWING SUBMISSIONS

Project:

Engineer:

Contractor: _____

Owner: Public Works Commission of the City of Fayetteville

PCM:

Submittal ID Number	Item	Expected Submit Date	Required by Date	Submitted to PCM	Submitted to PWC	Returned to PCM	Returned to Contractor	Status	Remarks
02730-07	Manhole Step								
02730-08	MH Ring & Cover								
02730-09	PVC Sewer Fittings for SDR-35								
02730-10	PVC Sewer Fittings for SDR-26								
02730-11	PVC Sewer Fittings for Sch 40								
02730-12	4" Flexible Coupling, PVC - CII								
02730-13	4" Flexible Coupling, PVC - C/O								
02730-14	CI Comb C/O Wye								
02730-15	4" PVC C/O w/ Plug								

DIVISION 2
SITE WORK

02110 SITE CLEARING

SCOPE

Work described in this section includes clearing and grubbing site, protecting adjoining property and trees as indicated on the drawings or as specified herein. The work shall include the complete removal and satisfactory disposal of all growth including trees, stumps, logs and roots; organic material, and other debris or items that interfere with construction operations. The site clearing operations shall be conducted in a manner to insure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

PROTECTION OF TREES AND VEGETATION

Trees and vegetation to be left standing shall be protected from damage incidental to clearing, grubbing, and construction operations, by the erection of timber barriers or by such other approved means. Such barriers must be placed and approved by the Engineer before construction operations can proceed. The protection shall include unnecessary cutting, breaking or skinning of roots; skinning and bruising of bark; smothering of trees by stockpiling construction materials or excavated material within the drip lines; excessive foot and vehicular traffic including parking of vehicles within drip line. Trees and vegetation receiving damage shall be repaired or replaced in a manner acceptable to the Engineer.

Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1½ inches or more in diameter and shall be trimmed of live branches to such heights and such manner as directed. Limbs and branches to be trimmed shall be neatly cut close to the hole of the tree or main branch. Cuts more than 1½ inches in diameter thus made shall be painted with an approved tree wound paint.

CLEARING AND GRUBBING

Clearing shall consist of the felling, trimming and cutting of trees into sections, and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface except such trees and vegetation as may be indicated or directed to be left standing. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations and to those under construction, and so as to provide for the safety of employees and others.

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. This material, together with logs and other

organic or metallic debris not suitable shall be excavated and removed to a depth of not less than 3 feet below any subgrade shoulder and slope surfaces in excavated areas indicated to be grubbed and in areas indicated as construction areas under this contract such as areas for buildings, roads, streets, shoulder areas, sidewalks. Depressions made by grubbing shall be filled with suitable material compacted to make the surface conform to the original adjacent surface of the ground. The required fill material will not be measured or paid for but should be included as part of the grubbing cost. Grubbing inside the drip line of trees to be left standing shall be by hand methods.

The combined item of clearing and grubbing shall also include the removal and satisfactory disposal of fences, steps, walls, building foundations, pavement, other rubble and debris.

DISPOSAL

All timber, logs, stumps, roots, brush, rotten wood, and other debris from the clearing and grubbing operations shall be disposed of off-site in an approved disposal pit. Such approval will include the conditions covering the disposal of such logs and stumps without burning, including the disposal area off-site. The contractor will be responsible for compliance with all state and local laws and regulations. Burning of timber and other refuse is not allowed within the City of Fayetteville.

DIVISION 2
SITE WORK

02111 SITE CLEARING (Utility)

SCOPE

Work described in this section includes clearing and grubbing, site, protecting adjoining property and trees as indicated on the drawings or as specified herein. The work shall include the complete removal and satisfactory disposal of all growth including trees, stumps, logs and roots; organic material, and other debris or items that interfere with construction operations. The site clearing operations shall be conducted in a manner to insure minimum interference with roads and other adjacent occupied or used facilities.

PROTECTION OF TREES AND VEGETATION

Trees and vegetation to be left standing shall be protected from damage incidental to clearing, grubbing, and construction operations. The protection shall include un-necessary cutting, breaking or skinning of roots; skinning and bruising of bark; smothering of trees by stockpiling construction materials or excavated material within the drip line; excessive foot and vehicular traffic including parking of vehicles within drip line. Trees and vegetation receiving damage shall be repaired or replaced in a manner acceptable to the Engineer.

Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1 1/2" or more in diameter and shall be trimmed of live branches to such heights and such manner as directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branch. Cuts more than 1 12/" in diameter thus made shall be painted with an approved tree wound paint.

CLEARING AND GRUBBING

Clearing and grubbing shall be performed within the permanent right-of-ways. In the interest of conserving natural resources and protecting the environment, clearing shall be kept to a minimum within the temporary right-of-ways limits. Where permanent and temporary right-of-ways are offset, the additional temporary area may be used as a "buffer" zone to aid in sediment control where possible. Clearing shall consist of cutting trees, with a stump left not more than two inches (2") above natural ground. Saleable timber shall become the property of the Contractor. Reasonable care shall be taken during construction to avoid damage to vegetation not located in the right-of-ways. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed to improve the appearance. Tree trunks receiving damage shall be treated with approved tree dressing.

Several areas along the Main where a temporary easement is indicated on the plans and is located in people's yards, the Contractor shall limit clearing only as absolutely necessary for the sewer installation. Where possible, individual trees shall be worked around and preserved. These particular areas will be noted on the plans.

In the interest of erosion and sediment control, if possible, clearing and grubbing should be staged in ½ mile sections or less. In all cases, the time of disturbance between clearing and grubbing operations and actual sewer line construction should be kept to a minimum, particularly if ditches and temporary roads are utilized for access to the project.

DIVISION 2
SITE WORK

02211 GRADING, UTILITIES

GENERAL

This section covers grading for the roadways and drives including all excavations, formation of embankments, preparation of subgrade for pavements and finishing and dressing of graded earth areas, shoulders, and ditches.

MATERIALS

Topsoil, material obtained from excavation suitable for topsoil's, is defined as natural, friable soil, characteristics of representative soils in the vicinity that produce heavy growth of crops, grass, or other vegetation. Topsoil shall be free from roots, stones, and other materials that hinder grading, planting, and maintenance operations, and free from objectionable weed seeds.

Satisfactory soil materials are defined as those in accordance with AASHTO Soil Classification Groups, A-1, A-2-4, A-2-5 and A-3 (or in accordance with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, SP, SC.) as determined by the Engineer. Satisfactory material shall be free from roots, organic matter, trash, debris, frozen material or stones larger than 3 inches in any dimension.

Unsatisfactory soil materials are defined as those in accordance with AASHTO Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, A-7 (or in accordance with ASTM D2487 soil classification groups GC, ML, MH, CL, CH, OL, OH, and PT) as determined by the Engineer.

Materials determined by the Engineer as too wet or too soft to provide a stable subgrade, foundation, or fill will be classified as unsatisfactory regardless of classification. The Engineer may require the Contractor to condition the wet soils provide a stable subgrade, foundation, or fill, the Contractor shall at no additional cost to the Owner, recondition the materials.

CONSERVATION OF TOPSOIL

Areas designated for operations that contain a blanket of soil, which is more satisfactory for the growth of grass than the embankment material to be placed, shall be stripped to a depth of approximately 4 to 6 inches and placed in convenient stockpiles as directed in the field, for later use as a topsoil blanket on the new graded areas specified herein, or as designated. The stripping of material for topsoiling shall be carefully determined and only the quantity required shall be stripped and stockpiled. Material ordered stockpiled shall be placed in a satisfactory manner to afford

drainage. When grading operations permit, instead of stockpiling, the topsoil shall be hauled and spread directly on the areas to receive topsoil.
Topsoil shall be placed on all shoulders, slopes, ditches, and other earth areas graded under this contract, excluding borrow areas, unless otherwise specified on the plans. Topsoil shall be uniformly placed on these areas to a compacted depth of not less than 3 inches or more than 4 inches. The material shall be free from clods of soil, matted roots greater than ½ inch in diameter, and any other objectionable material, which might hinder subsequent grass and mowing operations. The material shall be placed, leveled, and lightly compacted with at least one pass of a cultipacker, or other approved equipment weighing 100 to 160 pounds per linear foot of roller, to required cross sections, but shall be left one-tenth of a foot below the finished earth grade as specified in Paragraph FINISHED EXCAVATION.

BORROW EXCAVATION (Select Backfill)

Where satisfactory materials are not available in sufficient quantities from the required excavation, approved materials shall be obtained from borrow areas. Borrow excavation material shall be supplied by the Contractor from borrow areas located off-site. The work covered by this section shall consist of the excavation of approved material from borrow sources and the hauling and utilization of such material as required on the plans or directed by the Engineer. The borrow material shall be approved by the Engineer and shall not contain roots, root mats, stumps, highly plastic clay or other unsatisfactory materials. The material shall be a soil material, which meets requirements of AASHTO M145 for soil classification A-1-a, A-1-b, A-2-A, A-3 acceptable for select backfill material. All borrow material shall be in accordance with Section 1016, Class I or II backfill. Borrow excavation shall be in accordance with Section 1018 and 230 of the Standard Specification for Roads and Structures. Excess material removed within the work limits, suitable for Borrow Excavation, during "Unclassified Excavation" operations shall not be considered or paid for as Borrow Excavation.

UNDERCUT EXCAVATION

When the Owner determines that the natural soil materials (1) in areas where fill is to be placed, or (2) in the finished graded subgrade roadway cross section, or (3) in areas supporting structures or pipes, are determined to have a poor supporting value, the Engineer may require the Contractor to remove the materials and backfill with approved properly compacted material to the finished graded section. The Contractor shall conduct undercut operations in such a way that the Engineer can take the necessary measurements before any backfill is placed. Any material removed and backfilled without the approval of the Engineer, and/or all necessary measurements taken, and/or to a depth, length or width exceeding the dimensions shall not be considered undercut excavation and will not be paid for such. All undercut excavation shall be in accordance with Section 225 or Section 300 of Standard Specification for Roads and Structures. Undercut excavations suitable for backfill on toes of slopes and other approved areas will not be paid for as Borrow Excavation.

FINISHED EXCAVATION

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Surfaces shall be finished not more than 0.15 foot above or below the established grade and approved cross section. In areas where the bulking of soil as a result of grassing operations will tend to retard surface drainage along the edge of pavements, the finished grades shall be left 0.1 foot below grade prior to grassing.

Newly graded areas shall be protected from traffic and from erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades re-established to the required elevations and slopes. All work shall be conducted in accordance with the environmental protection requirements of the contract. Embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic of other operations and shall be protected and maintained by the Contractor in a satisfactory condition until subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade shall not be permitted. No base course or pavement shall be laid until the subgrade has been checked and approved, and in no case shall base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade. All work shall be conducted in accordance with the environmental protection requirements of the contract.

DIVISION 2
SITE WORK

02222 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITY SYSTEMS

SCOPE

Work described in this section shall consist of the excavation, trenching, and methods of pipe laying, backfilling, compaction and necessary disposal of unsuitable material as required to install the utilities systems. Grading of easements and soil restoration for utility systems not located within paved areas shall be in accordance with Section 02211 Grading, Utilities.

EXCAVATION

All excavation of every description and of whatever substance including rock and rock-like material encountered shall be to the lines and grades indicated. All excavation shall be by open cut, unless otherwise indicated. The work shall consist of the excavation, placement, compaction or satisfactory disposal of all unsuitable materials encountered within the limits of the work. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides or cave-ins. Failure to observe this precaution may result in a cave-in, and additional excavation to a greater depth to reach a firm footing will be required at the expense of the Contractor as determined by the Engineer. Where the line parallels a creek and/or ditch the excavated material shall be stockpiled opposite the creek, with the trench separating the two. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsatisfactory excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material, if directed, shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost to the Owner. Suitable material excavated shall be transported to and placed in fill areas within the work limits. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. All excess excavated material shall be disposed of by the Contractor at his expense unless ordered to another area of the project by the Engineer. The Contractor's obligation to remove and dispose of excess materials shall in no manner convey to him any rights of property in any material taken from any excavation. No extra payment shall be made for hauling excess material from one project area to another provided the distance of haul does not exceed two miles, defined as the "free haul limit". Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained. Unauthorized over excavation shall be backfilled with select bedding material at no additional cost to the Owner.

The Contractor is charged with the responsibility of actually investigating and examining the site before preparing the bid and no additional allowance for extra compensation will be allowed because of excavation and/or grading being a different nature than contemplated by him.

TRENCH EXCAVATION

The trench shall be ample to permit the pipe to be laid and jointed properly. The minimum width of the trench, from the top of the pipe bell to the bottom of the trench shall be at least 8" greater than the largest outside diameter of the pipe or bell. The maximum width of the trench shall not exceed the outside diameter plus 24" as shown on the Detail Sheet. The trench shall be braced and drained in such a manner that the work may be performed safely and efficiently. Trench shields or boxes may be used in lieu of sheeting and bracing as necessary to provide safety of the personnel. When using trench shields, care shall be taken when the shield is moved ahead, so as not to pull the already jointed pipe sections apart and designed so that the back end of the box sides do not extend below the spring line of the pipe. Where sheeting and bracing are used, sheeting to be removed shall not extend below the spring line of the pipe, otherwise, the sheeting and bracing shall remain in place.

The subgrade beneath the centerline of the pipe shall be finished to within 0.05 feet of a straight line between pipe joints to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes or coupling holes shall be excavated to the necessary size at each joint to eliminate bearing and permit joints to be made in an efficient, workmanlike manner. Stones of 3" or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed.

Where unstable material or ashes, cinders, all types of refuse, or other organic material is encountered at the grade established for installation of pipe or structures, additional excavation may be done if approved by the Engineer to the depths and widths so established. The additional excavated area shall be backfilled with select bedding material. Excavation to greater depths, unauthorized, shall be refilled with select bedding material and compacted as directed by the Engineer, at no additional cost to the Owner.

Excavation for catch basins, inlets, or similar structures shall be sufficient to leave at least 12" clear between the outer structure surfaces and the face of the excavation or support members. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unsuitable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

PIPE LAYING

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of the work. All pipes and fittings shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such manner as to prevent damage to materials and protective coatings and linings. Under no circumstances shall pipe materials be dropped or dumped into the trench. Pipe shall be carried into position and not dragged.

All dust, dirt, oil, tar (other than standard coating), or other foreign matter shall be cleaned from the jointing surfaces, and the gasket, bell, and spigot shall be lubricated with lubricant recommended by the manufacturer.

Except where necessary in making connections with other lines or as authorized by the Engineer, the pipe shall be laid upgrade beginning at the lower end with the tongue or spigot ends pointing in the direction of the flow to the correct line and grade. Joints for pipe sizes up to 24" in diameter can be assembled by the means of a bar and wood block or by hand. The axis of the pipe section to be installed shall be aligned as nearly as possible by batter board or laser beam with the axis of the last installed pipe section and spigot end inserted slightly into the socket. A bar shall then be driven vertically into the bedding and wedged against a wood block placed horizontally across the pipe to protect the joint end during assembly. By pushing the top of the vertical bar forward, lever action pushes the pipe into the home position indicated by a designated mark on the pipe for joint depth.

The use of excavating equipment to shove pipe sections shall not be allowed. Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. If after joint is made, and the grade needs correcting, the joint being laid shall be withdrawn, grade corrected, joint realigned, and the pipe pulled home. To pick up after joint is made results in rejoining without lubrication, usually causing a broken tongue and groove.

At time when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the Engineer. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry. No pipe shall be laid in water or where in the Engineer's opinion trench conditions are unsuitable.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench and "pushed home". If the pipe laying crew cannot put the pipe into the trench without getting earth into it, the Engineer may require while lowering the pipe into the trench, a canvas bag shall be placed over each end of the joint pipe. During laying operation, no debris, tools, clothing or other materials shall be placed in the pipe.

ALIGNMENT AND GRADE

All pipes shall be laid and maintained to the required lines and grades and structures, at the required locations with rings, covers and grates properly set. The lines and grades of the pipe will generally be indicated by stakes parallel to the line of the pipe and be set at such elevations that proper batter boards, grade boards or laser beams can be set. From these shall be stretched grade cords and the pipe shall be set carefully to conform to the grades indicated. The Contractor shall set all grades or shall be responsible for the finished pipe being laid to exact and proper line and grade.

Pipe sizes larger than 36" shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between structures or structure locations, or by use of television cameras passed through the pipe. If in the judgment of the Engineer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Owner.

TRENCH SAFETY

All excavations shall comply with the terms and conditions of the construction standards for excavations in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926. The Contractor shall have a "competent" person on the job at all times and when necessary employ a Professional Engineer to act upon all pertinent matters of the work.

TRENCH STABILIZATION (SHORING)

The Contractor shall design, furnish and install any trench stabilization necessary to maintain excavations for pipe and drainage structure installation. The method of shoring and excavation shall be in strict accordance with OSHA Regulations. The Contractor shall be responsible for installation and removal of any trench stabilization. The Contractor shall also be responsible for any damage to adjacent structures resulting from the installation, removal or absence of trench stabilization. Payment for all labor, equipment and materials involved in this specification will be considered a component of excavation, trenching and backfilling. The Contractor shall have a "competent" person on site during trenching operations.

There will be no separate payment for the work involved.

DEWATERING

The Contractor shall have available for immediate use at all times, a well point system adequate to handle the job for which it is intended. Sufficient header pipe and points shall be provided to maintain a dry and workable trench, in advance of any pipe laying. Dewatering will not be measured and paid for as a separate item of work.

BACKFILL

Backfill material shall consist of satisfactory material at a moisture content that will facilitate compaction, free from stones of such size as recommended by the pipe manufacturer, or larger than 3" in any dimension, whichever is smaller. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to insure thorough compaction of the fill under haunches of the pipe and to prevent injuring or moving the pipe.

Backfill material in trenches shall be placed in layers not exceeding 6" loose thickness to a point at least 12" above the pipe compacted with approved tampers to 90 percent maximum density. Backfill shall be deposited in the trench uniformly for the full width on each side of the pipe and along the entire length simultaneously. The remainder of the trench shall be backfilled in layers not exceeding 8" in loose thickness compacted as specified in subparagraph COMPACTION. Each layer shall be thoroughly compacted by an approved mechanical tamping device.

Backfill material around structures and appurtenances shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. No backfill shall be placed around manholes, catch basin, inlets or similar structure until the concrete has been allowed to cure for 3 days. The backfill material shall be deposited and compacted as specified in subparagraph COMPACTION and shall be placed in such manner as to prevent eccentric loading and excessive stress on the structure.

No backfilling will be allowed when in the opinion of the Engineer; weather conditions are such that an acceptable job cannot be obtained due to frozen material. Water flooding or jetting methods of compaction will not be permitted. The operation of heavy equipment shall be conducted so that no damage to the pipe may result.

COMPACTION

Backfill shall be compacted in accordance with the following table as a percentage of the maximum density at optimum moisture content as determined by the Standard Proctor Test, ASTM D-698.

Area	Percent ASTM D-698 Maximum Dry Density
Around and 1' above top of pipe	90
Remaining trench (within 4' of subgrade)	95
Pavement subgrade and shoulders	
Last 1' of fill (below subgrade)	100
Last 3' of fill - 12" below subgrade	98
Base material	100
Adjacent to structures (Areas not paved)	95

Under structures	98
Utility Outfalls (Cross Country)	95

Test for density of compaction may be made at the option of the Engineer, and the Contractor shall correct deficiencies without additional cost to the Owner.

Engineer may elect to have compaction tests performed after the backfill is complete. The Contractor shall be required to excavate to various elevations for density tests to be performed, backfill and re-compact without additional costs to the Owner.

DIVISION II
SITE WORK

02272 EROSION CONTROL - GENERAL PROVISIONS

GENERAL

The Contractor shall be responsible for conducting his site grading and drainage operations in such manner as to prevent or lessen excessive soil erosion of the construction site work areas. He shall at all times provide satisfactory means to prevent or minimize the movement and washing of large quantities of soil. The Contractor is expected to review his site grading and drainage operations periodically to determine the areas most susceptible to erosion by excessive rainfall and periodically maintain all installed measures for the project duration. The Contractor shall correct any deficiencies or problem areas as directed by the Engineer or NCDENR inspector within 48 hours.

EXECUTION

The Contractor's attention is directed to the fact that unless exposed earth areas are properly cared for during construction, they may result in substantial sedimentation damage downstream from the construction area. He shall at all times provide satisfactory means to prevent or minimize the movement and washing of quantities of soil onto pavements or into adjacent ditches, swales, inlets, and drainage pipes, to avoid the possibility of these structures becoming clogged with soil. Should this happen as a result of erosion at the site of this construction, the Contractor will be required to immediately provide means for removal of the soil and/or debris from the structures to restore the proper functioning of these structures. The Contractor shall assume all responsibilities to the affected property owners for correction of all damages. The Contractor is expected to review his site grading and drainage operations periodically with the Engineer with the view in mind of determining the areas most susceptible to erosion by excessive rainfall and shall take necessary temporary measures in sufficient time to minimize the washing away of the site soils that would likely occur before the areas are finished graded, top soiled and planted. The temporary measures to be provided by the Contractor at the critical areas may consist of, but not limited to, any one or a combination of the following, or by other approved means selected by the Contractor.

Interceptor or diversion swales and ditches.
Sowing oats, rye, etc. (for quick temporary cover).
Disking in straw mulch
Ditch checks.

If any earthwork is to be suspended for any reason whatsoever for longer than 15 days, the disturbed areas shall be seeded with temporary vegetative cover or otherwise protected against excessive erosion during the suspended period. Suspension of work in any area of operation does not relieve the Contractor of the responsibility for the erosion control and temporary measures will not be considered cause for a change in the price bid.

The Engineer has prepared an "Erosion and Sediment Control Plan Narrative" which is a part of the approval. The Contractor may elect to vary from the anticipated construction sequence submitted in this plan. Additional measures may be required to facilitate particular construction techniques and methods. The Contractor shall not have cause for additional compensation for additional measures required.

MAINTENANCE

The Contractor shall inspect and maintain each erosion control measure until the project is stabilized and accepted. After each significant rainfall, the Contractor shall remove and dispose of silt accumulation from each individual measure. The following maintenance may be required to each specific erosion and sediment control measure:

Silt Fence: Fabric shall be removed and replaced whenever deteriorated to such an extent the effectiveness is reduced. The toe of the fabric shall be buried a minimum of 6 inches.

Gravel Construction Entrance/Exit: Periodic top-dressing with two inch (2") of graded stone. Remove all objectionable materials spilled, washed or tracked onto public roadways.

Sediment Trap: Remove sediment and restore trap to original dimensions when accumulated silt volume equals ½ the design depth. Replace the contaminated gravel facing.

Gravel Inlet Protection: Remove sediment as necessary to provide adequate volume. Replace contaminated gravel facing if required.

Rip-Rap: Make repairs to dislodged stone and/or supplement as required if erosion occurs during heavy rainfalls.

REMOVAL

After the area has been stabilized and the project accepted, the Contractor shall remove all temporary erosion and sediment control measures. Silt fences shall be removed, sediment traps/pits and/or basins filled with suitable soil, compacted and seeded. The materials removed shall remain the property of the Contractor and shall be disposed of off-site, or may be reused in other locations if approved by the Engineer.

DIVISION II
SITE WORK

02273 TEMPORARY SILT FENCE

GENERAL

The work covered by this section consists of furnishing, installing, maintaining and removing a water permeable filter type silt fence for the purpose of removing suspended particles from the water passing through it.

The quantity of temporary silt fence to be installed will be affected by the actual conditions, which occur during the construction of the project. The quantity of temporary silt fence may be increased, decreased, or eliminated entirely at the direction of the Project Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

MATERIALS

Either wood posts or steel posts may be used. Wood posts shall be a minimum of 6 feet long, at least 3 inches in diameter, and straight enough to provide a fence without noticeable misalignment. Steel posts shall be 5 feet long, 1 3/4 inches wide and have projections for fastening the wire to the fence.

Wire fence fabric shall be at least 32 inches high, and shall have at least 6 horizontal wires. Vertical wires shall be spaced 12 inches apart. The top and bottom wires shall be at least 10 gages. All other wires shall be at least 12½ gages.

Burlap shall be at least 36 inches wide and shall weigh at least 6.7 ounces per square yard. Other materials may be used in lieu of burlap, provided the Project Engineer has approved these materials.

Wire staples shall be No. 9 staple and shall be at least 1½ inches long.

INSTALLATION

The Contractor shall install temporary silt fence as shown on the plans. The silt fence shall be constructed at the locations shown on the plans and at other locations directed by the Project Engineer.

Posts shall be installed so that no more than 3 feet of the post shall protrude above the ground and at 18 inches are driven into the ground. Filter fabric shall be attached to the wire fence fabric by wire or other acceptable means. The fabric shall be continual in length. The fabric shall extend into a

6"x 6" trench along the uphill side of the fence. The trench shall be backfilled and compacted. Place 6 inches of No. 57 stone along the toe of the fence to secure the fabric in place. The single stripe located approximately 6 inches form the silt fence outer edge should not be visible if the fabric and fencing are installed properly.

DIVISION II
SITE WORK

02274 GRAVEL CONSTRUCTION ENTRANCE/EXIT

GENERAL

The work covered by this section consists of furnishing, installing, maintaining and removing temporary gravel construction entrance/exits. The entrance/exit shall be located at points where vehicles enter and exit the project and as indicated on the plans to limit sediment "tracked" off the site.

MATERIALS

The stone shall be two inch (2") to three inch (3") washed stone.

INSTALLATION

The area to receive the stone shall be cleared of all vegetation, roots and other objectionable materials. The subgrade shall be graded and properly compacted. Areas yielding shall be covered with engineering fabric or undercut as directed by the Engineer. The stone shall be placed, graded and compacted to a minimum depth of six inches (6") and as shown on the plans. The minimum construction entrance dimensions shall be 50 feet in length and 12 feet in width. The construction entrance/exit shall be maintained and the stone supplemented throughout the life of the project and shall be removed upon stabilization and disposed of off-site at the Contractor's expense.

DIVISION 2
SITE WORK

02301 BORING AND JACKING (ROADWAYS AND RAILROADS)

GENERAL

Installation shall be by dry boring and jacking of a smooth wall steel pipe true to line and grade under roadways, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer. The Contractor shall notify the Owner's Representative 7 days prior to any contemplated work and securing any required permits.

MATERIALS

The casing pipe shall be spiral welded or smooth wall steel pipe in accordance with ASTM A53, Grade B having a minimum yield strength of 35,000 psi. The carrier pipe installed within the casing pipe shall be CL 50 Ductile Iron push-on joint 12" diameter or less and CL 50 Ductile Iron restrained joint for diameter greater than 12". The material for the sanitary sewer carrier pipe shall be CL 50 Ductile Iron with appropriate lining. The casing pipe minimum size and minimum wall thickness shall be in accordance with the following chart unless indicated otherwise on the drawings.

CARRIER PIPE	CASING PIPE (O.D.)	NCDOT WALL THICKNESS	RAILROAD WALL THICKNESS
4"	8" and under	0.188	0.188
	12 3/4"	0.188	0.188
8"	16"	0.250	0.281
	18"	0.250	0.312
	20"	0.250	0.344
12"	24"	0.250	0.375
16"	30"	0.312	0.469
24"	36"	0.375	0.531
30"	42"	0.500	0.625
36"	48"	0.500	0.688

The Contractor may substitute larger size casing pipe (particularly for sewer mains where grade and alignment are critical) with the proper wall thickness. A manual steering head or other approved guidance system is recommended for casing pipe 30 inches and larger and/or bores exceeding 100 feet in length.

INSTALLATION

Installation shall be by dry boring and jacking of a smooth wall steel pipe true to line and grade under roadways, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer. The Contractor shall notify NCDOT 7 days prior to any contemplated work and for securing any required permits.

The direction of the jacking shall be carefully established prior to beginning the operation, by provisions of guide rails in the jacking pit, or by the Engineer. Lubricants such as bentonite may be applied to the outside of the pipe to reduce frictional resistance during jacking. The boring auger shall not be a greater diameter than the outside diameter of the encasement and removal of the excavated material ahead of the pipe will be held to a minimum to prevent the formation of voids. Voids occurring outside the encasement pipe shall be filled with 3:1 Portland Cement grout and the ends of the encasement pipe closed with masonry after the carrier pipe placement. Grout holes shall be placed in the top section of the encasement pipe on 10' centers and the voids filled with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway or railroad.

The Contractor shall perform each bore before beginning the sewer line construction. A total maximum variation of 0.50 feet in invert elevation between terminating manholes is allowable. The boring shall be performed from the "uphill" to "downhill" direction maintaining the critical uphill invert elevation. The invert elevations of all manholes shall be adjusted "downhill" and sewer adjustment shall not constitute payment for extra depths of "cuts" or manholes. The sanitary sewer grade shown on the plans is considered the minimum allowable and in no case will a "flatter" grade percentage be acceptable, only grade greater than the proposed. Greater variations than allowable in invert elevations or slope shall require correction by the Contractor at no additional cost to the Owner.

The boring operations shall be conducted at all times in such a manner so as not to create a hazard to nor impede the flow of traffic.

The Contractor will be responsible for any repair costs if any settlement or damage to the roadway or railroad bed resulting from the boring operation occurs within one year after completion of the work. The Contractor shall maintain proper insurance as required by the North Carolina Department of Transportation.

DIVISION 2
SITE WORK

02350 STEEL "H" PILES

GENERAL

The work covered by this section consists of furnishing and driving steel H piles as indicated on the plans and as directed by the Engineer, in conformity with these specifications and to the bearing and penetration required.

MATERIALS

Steel H piles shall be of the sizes and weights shown on the drawings and shall conform to the requirements of ASTM A-36. The Contractor shall submit a manufacturer's certification to the Engineer that the H piles are in accordance with the project specifications.

INSTALLATION

Steel piles shall be handled and stored by methods that will not injure the pile. The piles shall be stored above the ground on platforms, blocks, or other supports. The piles shall be kept free from dirt, grease, and other foreign matter and shall be protected in so far as practical from corrosion.

The Contractor shall furnish sufficient lengths to develop load requirements as stated on the plans. Full butt-welded splices shall be used. H piles shall be driven to a minimum penetration of 10 feet by an approved hammer developing not less than 7500 ft.-lbs. of energy per blow. The load capacity of each pile shall be determined by the following formula:

$$Ra = \frac{2E}{S + 0.3}$$

where:

Ra	=	Safe load (lbs.)
E	=	Energy per blow (ft.-lbs.)
S	=	Final penetration per blow (inches) (average of last 6 blows)

Deviation of the location of the top of the pile from that shown on the plans shall not exceed 2 inches. A suitable driving cap shall be provided to prevent undue damage to the top of the pile. Piles shall be cut off at the required elevations along a plane normal to the axis of the pile. Methods used in cutting off piles shall meet the approval of the Engineer.

SHOP PAINTING

All steel piling shall be sandblasted in the shop to a minimum of SSPC-SP6-63. All sandblasted surfaces shall receive one (1) coat of Epoxy Primer the same day that piles are blasted. The primer shall be applied at the rate of 385 sq. ft. per gallon, which will provide 1.5 mils dry film thickness. Application method of the primer can be made by brush, roller brush, and conventional or airless spray.

FIELD PAINTING

After the piles have been driven, exposed primed surfaces shall be cleaned of dust and other foreign materials prior to applying two (2) coats of Coal Tar Epoxy at the rate of 90-115 square feet per gallon, which will provide a dry thickness of 8-10 mils coat. The minimum dry film thickness for the two coats shall be 16 mils. Application may be by brush, roller, conventional air spray or airless spray.

The re-coat time for the Coal Tar Epoxy can be as little as three (3) hours, but must not exceed 24 hours. Drying time of the coating is greatly affected by the temperature and humidity. If the first coat has exceeded the allotted time, it will be necessary to treat the coating prior to application of the second coat. The Coal Tar Epoxy shall not be applied in the rain or when the temperature is lower than 50 degrees F. Damaged surface areas due to handling and field welding must be wire brushed to original surface preparation and then coated with two (2) coats of Coal Tar Epoxy with minimum dry film thickness of 16 mils as specified above.

DIVISION 2
SITE WORK

02505 ADJUSTMENT OF EXISTING STRUCTURES

GENERAL

The work covered by this specification consists of the raising or lowering of existing catch basins, manholes, drop inlets and valve boxes encountered within the limits of the project to match the adjacent finished work.

MATERIALS

The materials shall be in strict accordance with the N.C. Department of Transportation Standard Specifications for Roads and Structures as set forth in Section 858-2.

Adjustable riser rings may be used to adjust manholes only, vertically 1 inch or greater. 3/4-inch adjustment rings are not acceptable. The steel rings shall be manufactured to a specific manhole location to allow adjustment to the proper roadway slope, longitudinally and cross slope; to the specific casting bearing surface; and for the existing manhole cover top and bottom diameter and thickness. All components shall be manufactured in accordance with the ASTM A-36 carbon steel with 3/4 inch thickness inner and 1/2 inch thickness steel outer rings. The riser system shall be anchored to the manhole frame to prevent any movement from traffic loads with three 1/2 inch #5 cone head set screws or bolts. The adjustment device shall be fabricated from stainless steel, have a positive lock and be in line with the lower bearing bar. The adjustment device shall be capable of adjustment ± 3/8 inch from nominal. The manhole adjustment ring shall fit within the existing casting without interference and the lid shall have bearing on the entire surface of the inner ring to prevent rocking from occurring. The lid shall be removed without binding. The inner and outer ring shall be securely welded to prevent any differential movement and fabricated to ± 1/16-inch concentricity. The outer riser ring shall have an inside diameter no greater than 3/16 inch larger than the outside diameter of the lid. All materials shall be bituminous asphalt coated. Certified welders shall perform all welding.

INSTALLATION

Adjustment of structures shall not be performed until after placement of base course and/or any leveling course and prior to placement of final course. All adjustments of structures shall be accomplished at least 72 hours prior to commencing paving. All defective castings (sunken lid 1/4 inch or greater), broken flanges, cracked ring or lid, or badly worn casting shall be replaced with new castings provided by the City and/or PWC at no cost to the Contractor. The Contractor shall be responsible for exchanging worn casting at the PWC or City's facility. Any debris that falls into the manhole or valve box during adjustment shall be removed immediately. The final surface course

shall be placed within ten (10) days of the adjustments have been made on each individual street. Work shall be performed in a manner to maintain at least one lane of traffic open at all times.

Excavate all material from around the casting to a width of 12" and to a depth of at least 2" below the existing brickwork or 2 inches below the top of the cone section. All loose material shall be removed and disposed of off-site appropriately. The edges of the excavation shall not be sloped. The height of the adjustment shall be determined by the use of a string line that is pulled across the casting for at least 10 feet in each direction at the desired adjustment height. Every effort shall be taken to ensure that the surface course and casting provide as smooth a ride as possible.

When raising a manhole casting, all brick are to be placed in a "spoke" pattern and laid in a bed of clean fresh mortar. The Contractor shall ensure all brick are set firm to eliminate movement of the casting. When lowering a casting, all brick and concrete are to be cut away, leaving a smooth surface. The casting shall be centered over manhole. A cap of clean fresh mortar shall be applied to the surface as a setting bed for the casting. When the casting is set back on the brick, care shall be taken to ensure that the casting is set on a bed of clean fresh mortar to eliminate movement. Once the casting has been set and secured, the excavated area around it shall then be backfilled with 3000 psi Portland cement concrete that is level to the existing surface. The top of the concrete shall be struck smooth with the existing surface. The asphalt edge shall be clean and the concrete is tied smoothly into the asphalt edge and not the soil. Any concrete spillage, excess debris and/or mortar shall then be cleaned from the casting. Asphalt shall not be used to backfill around casting. Drain holes in front of catch basins shall be bricked up or sealed with lean mortar.

All adjustments shall be protected for at least 72 hours before the placement of any surfacing material. Each adjustment shall be protected by a barricade with a light. A finish surface tolerance shall not vary more than 1/4" in any direction. No more than 7 days shall elapse between the time a structure has been raised and the time that bituminous plant mix has been placed flush with the top of the structure.

Where cast iron or steel riser rings used for adjustments, the existing structure's walls shall remain in place and the fittings shall be securely attached to the existing walls or installed in a manner, which will eliminate movement of the fitting. All bearing surfaces shall be cleaned thoroughly with a stiff wire brush. The riser ring shall be moved in a circular motion to obtain the "best fit" and adjust the diameter to provide a maximum 1/8-inch gap around the lid. After diameter adjustment tighten lock nut on adjuster to secure adjustment setting. Tighten all cone pointed setscrews firmly in to casting sidewalls, re-check all tightness of all fasteners and anchoring systems. Apply an even coat of manhole lid silencer to the riser to prevent the lid from rattling.

DIVISION 2
SITE WORK

02573 REMOVE AND REPLACE PAVEMENT (PERMANENT PATCH)

GENERAL

Open cutting and replacing existing pavement is required as indicated on the plans and shall conform to the North Carolina Department of Transportation Standards and as specified herein. The Owner will secure encroachment permits but the Contractor shall furnish all necessary insurance as required by NCDOT.

REMOVAL

The Contractor shall provide a neat edge along the pavement being retained by sawing, straight and true, the pavement approximately 2" deep before breaking away. The pavement shall be removed for its entire depth and removed from the site, disposed of at the Contractor's expense.

BACKFILLING

After the line has been installed and approved, backfilling shall be done with suitable material, free of large clods or stones. Backfilling materials shall be placed evenly and carefully around and over the pipe.

PAVEMENT

Replacing the pavement shall consist of the following:

Base Course

The stabilized aggregate base course shall be installed to a minimum 8" thickness (compacted) and extending 6" beyond the edge of the trench as indicated on the Permanent Pavement Patch Detail. The base course shall be compacted to 100% maximum dry density at optimum moisture content as determined by the AASHTO T-99 as modified by NCDOT.

In areas where approved by the Engineer, the stone base course is to remain for an acceptable period of time prior to asphalt patching, the base must be maintained. Maintenance shall include sweeping the adjoining pavement, blading and/or leveling the stone, compacting and wetting the stone to insure smooth drivable surface. The Contractor shall have on the project the proper equipment. Maintenance shall be performed at least weekly, after a rainfall, or at the direction of the Engineer.

Tack Coat

All existing pavement edges shall be tacked in accordance with Section 605 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.

Bituminous Concrete Surface Course

The bituminous concrete surface course shall be Type I-1, placed in a 2" minimum thickness or to the full depth thickness existing whichever is greater and in strict accordance with Section 645 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.

The patch shall be made the same day as the cut and installation of the line. If settlement should occur within one (1) year, the Contractor shall repair/re-pave the area to provide a smooth transition between the new and existing pavements. The finished product shall be neat in appearance and of equal or exceeding quality of the surrounding pavement or area.

CONCRETE DRIVES

Portions of concrete drives to be removed shall either be sawed or removed along existing joints. In either case, the edges shall be neatly made. Where new concrete is to be placed against concrete, preformed expansion joint filler, 3/4" in thickness and of a width extending for the full thickness and of a width extending for the full thickness of the slab, shall be used. All concrete shall have a 28 day compressive strength of 3000 psi and shall be placed to the same thickness as the removed portion except that in no case shall any new slab be less than 5" thick. The concrete shall be accurately screed to produce a uniform surface, floated, and given a broom finish. The finished work shall be first class in every respect.

DIVISION 2
SITE WORK

02660 WATER DISTRIBUTION

GENERAL

Water lines and all appurtenant items shall be constructed of materials specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defects in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Engineer at no expense to the Owner.

MATERIALS

MANUALLY OPERATING GATE VALVES

All manually operated gate valves four inches (4") and larger shall be ductile iron body resilient wedge type rated for 250 psig working pressure gate valves and shall conform to AWWA C-515 and NSF 61. Flanges shall not be buried. An approved pit shall be provided for all flange connections. All valves must open counter-clockwise equipped with a two-inch (2") square-operating nut. The operating nut or wheel shall have an arrow cut in the metal, indicating the direction of opening. All valves up to and including thirty-six inch (36") diameter shall have triple "O" ring stem seals. The design and machining of valves shall be such as to permit the replacement of the upper 2 "O" rings without undue leakage while the valve is wide open and in service. The wedge shall be ductile iron encapsulated in nitrile rubber (4"-12") sizes and SBR rubber (14"-24") sizes. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating complying with ANSI/AWWA C550 applied electrostatically prior to assembly, conforming to AWWA C-550-90. All valves up to and including thirty-six inch (36") diameter shall have a safe working pressure of 250 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500.

Gate Valves 16" and larger shall be furnished with a by-pass to equalize pressure for easier opening and to provide for low flows to fill lines where indicated on plans. Valve shall conform to AWWA C-500. Geared valves shall have gear trains totally enclosed in a ductile iron leak-less case, which shall be fully packed with grease. The gear train shall be mounted on an extended yoke in order to permit repacking of the valve stem without disturbing the gears or gear housing. In order that adjustable valve boxes may be placed over the operating and the by-pass valve operating nut in lieu of manholes or valve vault structures, a suitable cast iron protecting shield shall be provided around the valve stem and packing gland to prevent the entry of grit or

other abrasive substances. Adjustable valve boxes shall be placed over the 16" valve opening nut and the by-pass valve-operating nut requiring two boxes per valve. All valves shall be tested for leakage and distortion in strict accordance with AWWA C-500. Megalug will not be considered an acceptable method of restraining the valve.

Resilient seated tapping valves shall be furnished with the tapping flange having a raised face or lip designed to engage the corresponding recess in the tapping sleeve flange in accordance with MSS-SP60. Tapping valves without the raised face on the tapping flange are not permitted since they do not assure the proper alignment required to prevent damage by a misaligned shell cutter. The interior of the waterway in the body shall be a full opening and capable of passing a full sized shell cutter equal to the nominal diameter of the valve.

All valves shall be manufactured in strict accordance with the latest specifications of the American Water Works Association (AWWA). Valves shall be manufactured by: Mueller Company, Clow Corporation, American Darling Company, or approved equal. Certification shall be furnished to the Engineer by the manufacturer that all valves meet project specifications. Where specified on plans, resilient valves shall be supplied with gearing. Valves installed in a vertical position shall have spur gearing and bevel gearing for valves installed in a horizontal position.

BALL VALVES

Ball Valves shall be installed in accordance with the applicable utility provisions herein, as shown on the utility plans, and/or as directed by the Engineer.

Ball Valves shall be all bronze construction, with tee head operator and having a removable disc. Ball valves shall be in accordance with AWWA C507, Class 250. The interior coating of the valve shall be in accordance with AWWA C550. The valve shall be equipped with packing nut, gland, and packing material. Ball valves shall be of an approved type made from approved materials conforming to ASTM specifications and shall also meet the approval of the Engineer. The turn required to travel from fully closed to fully open on a ball valve shall be 90 degrees.

BUTTERFLY VALVES

Butterfly valves 16" in diameter and larger shall be Class 150B and shall meet the requirements of the latest revision of AWWA C-150. Valve bodies shall be cast iron or ductile iron conforming to the specifications for the physical and chemical properties of those materials contained in AWWA Standard C-504 latest revision edition. The bodies of all valves shall have two hubs for shaft-bearing housings cast integrally with the valve bodies. End connections shall be mechanical joint or flanged as specified or indicated for the piping in which they are to be installed. Valve discs shall be designed to sustain full differential pressures across a closed valve disc without exceeding a working stress of one fifth of the tensile strength of the disc material.

The design of the disc shall provide a full circle seating surface and shall have no external ribs transverse to the flow. Valve seats shall be resilient natural or synthetic rubber compounds and shall be so designed as to provide tight shutoff at the pressure differentials indicated by the AWWA pressure class designation of the valve. Rubber seats may be applied to either the body or the disc and shall be mechanically secured. Rubber used in the manufacture of the seats shall be resistant to microbiological attack, copper poisoning, and ozone attack. Valve seats must be capable of removal for field replacement without the necessity of chipping, grinding, or burring. The mating surfaces for valve seats shall be stainless steel or bronze. Valve shafts shall be of the "stub shaft" type comprised of two separate shafts inserted into the valve disc hubs for a distance of at least 1/2 shaft diameters. Shafts shall be wrought stainless steel and shall have a minimum diameter extending through the valve bearings and into the valve disc as indicated in Table 4, AWWA C504-80. The closeness of fit of the shaft-to-disc connection shall be such that valve performance during operation and closure is not adversely affected. Valve shall be fitted with sleeve type bearings contained in the hubs of the valve body. Each valve shall be equipped with either one or two thrust bearings to hold the valve disc securely in the center of the valve seat. Sleeve and other bearings fitted into the valve body proper shall be of "self-lubricated" materials that do not adversely affect water or rubber. Where shafts project through the valve bodies for operator connection, a shaft seal shall be provided. The seal shall be the "O" ring type and shall be contained in a removable corrosion-resistant recess. Shaft seals shall be designed so as to be replaceable without removal of the valve shaft. Butterfly valve operators shall comply with the provisions of AWWA Standard C-504 or latest revision. The rated torque capability of each operator shall be sufficient to seat, unseat, and rigidly hold in any intermediate position the valve disc it controls under the operating conditions specified. Stop-limiting devices shall be provided in the operators for the open and closed positions. All operator components between the input and these stops shall be designed to withstand, without damage, a 200 lb. handwheel pull and a 300 ft.-lb. torque on operating nuts. All valves shall open with a counterclockwise rotation, and all valves except direct buried valves shall have disc position indicators on the operator housing. Manual operators for direct buried valves shall be equipped with a 2" square-operating nut and with proper lubricant and seal for buried service. Butterfly valves shall be the product, meeting these specifications of American Darling, Henry Pratt Co., Mueller, or DeZurik. Megalug will not be considered an acceptable method of restraining the valve.

VALVE BOXES

Valve boxes shall be "slip-type" made of close-grained, gray cast iron metal painted before being shipped with one coat of first quality protective asphaltum paint with a minimum thickness of 3/16". Construction shall be in three pieces as follows: The lower of base pieces, which shall be beveled at the bottom to fit around the stuffing-box gland and rest on the valve bonnet or gear disc, as the case may be; the upper part which shall be flanged on the lower end, and of such size as to telescope over the lower part, the upper end being constructed in the form of a socket to receive the cap or cover; and the cover or cap shall have cast on the upper surface, in raised letters, the word "WATER". All valve boxes shall be equal in quality and workmanship to those

manufactured by Alabama Pipe Company, Chapman Valve Manufacturing Company, Columbian Iron Works, R.D. Wood Company, or an approved equal. Valve box shall have a _" hole drilled in the upper part to accommodate 1/4" x 1-1/2" Galvanized Bolt for securing tracer wire.

Valve box protector rings shall be installed to protect valve boxes located outside pavements (i.e. roadway shoulders). The ring shall be constructed as shown on the detail sheet. The concrete shall be a minimum of 2500 psi, reinforced with two #3 reinforcing bars, and have an outer diameter of 24 inches. The top of the protector ring shall be set approximately ½ inch above grade.

FIRE HYDRANTS

All fire hydrants shall be dry top, traffic type and conform to the latest revision of AWWA Specification C-502 except as listed below or as otherwise directed in the Proposal, Addenda, or on the Drawings. All working parts shall be bronzed. The size of the fire hydrants (designated by the nominal diameter of the valve opening) shall not be less than four and one-half inches (4 1/2"). All hydrants shall be able to deliver 1000 gallons per minute with a friction loss of not more than five (5) pounds per square inch total head loss through the hydrant. Hydrants shall be of compression type (opening shall be of such design that when the barrel is broken off the hydrant valve will remain closed and reasonably tight against leakage). All hydrants shall be mechanical joint to accommodate the spigot end of six inch (6") Class 150, AWWA Standard, ductile iron pipe. The bury line length of all hydrants shall be as shown on the Drawings or as indicated in the Proposal. Bosses (6") may be substituted for Tees in pipe sizes exceeding 12 inches. The boss shall be welded to the bottom of the main to provide effective flushing of the system.

All hydrants shall be furnished with two (2) two and one-half inch (2 1/2") nozzles and one (1) four and one-half inch (4 1/2") pumper nozzle. Outlets shall have American National Standard fire hose coupling thread, in accordance with the City of Fayetteville Standard, and shall be provided with nozzle caps securely chained to the body of the hydrant. The base of the hydrant shall have two (2) cast lugs suitable for use in strapping the hydrant to the connecting pipe. The operating nut shall be pentagonal in shape, finished with a slight taper to one and one-half inches (1/2") from point to flat to conform to the standard now in use by the Commission. All hydrants shall open left or counter-clockwise. Hydrants shall be suitable for working pressure of one hundred and fifty (150) pounds per square inch and test pressure of twice the working pressure. Fire hydrants shall be specific models manufactured by Mueller Company (Model Centurian 200), Kennedy Valve Manufacturing Company (Model K81A, Guardian), Clow Corporation, Medallion, American Darling (Model Mark 73-1) or approved equal. The interior of the hydrant shoe shall be coated with a 4-mil thickness FDA approved epoxy coating.

COMBINATION AIR VALVES ASSEMBLY

Combination air valves shall be of the single housing style that combines the operation features of both an air/vacuum and air release valve. The air/vacuum shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allows air to re-enter the pipeline when the internal pressure of pipeline approaches a negative value due to column separation, draining of the pipeline, power outage while the pipeline is in operation and under pressure. The air release port shall automatically release small pockets of air from the pipeline while the pipeline is in operation and under pressure. The combination air valve shall have two-inch (2") inlet and outlet connections and a 3/32" diameter orifice (or be determined by the Engineer for each project) for a maximum working pressure of 300 psi. The assembly shall be equipped with a two-inch (2") cut-off valve. The materials of construction shall be: Body, cover, and baffle of cast iron; float and all other trim, shall be of stainless steel with the exception of Buna-N seat, no plastic parts accepted. Valves shall be Clow Corp., APCO Valve, Crispin, Empire Corp. or approved equal.

WATER DISTRIBUTION PIPE

DUCTILE IRON PIPE

Piping for 4" water lines shall be CL51. Water lines 6" and larger shall be Ductile Iron conforming to ANSI A21.51 and AWWA Standard C-151, Class 50 working pressure not less than 200 psi unless otherwise shown or specified. Ductile iron pipe designated as "Pressure Class" shall be furnished with a minimum thickness calculated in accordance with ANSI A 21.50 (AWWA C-150) with a factor of safety of two; a working pressure of 200 to 350 psi, plus 100 psi water hammer allowance and ASHTO H-20 live truck load with 2½ feet of cover. In no case shall "Pressure Class" pipe's nominal thickness be less than the following:

SIZE	PRESSURE CLASS	NOMINAL THICKNESS (In.)
4"	350	0.25
6"	350	0.25
8"	350	0.25
10"	350	0.26
12"	350	0.28
16"	250	0.30
24"	250	0.37

Joints shall be mechanical joint or push on joint as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for 3" pipe and larger. Dependable, double sealing, push on joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Fittings and specials shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be mechanically restrained, Ductile Iron in accordance with ANSI A 21.53 (AWWA C-153) for 3" thru 24" sizes only. Where thrust blocking is utilized, fittings shall be full body Ductile Iron in accordance with ANSI A 21.53 (AWWA C110). Pressure rating shall be not less than 200 psi unless otherwise specified. All ductile iron pipe and ductile iron-cast iron fittings and specials shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). Pipe and fittings to have outside asphaltic coating as specified in AWWA Standard C-151 and C-110, respectively. The final coat shall be continuous and smooth being neither brittle when subjected to low temperatures nor sticky when exposed to hot sun. The coating shall be strongly adherent to the pipe at all temperatures. Where bosses are utilized, the pipe shall be a minimum Pressure Class 250 for sizes 16 inches and larger. When deemed necessary and requested by the Engineer, each joint of pipe and each fitting shall be inspected by an independent domestic testing laboratory, approved by the Engineer, and certification shall be supplied to the Engineer by them that all pipe and fittings meet project Specifications. In addition, the Contractor shall furnish to the Engineer a six-inch (6") test section from each lot of water pipe as per AWWA Specification ASA 21.4 to be used for additional test of the pipe lining by the Owner. Satisfactory results of this test must be obtained before acceptance of the pipe.

For aerial crossings or noted specifically on the plans, Flange Joint Ductile Iron Pipe shall be Class 53 with a working pressure not less than 150 psi. Flanges shall be standard Class 125 unless noted on the plans as "F & D 250". "F & D 250" flanges shall have a raised face and be faced and drilled to match Class 250 flanges shown in ANSI B16.1 latest revision. The Flange Pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed, Class 125 pound standard. Welding of flanges to the body of the pipe will not be acceptable. Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full-faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8" thickness. Linings and coating shall be as outlined for all ductile iron pipe and fittings, previously.

Restrained push-on joints for pipe and fittings shall be furnished for the locations shown on the plans. The pipe, joints, gaskets, and accessories shall be in accordance with ANSI/AWWA Standards as previously specified for ductile iron pipe. Welding, if required, shall be performed by qualified welders. Restrained joints, fittings and valves shall be rated for a working pressure of 350 psi for sizes 14" through 24" and 250 psi for larger sizes. The manufacturer shall furnish test results showing that the restrained joints in the sizes specified have been successfully tested

at least twice the specified pressure rating of the joint without leakage or failure. Tests shall be performed on the pipe with the same thickness class as specified. All ductile iron piping 30" and larger shall be as manufactured by American Cast Iron Pipe Company's LOK-RING or U.S. Pipe Company's TR-FLEX for restrained joints. The restraint joint shall be totally compatible with the push-on pipe joint without special accessories such as mechanical joint retainer glands, US Pipe's Field-LOK gasket, etc. Other manufacturers may be considered if the company has a minimum of 5 years experience with documented successful installations for restrained joint pipe. Mega-lug restraint mechanism will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12" diameter.

PVC PIPE

Water main pipe 2" and smaller shall be manufactured using Grade 1 PVC Compound Material as defined in ASTM D-1784 and shall be SDR21, Pressure class 200 in accordance with ASTM D 2241 or SDR-17 pressure rating 250 psi ASTM D-2241. Fittings for PVC 2" shall be push on fittings. The pipe shall be plainly marked with the manufacturer’s name, size, material (PVC) type and grade or compound, NSF seal, pressure rating and reference to appropriate product standards.

All PVC pipe (4" thru 12" diameter) and couplings shall be manufactured using virgin compounds as defined in ASTM D-1784, with a 4000 psi HDB rating and designated as PVC 1120 to be in strict accordance with AWWA C-900. The pipe shall be Pressure Class 235 and conform to the thickness requirements of DR18. The pipe and fittings shall be manufactured to withstand 755 psi quick burst pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1000 hours tested in accordance with ASTM D-1598. Couplings shall be compression, twin gasket type in accordance with ASTM D-3139 for push-on joints and ASTM F-477 for elastomeric seals (gaskets). **PVC fittings are not acceptable for water mains 3" or greater.** Threaded PVC connections will not be permitted, nor will cemented joints except as part of factory made fittings and adapters. Fittings shall be elastomeric-gasket bell and socket fittings with built-in stops, pipe ends tapered to fit the socket or elastomeric-gasket couplings with built-in stops, pipe and tapered to fit the coupling. The pipe joints shall be of the integral bell type with rubber gaskets shall conform to the requirements of ASTM D-3139 or ASTM F-477. Fittings and specials shall be ductile iron, bell end in accordance with AWWA C-110, 200-psi pressure rating unless otherwise shown or specified, except that profile of bell may have specials of the same material as the pipe with elastomeric-gaskets, all in conformance with the requirements of AWWA C-900. Ductile iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

For the purpose of identification of buried plastic or non-metallic pipes during future trenching or location, a continuous "detectable" identification wire shall be installed. The wire shall be minimum 12 gauge THHN copper. The wire shall be buried continuously along the pipe. The

wire shall be "stubbed" into valve boxes and secured such that a "direct/conductive metal detector may be used to trace the pipe location. Bolts or other approved methods shall be used to secure the detectable wire and the attachment location shall be readily available from finished grade without special equipment. The location inside the valve boxes or other similar structures shall be marked with an approved fluorescent paint for easy identification. The wire shall be installed above all non-metallic pipelines.

SPECIFICATION FOR POLYETHYLENE PIPE, TUBING AND FITTINGS FOR WATER MAINS AND DISTRIBUTION

GENERAL

All polyethylene pipe, tubing and fittings furnished under this specification shall conform to all applicable provisions and requirements of the latest revision of AWWA C901, C906 or CSA B137.1 and, by inclusion, all appropriate standards referenced therein.

MATERIALS

Polyethylene compounds utilized in the manufacture of products furnished under this specification shall have a grade of PE24 with a minimum cell classification of PE 234343[C, D, or E] for PE2406 materials, or a grade of PE34 with a minimum cell classification of PE 345444[C, D, or E] for PE3408 materials, as defined in ASTM D3350. In conformance with AWWA C901, AWWA C906, or CSA B137.1, they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1250 psi (PE2406) or 1600 psi (PE3408) at a temperature of 73.4ºF (23ºC).

All materials, which come in contact with water, including lubricants, shall be evaluated, tested and certified for conformance with ANSI/NSF Standard 61, if required by the production standard or requested by the end user.

Clean re-work material of the same type grade, and cell classification generated from the manufacturer’s own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing and fittings produced meet all the requirements of AWWA C901, AWWA C906, or CSA B137.1.

PIPE AND TUBING

Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of Section II above. Dimensional and performance characteristics shall conform to the requirements of AWWA C901, AWWA C906, or CSA B137.1. The pipe’s DR (Dimension Ratio) and Working Pressure Rating (WPR) shall be as

specified by the project design engineer.

FITTINGS

Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of Section II above, and all appropriate requirements of AWWA C901, AWWA C906, or CSA B137.1. Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Mechanical fittings produced from material not listed in Section II shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. In all cases, the specifications and requirements for the fittings supplied shall comply with the appropriate sections of AWWA C901, AWWA C906, or CSA B137.1.

PRESSURE CLASS

The Pressure Class of the PE pipe and PE fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use.

For PE 2406, the net pressure capability shall be the Working Pressure Rating (WPR) @ 73° F as follows:

DR	WPR Burst (psi)	WPR + Surge (psi)	Hydrotest sec. (psi)	Nominal 60 (psi)
32.5	40	60	60	160
26.0	50	75	75	200
21.0	63	94	94	250
17.0	78	117	117	312
15.5	86	129	129	344
13.5	100	150	150	400

11.0	125	187	187	500
9.0	156	234	234	624
7.0	208	312	312	832

For PE 3408, the net pressure capability shall be the working pressure rating (WPR) @ 73° F as follows:

DR	WPR Burst (psi)	WPR + Surge (psi)	Hydrotest sec. (psi)	Nominal 60 (psi)
32.5	51	76	76	200
26.0	64	96	96	256
21.0	80	120	120	320
17.0	100	150	150	400
15.5	110	165	165	440
13.5	128	192	192	512
11.0	160	240	240	640
9.0	200	300	300	800
7.0	266	400	400	1064

MARKETING

Pipe and tubing shall be marked in accordance with either AWWA C901, AWWA C906, or CSA B137.1 which ever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided (1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, (2) it has been demonstrated that these marks have no effect on the long term strength of the pipe or tubing and (3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either, ASTM D2683, ASTM D3261, AWWA C906 or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

WORKMANSHIP

Pipe, tubing and fittings shall be homogeneous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

3

QUALITY CONTROL

Pipe, tubing and fittings furnished under this specification shall comply with AWWA C901, AWWA C906, or CSA B137.1, which ever applies.

FUSION QULIFICATION

The manufacturer of pipe, tubing and fittings supplied under this specification shall establish and qualify heat fusion procedures for the joining of the materials supplied if required. Qualified fusion procedures, with appropriate supporting data, shall be furnished to the purchaser upon request.

RESOLUTION OF CONFLICTS

The use of ASTM standard specification references without a year designation implies the most current applicable specification. In the event this specification conflicts with the specification referenced in AWWA C901, AWWA C906, CSA B137.1 or local regulations, the requirements of AWWA C901, AWWA C906, CSA B137.1 or local regulations shall apply.

TAPPING SLEEVES

Water tapping sleeve shall be ductile/cast iron mechanical joint or stainless steel full gasket and have a minimum working pressure of 200 psi for all tappings of mains up to and including 30 inch diameter with a branch less than or equal to 12" diameter. Branch Diameter greater than 12" on 16" diameter pipe and larger shall require full body D.I. M.J. tapping sleeve.

Mechanical joint tapping sleeves shall be as manufactured by Clow, M&H, Mueller or American and shall be furnished with complete joint accessories including split glands, split end gasket, bolts, etc. The mechanical joint sleeve shall be compatible with type and class of pipe being

tapped. The outlet flange shall be class 125 per ANSI B16.1 compatible with approved tapping valves.

Stainless steel tapping sleeves shall be approved by PWC. The sleeve, lugs, bolts and nuts shall be 18-8 type 304 stainless steel. The outlet flange shall be ductile iron or stainless steel. The gasket shall be a grid pattern design and shall provide full circumferential sealing around pipe to be tapped. The sleeve shall include a 3/4 NPT test plug. All welds shall be passivated. The outlet flange shall be class case D per AWWA C-207-ANSI 150 lb. drilling compatible with approved tapping sleeves.

All tapping sleeves shall be pressure tested prior to tap being accomplished.

WATER SERVICE SADDLES

All water service saddles for use on 2-inch PVC shall be brass and as manufactured by Ford, Model S-70; Jones, Model J-995; McDonald Model 3801; or Mueller Model 13420.

Water service saddles for 1 and 2 inch taps on 4, 6, 8, 12-inch and larger size PVC and AC and also 4-inch and larger size iron pipe shall be ductile iron with stainless steel strap(s), bolts, nuts and washers (Double strap saddles with U-bolt style straps shall be acceptable for use on iron pipe). Ford Models FS 101, FS 202; Romac Models 101S, 202S; or Rockwell Model 315.317 shall be used. Stainless steel straps must be preformed at the factory to the specified outside diameters of PVC pipe.

Water service saddles with 2-inch outlet shall be double strap or approved equal.

Water service saddles for pipe sizes 12-inch through 24-inch shall be double strap or approved equal.

Water service saddles for pipe sizes exceeding 24-inches shall be as specified by the PWC Water Resources Engineering Department.

INSTALLATION

GENERAL

Pipe installation shall be in strict accordance with Section 02222 Excavation, Trenching, and Backfilling for Utility Systems with the following additions:

The water mains will not require laser for construction; but a minimum of 4 feet of cover is required without excessive displacement or misalignment.

The pipe bed shall be prepared by excavating not less than 4" or more than 6" below finish pipe grade. The trench shall then be refilled to finish grade by the addition of a minimum of 4" of select material from trench excavation. Loose soil or select material shall be native soil excavated from the trench, which, in the opinion of the Engineer, is suitable for bedding, and shall be free of rocks, foreign materials and frozen earth. All pipes shall be installed on the bed at least equal to the requirements of ANSI A21.50 Laying Condition Type 3. Select material from borrow for bedding or backfilling shall be used only where authorized by the Engineer as a result of encountering unstable material and where material from trench excavation is not suitable. Bedding, where authorized, shall be placed a minimum depth of 4" beneath the pipe for the full width of the trench and shall be granular material such as clean, coarse, washed sand, pea gravel, well graded crushed rock or other select material approved by the Engineer.

All ductile iron pipe and fittings shall be installed in strict accordance with ANSI/AWWA C-110/A21.10 respectively. All C-900 pipe shall be installed and embedded in strict accordance with ASTM D-2321. The PVC pipe shall be installed in a manner that will insure that external loads will not subsequently cause a decrease of more than five percent (5%) in the vertical Cross Section dimension (deflection). Whenever it is necessary to deflect pipe from a straight line, either in a vertical or horizontal plane, to avoid obstructions or plumb stems, or where long radius curves are permitted, the amount of deflection allowable shall not exceed the values in the following table as specified in AWWA C-600.

Maximum Deflection of Ductile Iron Pipe

PIPE DIA. (In.)	LAYING LENGTH Ft.	DEFLECTION ANGLE	RADIUS OF PIPE Ft.
3-12	20	5 degrees	230
14-16	20	4 degrees	285
18-36	20	3 degrees	380
42-48	20	2 degrees	570

PIPE SIZE	18 FEET R.G.	18 FEET M.J.	20 FEET R.G.	20 FEET M.J.
8"& 12"	19"	20"	21"	22"
16"	15"	13.5"	21"	15"

PIPE SIZE	18 FEET R.G.	18 FEET M.J.	20 FEET R.G.	20 FEET M.J.
24"& 30"	11"	9"	21"	10"
36"	11"	8"	17"	9"

Maximum Deflection of PVC Pipe (18' Joint Lengths)

SIZE OF PIPE, INCHES	PUSH-ON JOINTS, INCHES
4	23
6	16
8	12
12	8

If alignment requires deflection in excess of the above limitations, special bends shall be furnished to provide angular deflections within the limit set forth. Joint deflection for restrained joint ductile iron pipe shall not exceed the limits recommended by the pipe manufacturer, which shall be submitted to the Engineer.

Pipe passing through walls of valves pits and structures shall be provided with cast-iron wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

The spigot end of rubber gasket pipe shall be tapered to ease its sliding fit with the gasket. When rubber gasket pipe is field cut, the cut end shall be smooth and at right angles to the axis of the pipe without damage to the pipe or linings. The cut end must be chamfered 1/8" x 45 degrees before inserting into a rubber gasket bell. This may be done by grinding or filing. All sharp edges must be removed. Hydraulic squeeze type mechanical cutters shall not be permitted for cutting ductile iron pipe.

The outside diameter of the spigot end of bell-and-spigot pipe varies with the type, size, and class of pipe. There is only one joint size for each diameter of mechanical joint pipe and rubber gasket pipe. Thus, difficulty may be met when attempts are made to connect existing bell-and-spigot lines to mechanical joint or rubber gasket pipe. When such a connection must be made, an adapter having a fitting bell and a mechanical joint socket is manufactured and may be used. Mechanical and push-on type joints shall be installed in accordance with AWWA C-600 for buried lines of AWWA C-606 for grooved soldered pipe above ground or in pits. The last eight inches (8") outside of the spigot, and inside the bell or mechanical joint pipe shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the

joints, and then painted with a non-toxic vegetable soap solution or other approved soap solution all as specified by the pipe manufacturer. The cast-iron gland shall then be slipped on the spigot end of the pipe with the extension of the gland toward the socket or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with thick edge toward the gland. The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The cast-iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a suitable (preferable torque-limiting) wrench. The torque for various sizes of bolts shall be as follows:

PIPE SIZE INCHES	BOLT SIZE INCHES	TORQUE (FT. - LBS)
3	5/8	45-60
4-24	3/4	75-90
30-36	1	85-100
42-48	1 1/4	105-120

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

SETTING VALVES AND FITTINGS

Valves, fittings, plugs, and caps shall be set and jointed to pipe in the manner heretofore specified for cleaning, laying and jointing pipe. Valves in water mains shall be located as shown on plans. Stuffing boxes shall be tightened and the valve shall be fully opened and fully closed to insure that all parts are in working condition. A valve box or masonry pit shall be provided for every valve. The valve box shall be centered and plumb over the wrench nut of the valve. It shall not transmit shock or stress to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed soil. Combination Air Release Vacuum Valves shall be installed on D.I. pipe, installation on PVC pipe will not be acceptable.

All dead ends on new mains shall have 2" Blow-off assembly installed as indicated on the drawings.

SETTING HYDRANTS

Fire hydrants shall be located and installed as shown. Each fire hydrant shall be connected to the main with 6" branch line having at least as much cover as the distribution main. Fire hydrant branches shall have sufficient cover when crossing existing ditches. Fittings at the tapping sleeve and valve may be required. The costs of fittings, offset connectors, etc., shall be reflected in the fire hydrant unit price bid. Hydrants shall be set plumb with pumper nozzle facing

roadway and with the bottom flange of the hydrant at least 1-inch above existing ground, but not more than 3-inches as shown on the detail. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade line immediately after installation to obtain beneficial use of the hydrant as soon as practicable. Not less than 7 cubic feet of free draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to insure drainage.

ANCHORAGE

The bowl of each hydrant shall be tied to the valve and pipe with suitable tie rods and clamps, or mechanical joint restraint, as shown on the standard Fire hydrant and Valve Installation detail. All plugs, caps, tees, and bends deflecting 22 ½ degrees or more, either vertically or horizontally, on mains six inches (6") in diameter or larger shall be provided with a reaction backing or movement shall be prevented by attaching suitable metal rods or clamps or mechanical joint restraint. Valves shall be securely anchored or restrained for valves greater than 12" diameter, to prevent movement. Reaction backing shall be 3,000 lb, concrete. Backing shall be placed between solid ground and the full body D.I. C110 fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be sufficient for the blocking needed as indicated on the concrete thrust block detail. The backing shall, unless otherwise specified, be so placed that the joints will be accessible for repair. Metal harness of tie rods, clamps or mechanical restraint of adequate strength to prevent movement may be used instead of concrete backing. Rods and clamps shall be galvanized or rustproof as approved. Mechanical restraining system (or similar method) will not be considered an acceptable method of restraining for pipe, valves and fittings larger than 12 inches diameter or for use on PVC pipe and/or fittings.

HYDROSTATIC TESTS

After the pipe has been laid and partially backfilled as specified, all newly laid pipe, or any valved section thereof shall be subjected to a hydrostatic pressure test. Each valved section shall be tested individually. Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic test shall not be made until at least five (5) days after installation of the blocking unless otherwise approved. The Contractor will furnish all labor and material, including test pumps, taps, and corporations, for making hydrostatic tests. Cost for said tests shall be included in the Proposal. A PWC representative shall be present and shall open and close any valves on the current PWC water system. Under no circumstances, shall a Contractor tamper with any valves not installed by him. The Contractor shall submit to the Engineer for approval, a proposed method for disposing of the test water from the system.

The duration of the pressure test shall be at least one hour or longer, as directed by the Owners Representative. The hydrostatic pressure shall be 200 psi. Each valved section of pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. When

testing a valved section, pressure should be applied to adjacent sections so that the disc differential across the gate valves at each end of the section will not exceed 150 psi. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow offs are not available at the high places, taps shall not be made to provide blow offs.

All exposed pipes, fittings, valves, hydrants, and joints will be carefully examined during the open trench test. All joints showing visible leaks shall be made tight. Cracked or defective pipe, joints, fittings, hydrants, and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Engineer in certain conditions. The test shall be repeated until satisfactory to the Engineer.

The leakage test shall be conducted after the visual test has been satisfactorily completed. The leakage test shall be made at a pressure of 200 psi and shall have a minimum duration of two (2) hours. The quantity of water supplied to the newly laid pipe in order to maintain the leakage pressure shall be measured. The allowable leakage in gallons per hour per 100 joints of pipe is as follows:

Pipe Size	4"	6"	8"	12"	16"	20"	24"	30"	36"
Leakage	0.74	1.10	1.46	2.20	2.94	3.68	4.42	5.52	6.62

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Owner. Pressure test and leakage test may be conducted concurrently. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be re-accomplished.

STERILIZATION

Sterilization shall be according to the requirements of NCDNR. The Contractor shall perform and furnish all chlorinating equipment, sterilization solution, materials, excavation, barricades, backfilling, and any taps and corporations needed for Carolina Rules governing Public Water Supply Section .220, and AWWA 601A. The Contractor shall cooperate with the Public Works Commission's representative and furnish him any needed assistance, and schedule the testing with the Owner's representative.

Water distribution mains, after flushing to remove sediment and other foreign matter, and after testing for leaks, shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least 50 milligrams per

liter (or ppm) in the water throughout the distribution system. In no case will the agent be introduced into the lines in a dry solid state. The Contractor shall take all necessary measures to prevent downstream erosion caused by flushing the lines. All erosion/damages shall be repaired at no additional expense to the Owner.

The chlorine solutions shall remain in contact with interior surfaces of the water system for a period of 24 hours and shall produce not less than 10 ppm of chlorine throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. Then the water system shall be flushed with fresh water from an approved water source until the chlorine solution is dispelled. During the flushing period, each fire hydrant on the line shall be opened and closed several times.

After disinfection the water supply shall not be accepted or placed into service until bacteriological tests results. Samples will be taken by PWC Project Coordinators and analyzed by the PWC laboratory. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days.

In the event complete sterilization is not obtained within a reasonable number of "tries", the Contractor shall then take such steps as deemed necessary by the Engineer to eliminate any source of pollution originating within the system.

DIVISION 2
SITE WORK

02662 FIRE HYDRANT PAINTING

GENERAL

The object of these specifications is to provide the material and workmanship necessary to produce a first class job.

The Contractor shall paint all exposed exterior fire hydrant surfaces. Minor items not specifically specified, but necessary for proper completion of the work, shall be painted as directed by the Owner.

Painting shall be done at such times the Contractor and Engineer may agree upon in order that a dust free and neat work may be obtained. All painting shall be done in strict accordance with the paint manufacturer's recommendations and shall be satisfactory to the Engineer. Protective covering shall be utilized, as necessary and extreme care taken for protection of adjacent areas, equipment, shrubbery, or other items while painting is in progress. After painting is complete, all spilled paint drops, or other defects shall be removed from surfaces and the entire area thoroughly cleaned up. The Contractor shall submit to the Engineer, upon completion of the painting, certification from the paint manufacturer indicating that the quantity of paint, purchased for each item, was sufficient to properly coat all surfaces.

PAINT

All paint materials shall be first quality and shall be delivered on the job in the original sealed containers bearing the manufacturer's name and trademark. Paint shall conform to the requirements of Federal Spec. TT-V-51 or Military Spec. MIL-C450 or equal. The prime coat from the ground line up shall conform to Federal Spec. TT-P-86 (Type IV), Federal Spec. TT-P-636 or equal.

Thinners: Where thinning is necessary, only the products of the manufacturer furnishing the paint, and for the particular purpose, shall be allowed and all such thinning shall be done strictly in accordance with the manufacturer's instructions as well as with the full knowledge and approval of the Engineer.

SURFACE PREPARATION

All surfaces to be painted shall be prepared in a workman-like manner with the objective of obtaining a smooth, clean and dry surface. All painted surfaces shall be prepared and finished in accordance with the following specifications and shall be approved by the Engineer.

Metal: All exposed surfaces of fire hydrant and other ferrous metal items generally are to be shop primed and shall have all rust, scale, dust, grease or other deleterious substances removed by sandblasting or pickling in accordance with SSPC-SP-6. Cleaned metal shall be immediately primed to prevent new rusting. All ferrous metal items, not shop primed, shall be field cleaned by wire brushing (if approved by the Engineer) or sandblasting and immediately primed. Non-ferrous metals shall be solvent cleaned just prior to the application of prime coat or pre-treatment. Equipment not shop finished to the Engineer's satisfaction shall also be painted.

Application: Paint shall be applied evenly. Where necessary to obtain a smooth finish, the surface shall be sanded after application of the prime coat. Paint shall be applied, for each coat, at the rate specified by the manufacturer. Any difficulties in film thickness shall be corrected by the application of additional coats until the recommended thickness is obtained. If material has thickened or must be diluted for application by a spray gun, the coating shall be built-up to the same film thickness achieved with undiluted material. Additional coats of paint shall not be applied nor shall units be returned to service until paints are thoroughly dry. Paint shall not be applied in rain or damp weather or when the temperature is lower than 50 degrees F. Painting shall be suspended when relative humidity exceeds 85% or when air temperature will drop to below 40°F within 18 hours of application.

PAINTING SCHEDULE

Schedule of colors and coating requirements are as follows: Acceptable dry mil thickness will be 4-6 for each coat. Bonnet of hydrant shall be Acrylic Enamel, Dark Green paint or approved equal. Fire hydrant barrel, caps, chain and other exterior surfaces shall be Quick Drying Acrylic Enamel Yellow Paint or approved equal.

DIVISION 2
SITE WORK

02730 SANITARY SEWER SYSTEMS - ADDENDUM

VACUUM TESTING MANHOLES

All precast sanitary sewer manholes installed by the Contractor shall be vacuum tested for leakage. This test shall be done in accordance with ASTM C-1244 and in the presence of a PWC Project Coordinator. The Contractor shall be responsible for providing all the necessary labor, materials, equipment, testing apparatus, and all other incidentals necessary to complete the vacuum test. All testing equipment utilized shall be approved for use in vacuum testing manholes. All costs associated with the vacuum testing will be incidental to the unit cost of the manholes.

Each manhole shall be tested after assembly. All lift holes shall be plugged with an approved non-shrink grout. All lines, including laterals, entering the manhole shall be temporarily plugged. The Contractor should take care to ensure that the pipes and plugs are secure in place to prevent them being drawn into the manhole. The test head shall be placed directly on top of the concrete surface of the manhole following the manufacturer's recommendations, rather than to the cast iron seating ring.

Manholes may be tested either prior to backfill or post backfill at the contractor's option. For pre-backfill testing, a vacuum of 10 inches of Mercury (in. Hg) shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of Mercury (in. Hg). The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of Mercury to 9 inches of Mercury meets or exceeds the values indicated below:

	Diameter of Manhole		
Manhole Depth	**4' Diameter**	**5' Diameter**	**6' Diameter**
10' or less	**25 sec**	**33 sec**	**41 sec**
11' to 15'	**38 sec**	**49 sec**	**62 sec**
16' or more	**74 sec**	**98 sec**	**121 sec**

Vacuum testing backfilled manholes is not recommended in the presence of groundwater. Vacuum testing a backfilled manhole that is subjected to hydrostatic pressure may exceed the design limits of the flexible connecters and could lead to failure of the structure, joints, and/or connectors. Where groundwater is present a reduction in the vacuum pressure applied to the manhole will be required. The vacuum shall be reduced by 1 inch of Mercury for every 1 foot of hydrostatic head between 12 feet and 21 feet. A vacuum test should not be performed when the hydrostatic head exceeds 22 feet. See the chart below:

Hydrostatic Head (ft)*	12	13	14	15	16	17	18	19	20	21	22
Vacuum Pressure (in Hg)	10	9	8	7	6	5	4	3	2	1	**

*Hydrostatic head above the critical connector (critical connector is bottom most flexible connector)
**Do not perform vacuum test

If the manhole fails the initial test, the manhole shall be repaired by an approved method until a satisfactory test is obtained. All repair methods shall be approved by the Engineer prior to being utilized. Retesting shall be performed until a satisfactory test is accomplished.

DIVISION 2
SITE WORK

02730 SANITARY SEWER SYSTEMS

GENERAL

Sanitary sewer lines and all appurtenant items shall be constructed of materials specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Engineer at no expense to the Owner.

MATERIALS

SEWER MAINS

Prior to shipment each joint of pipe shall be stamped by an independent testing laboratory, certifying compliance with the specifications stated therein. Pipe sizes indicated shall be understood to be nominal inside diameter of the pipe. The pipe shall be tested for compression strength and absorption in accordance with ASTM C-301 for vitrified clay pipe. The material supplier shall furnish the Engineer certified copies of all test results.

VC PIPE

All vitrified clay pipe (18" and less in diameter) shall be in strict accordance with ASTM C-700, Extra Strength Clay Pipe, in every respect and the absorption not to exceed 6% as determined in accordance with ASTM C-301. All pipes shall be full internal diameter and furnished with flexible "O" compression joints conforming in all respects to ASTM C-425, Type III. The pipe and fittings shall be installed in strict accordance with ASTM C-12 in every respect.

DUCTILE IRON PIPE

All ductile iron pipe and fittings shall be in strict accordance with ANSI A21.51 and AWWA C151, Class 50 or Class 51, as applicable, in every respect. The working pressure shall be a minimum of 200 psi. Pipe shall be furnished in 18' or 20' lengths. Ductile iron pipe designated as "Pressure Class" shall be subject to the Engineer's approval. All pipe joints used in open trench construction shall be furnished with "push-on" joints, unless otherwise indicated on the drawings or specified. All joints and fittings shall be in accordance with ANSI A21.11 and AWWA C111. All ductile iron interior surfaces shall be lined with two (2) coats of Ceramic Epoxy to produce a total minimum dry film thickness of 40 mils or a cementitious (fused calcium aluminate) mortar lining protected with a

seal coat to produce a total minimum dry film thickness of 187 mils. The exterior pipe surfaces shall be protected with asphaltic coating as specified in AWWA C151 and C110.

For stream crossings, aerial crossings or as noted on the drawings, mechanical joint ductile iron pipe shall be required. Mechanical joints shall be of the stuffing box type and shall be in accordance with ANSI A21.11. Pressure ratings, linings and coatings shall be as outlined for ductile iron pipe.

For aerial crossings or as noted on the drawings, either flanged or restrained joint ductile iron pipe shall be required. The flanged pipe shall be in accordance with ANSI/AWWA 21.15/C115. Flange shall be standard Class 125, serrated face, shop fabricated and completely factory installed. Gaskets for flanged pipe shall be full-faced SBR rubber in accordance with ANSI/AWWA A21.11/C11 with a minimum 1/8-inch thickness. Flanges shall not be buried. Restrained joint pipe shall be in accordance with ductile iron pipe referenced standards. Restrained joint shall be totally compatible with the push-on pipe joint without special accessories such as mechanical joint retainer glands. Both flanged or restrained joint ductile iron pipe shall be in accordance with the specified minimum working pressures, linings and coatings outlined for ductile iron pipe. Welding will not be permitted.

PVC PIPE

PVC sewer pipe and fittings 4 inches thru 15 inches shall be in accordance with ASTM 3034 with a standard dimension ratio (SDR) of 26 for sewer mains and SDR 35 for laterals, elbow and Tee for Interior Drop Structure shall be SDR 35 Solvent Weld fittings. Larger diameter pipe (18 inches thru 27 inches) shall be in accordance with ASTM F-679. Both pipe and fittings shall be made of PVC plastic having a cell classification of 12454-B as specified in ASTM D-1784. The material shall be highly resistant to hydrogen sulfide, sulfuric acid, and other chemicals commonly found in sewage and industrial waste. Pipe joining shall be push on elastomeric gasket joints only and the joints shall be manufactured and assembled in accordance with ASTM D-3212. Elastomeric seals shall meet the requirements of ASTM F-477. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory and in accordance with ASTM D-3212 and contain a steel-reinforcing ring. PVC sewer pipe shall be made by continuous extrusion of prime green or white unplasticized PVC and contain identification markings as required by the applicable ASTM standard.

PVC LARGE DIAMETER RIBBED SEWER PIPE

All pipe and fittings shall be manufactured and tested in accordance with ASTM F-794, Series 46, for "Poly (Vinyl Chloride) (PVC) Large Diameter Ribbed Sewer Pipe and Fittings Based on Controlled Inside Diameter." Integral wall bell and spigot joints shall be designed with compression joints and assembled to form a watertight seal in accordance with ASTM-D2825 and taking cognizance 402. The material supplier shall furnish and Engineer certified test results for impact resistance, pipe stiffness, flattening, etc., for each days run.

FIBERGLASS PIPE

Fiberglass pipe and fittings 18" thru 36" shall be manufactured in accordance with ASTM D 3262 for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) sewer pipe. Pipe shall be centrifugally cast to result in a dense, non porous, corrosion-resistant, consistent composite structure using polyester resin systems suitable for sewer applications, reinforcing glass fibers of highest quality commercial grade - E glass filaments with binder and sizing compatible with impregnating resins, and silica sand that is 98% silica with maximum moisture content 0.2%. Joints shall be filament wound fiberglass exterior sleeve couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound. The joints must meet the performance requirements of ASTM D 4161. The fiberglass reinforced plastic pipe shall have a minimum specific pipe stiffness of 46 psi when tested in accordance with ASTM D 2412 (up to 24' of cover) over 25’ of cover use 72 psi pipe stiffness. Fittings for fiberglass reinforced plastic pipe may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays.

SPECIFICATION FOR POLYETHYLENE PIPE, TUBING AND FITTINGS FOR WATER MAINS AND DISTRIBUTION

GENERAL

All polyethylene pipe, tubing and fittings furnished under this specification shall conform to all applicable provisions and requirements of the latest revision of
AWWA C901, C906 or CSA B137.1 and, by inclusion, all appropriate standards referenced therein.

MATERIALS

Polyethylene compounds utilized in the manufacture of products furnished under this specification shall have a grade of PE24 with a minimum cell classification of
PE 234343[C, D, or E] for PE2406 materials, or a grade of PE34 with a minimum cell classification of PE 345444[C, D, or E] for PE3408 materials, as defined in ASTM D3350. In conformance with AWWA C901, AWWA C906, or CSA B137.1, they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1250 psi (PE2406) or 1600 psi (PE3408) at a temperature of 73.4ºF (23ºC).

All materials, which come in contact with water, including lubricants, shall be evaluated, tested and certified for conformance with ANSI/NSF Standard 61, if required by the production standard or requested by the end user.

Clean re-work material of the same type grade, and cell classification generated from the

manufacturer's own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing and fittings produced meet all the requirements of AWWA C901, AWWA C906, or CSA B137.1.

PIPE AND TUBING

Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of Section II above. Dimensional and performance characteristics shall conform to the requirements of AWWA C901, AWWA C906, or CSA B137.1. The pipe's DR (Dimension Ratio) and Working Pressure Rating (WPR) shall be as specified by the project design engineer.

FITTINGS

Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of Section II above, and all appropriate requirements of AWWA C901, AWWA C906, or CSA B137.1. Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Mechanical fittings produced from material not listed in Section II shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. In all cases, the specifications and requirements for the fittings supplied shall comply with the appropriate sections of AWWA C901, AWWA C906, or CSA B137.1.

PRESSURE CLASS

The Pressure Class of the PE pipe and PE fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use.

For PE 2406, the net pressure capability shall be the Working Pressure Rating (WPR) @ 73° F as follows:

DR	WPR Burst (psi)	WPR + Surge (psi)	Hydrotest sec. (psi)	Nominal 60 (psi)
32.5	40	60	60	160
26.0	50	75	75	200
21.0	63	94	94	250
17.0	78	117	117	312
15.5	86	129	129	344
13.5	100	150	150	400
11.0	125	187	187	500
9.0	156	234	234	624
7.0	208	312	312	832

For PE 3408, the net pressure capability shall be the working pressure rating (WPR) @ 73° F as follows:

DR	WPR Burst (psi)	WPR + Surge (psi)	Hydrotest sec. (psi)	Nominal 60 (psi)
32.5	51	76	76	200
26.0	64	96	96	256
21.0	80	120	120	320
17.0	100	150	150	400
15.5	110	165	165	440
13.5	128	192	192	512
11.0	160	240	240	640
9.0	200	300	300	800
7.0	266	400	400	1064

MARKETING

Pipe and tubing shall be marked in accordance with either AWWA C901, AWWA C906, or CSA B137.1 which ever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided (1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, (2) it has been demonstrated that these marks have no effect on the long term strength of the pipe or tubing and (3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either, ASTM D2683, ASTM D3261, AWWA C906 or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

WORKMANSHIP

Pipe, tubing and fittings shall be homogeneous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

QUALITY CONTROL

Pipe, tubing and fittings furnished under this specification shall comply with AWWA C901, AWWA C906, or CSA B137.1, which ever applies.

FUSION QUALIFICATION

The manufacturer of pipe, tubing and fittings supplied under this specification shall establish and qualify heat fusion procedures for the joining of the materials supplied if required. Qualified fusion procedures, with appropriate supporting data, shall be furnished to the purchaser upon request.

RESOULTION OF CONFLICTS

The use of ASTM standard specification references without a year designation implies the most current applicable specification. In the event this specification conflicts with the specification referenced in AWWA C901, AWWA C906, CSA B137.1 or local regulations, the requirements of AWWA C901, AWWA C906, CSA B137.1 or local regulations shall apply.

REINFORCED CONCRETE SEWER PIPE

Reinforced concrete sewer pipe and special/bends or fittings, sizes 24" through 48"diameter shall be in strict accordance with ASTM C-76, Wall C, Class III and Class IV, as shown on the drawings. 24" pipe may be furnished in 8-foot joints and larger size diameter in 12-foot joints. Reinforced concrete pipe shall be furnished with "O-ring" rubber gaskets conforming to the requirements of ASTM C-443, with reinforced bell. All concrete pipes shall be made with tongue (spigot) and groove (bell) rings or castings that form the mating surfaces of the joint. Those rings shall remain on the pipe for a minimum of twelve (12) hours after manufacture.

As an alternate bid, the reinforced concrete pipe, bends, fittings, and manholes shall be manufactured with a minimum Life Factor Design of "AZ = 0.95". "AZ" is defined as the pipe life factor and is equal to the product of the alkalinity of the concrete cover expressed as calcium carbonate equivalent "A" times the thickness of concrete cover over the inner reinforcing steel "Z" expressed in inches. The pipe shall be manufactured with a minimum "A" value of 0.55 concrete alkalinity as equivalent calcium carbonate, (CaCO (3)). Life Factor Design calculations and supportive certified test (by an independent testing laboratory) shall be submitted to the Engineer prior to pipe installation. Tests shall be performed as described in the Concrete Pipe Handbook published by the American Concrete Pipe Association or latest revision thereof. In no case shall the pipe have less than "C" wall thickness or a reduction in the specified class strength. Additional concrete cover over the inner reinforcing steel required to provide the design thickness shall be accomplished by moving the inner required concrete. The internal pipe diameter shall not be reduced. The use of two mixes, a lower alkalinity layer followed by a higher alkalinity inner layer in a two-pass production shall not be allowed.

PRECAST CONCRETE MANHOLES

Pre-cast circular reinforced concrete manhole units shall be in accordance with ASTM C-478. The tongue and groove ends of the concrete rings shall be manufactured for jointing with rubber gaskets. Unless otherwise indicated, near the ground surface, an eccentric cone shall be installed to reduce the access entry diameter sufficient to install a frame and cover. The manhole ring and cover shall be set into a bed of clean, fresh mortar and/or a concrete collar as detail on the drawings.

Manhole step shall be placed in all manholes 5 foot deep or greater and shall be steel reinforced (½" grade 60) copolymer polypropylene plastic steps in accordance with ASTM C-478 for material and design or as approved by the Engineer. The steps shall be spaced 16" o.c. with serrated treads and wide enough to stand on with both feet. Materials of construction and method of installation shall be in accordance with OSHA Standards.

Manhole frames and covers shall be made of gray cast-iron of superior quality, tough, and of even texture, and the iron shall possess a tensile strength of not less than 18,000 psi. Cast Iron shall conform to ASTM Spec A 48-83 Class 35, Frame and cover shall be manufactured by same manufacturer. All castings shall conform to the shape and dimensions shown on the plans, clean and perfect without blow, sand holes, or defects of any kind, which tend to impair their strength. No plugging or other stopping of defect holes will be allowed. The raised letters "SAN SEWER" and "PWC-FAY-NC", at least 2" high shall be cast into the cover so as to be plainly visible. Ring and casting shall conform to the Standard of the Public Works Commission. Camlock Ring and Cover shall have wiper gasket and 2 stainless steel roll pins ½" diameter by 1-3/4" 180° apart on manhole cover. Camlock Bolt head shall be compatible with PWC standard tool for turning camlock mechanism.

SELECT BUILDING MATERIAL

Select granular material (select bedding material or select bedding for backfill) shall be Bedding Classes A, B, C or crushed stone, gravel, crushed gravel as described in ASTM C12 for all rigid pipe or Classes I, II or III as described in ASTM D2321 for all flexible pipe.

INSTALLATION

Pipe installation shall be in strict accordance with SECTION 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS and jointing procedures as recommended by the manufacturer with the following exceptions:

The bottom of the trench shall be excavated to a minimum of 4" below the outside bottom of the pipe being installed to allow adequate placement and compaction of bedding material prior to installation.

Select bedding material shall be placed a minimum of 4" and a maximum of 6" under the pipe for full width of the trench and halfway up the pipe on the sides. Bedding material shall be placed in layers not exceeding 6" loose thickness for compacting by vibratory mechanical tamps under the haunches and concurrently on each side of the pipe for the full width of the trench. The final result shall be a "Class B" bedding for rigid pipe. Select bedding for backfill is considered the stone material backfilling authorized undercut excavation below the select bedding material under the pipe invert.

All water entering the excavations or other parts of the work shall be removed until all work has been completed. No sanitary sewer shall be used for disposal of ground water entering the excavation, unless specifically approved by the Engineer. At no time shall ground water be allowed to enter active sewers or existing pumping or wastewater treatment facilities.

All manholes shall be constructed to Public Works Commission's Standards or as shown on the plans or described in the specifications. All manholes shall be constructed to have a neat and pleasing appearance by persons skilled in this work. Installation shall be in accordance with ASTM C-891.

Manholes shall be constructed of precast reinforced concrete circular sections installed in a vertical position on a flat concrete base or base riser section with integral floor and shall have a pre-formed "cut-out" section to accommodate various pipe connections, all as detailed on the drawings. Pipe connections to manhole base shall be by gasketed flexible watertight connections (boot for small diameter and A Loc for larger diameter pipe) or as approved by the Engineer. The size shall be in accordance with the following table:

Pipe Size	Concrete Riser **
21" and less	48" diameter *
24" - 36"	60" diameter
42"	72" diameter

* Except where interior drop structures are required, use 60" diameter.
** Where multiple connections or acute angles are required, larger diameter manhole may be required as indicated on the plans.

The invert channel shall be smooth and semicircular in shape conforming to the inside of the connecting sewer section. Changes in direction of flow shall be made with a smooth curve as large as a radius as the size of the manhole will permit without a decrease in flow velocity. Changes in size and grade of the channel shall be made gradually and evenly. The invert channel shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar. The invert channel walls shall be formed or shaped to three quarters (3/4) of the height of the crown of the outlet sewer and in such a manner not to obstruct maintenance, inspection or flow in the sewers. The inverts shall be sloped to maintain acceptable velocity at minimum slopes of in-coming sewers. A shelf (bench on manhole floor) shall be provided on each side of any manhole invert channel. The shelf shall be sloped not less than 1:12 min - 2:12 max. Invert shall be located a minimum of 1" above the surface of the bench on existing manholes bottom of boot shall be set one inch above existing shelf unless otherwise indicated. Preformed manhole inverts are subject to the Engineer’s approval only in areas difficult to access, and usage is not preferred.

When used in a paved street, the ring and cover shall be set in suitable mortar surrounded by a concrete collar to a grade one-fourth inch (1/4") above the finished street grade so as to provide drainage away from the manhole. When used in places other than in a paved street, the ring and cover shall be set to the grade shown on the plans or directed by the Engineer. In unpaved areas not subject to vehicular traffic the frame shall be fully mortared to the manhole to create a neat and pleasing appearance. Camlock Ring and Cover shall be anchored to manhole with stainless steel bolt and wedge anchors, 4 each.

The interior manhole riser joints, lift holes and grade adjustment rings shall be sealed with non-shrinking mortar to provide a watertight manhole, lift holes sealed by manufacturer with plastic caps do not require mortar seal. Additionally, the frame and manhole connection shall have mortar placed on the inside (as well as outside). The hardened mortar shall be smooth to rub with no sharp edges, particularly opposite the access ladder.

Care shall be exercised during construction of the manhole to see that materials do not enter the sewer line. The invert channel and shelf (bench) of the manhole shall be kept clean of all mortar, broken brick, sand, or any other materials falling into the manhole. Such material shall be immediately removed. This condition shall be maintained until final acceptance of the work.

CONNECTION TO EXISTING MANHOLES OR LIFT STATIONS

Where new mains are to be connected to existing active sanitary sewers, the active sewers shall remain in service by the Contractor. Unless otherwise indicated, where new lines are connected into existing manholes, all or such portion of the manholes invert as is necessary at the option of the Engineer, shall be removed and a new invert shall be constructed to accommodate both new and existing effluent pipes and flows. All work will conform as nearly as practicable to the essential applicable requirements specified for new manholes including all necessary concrete works, brick work, cutting, shaping and pipe fitting. The connection and wall penetration shall be "cored" and a gasketed flexible watertight connection (boot) installed. The Contractor shall coordinate and cooperate with the Public Works Commission on all connections.

INSIDE DROP MANHOLE STRUCTURE

Inside manhole drop structures shall be constructed as shown on the sanitary sewer detail sheet. The transition of pipe other than SDR-35 or SDR 26 PVC pipe shall be accomplished outside the manhole wall using an approved full body MJ sleeve as indicated on the standard interior drop structure detail. Connection to the manhole wall shall be by using a flexible boot connected to manhole with stainless steel expansion ring and sealed with non-shrink grout, unless otherwise approved in writing by the Engineer. The drop pipe shall be anchored to the minimum 5' diameter manhole wall using 1"x 1/8" stainless steel straps, with stainless steel bolts and wedge anchors. The strap spacing shall not exceed 3 feet on center and in no case less than 2 straps per drop manhole structure. Manhole shall be 5' diameter up to 12" above the top of the drop structure Tee into the manhole.

MANDREL TESTING

Defection tests shall be performed on all pipe installations. PVC and fiberglass pipe's maximum deflection after backfilling shall not exceed 5 percent. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average

inside diameter of the pipe depending on the type of pipe manufactured and the applicable ASTM Specification. The pipe shall be measured in compliance with ASTM D2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. Installation shall be in accordance with the recommended practice specified in ASTM D-2321. Mandrel testing shall be required and the Contractor shall supply all labor, equipment and materials necessary to perform the test in the presence of the Engineer or Owner's representative. The test shall be performed without mechanical pulling devices. The mandrel shall be constructed so as to preclude any yield in diameter, and with a pull line on each end to facilitate withdrawal. The deflection/mandrel test shall not be performed until a minimum of 30 days after backfill operations are completed and the area graded to final contours or upon verification by an independent testing lab the entire trench has been compacted to at least the maximum density as shown in the detail and in no case less than 95% maximum density. If the deflection exceeds the allowable, the Contractor shall remove and replace the pipe at no additional costs to the Owner.

CLEANING

Every sanitary sewer lateral and every sewer main on the collection system shall be flushed and cleaned of all dirt and debris. Inverts in manholes with standing water will not be acceptable. During the flushing operation, the downstream manhole shall be closed with a watertight plug to protect the existing sewer main. All water shall be removed and properly disposed of by the Contractor.

LEAKAGE/INFILTRATION TESTING

Completed sewers shall be tested for leakage in sections, to be determined by the Engineer, but in no case will a section to be tested exceed 900 feet in length. The infiltration test shall be performed with a minimum positive head of 2 feet (groundwater minimum of 2 feet above the crown of the pipe). All visible flowing leaks shall be repaired by the Contractor prior to testing. The Contractor will furnish all weirs and other equipment, labor or materials necessary for flushing and testing as approved by the Engineer. Leakage exceeding 100 gallons per 24 hours per inch diameter of pipe per mile will not be acceptable. When leakage exceeds the above maximum, satisfactory corrections shall be made and re-testing accomplished. Testing, correction and re-testing shall be done at no additional cost to the Owner.

EXFILTRATION

Where leakage/infiltration testing is not performed due to lack of ground water, at the Engineer's option, exfiltration testing shall be performed to determine acceptability. The length of sewer subject to an exfiltration test shall be the distance between two adjacent manholes as a maximum, but shall be left to the discretion of the Engineer. No test shall exceed 900 feet. The exfiltration test to be performed shall be with air and coordinated with the Engineer and PWC. The Contractor is required to supply all equipment, labor, and materials and pay all costs associated with the test

performed. All exfiltration tests shall be performed after installation of the sewer laterals. All lines and laterals will be tested unless determined otherwise by the Engineer.

The low-pressure air test shall be performed with satisfactory results in accordance with ASTM C-828 for clay pipe and ASTM C924 for concrete and other materials. The pipe shall be plugged and air added slowly until the internal pressure of the line is raised to not greater than 4.0 psi. The test shall not begin until approximately 5 minutes after the test pressure is achieved to allow stabilization of air temperatures. If the pressure drops 1.0 psi during the test time, the line fails. The test time shall be as follows:

NOMINAL PIPE SIZE, INCHES	TIME, MINUTES PER 100 FEET
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4

The Contractor shall observe all safety precautions to include allowing no one in the manholes during testing; securing all plugs and providing additional plug bracing. The Contractor shall be required to furnish, install and remove after testing at no additional cost, a temporary rubber cap/plug to be airtight for all cleanout stacks to accomplish air testing. The air pressure shall never exceed 8 psi. All gauges shall be accessible outside of the manholes.

HYDROSTATIC TESTS (Ductile Iron Pipe)

After the ductile iron sewer pipe has been laid within the "protected" area and partially backfilled as specified, all newly laid pipe, shall be subjected to a hydrostatic pressure test. All sewers subject to Hydrostatic testing shall include (1) sewers entering or crossing streams, unless mechanical joint pipe is utilized, (2) sewers located less than 100 feet from any public or private water supply source including any WS-I waters or Class I or Class II impounded reservoirs, (3) minimum 18 inch vertical and 10 feet horizontal separation can not be maintained between sewers and water mains (see DEM Regulations), (4) as specified and/or indicated on the drawings. The Contractor will furnish all labor and material, including test pumps, taps, and corporations, for making hydrostatic tests.

The duration of the pressure test shall be at least one hour or longer, as directed by the Engineer. The hydrostatic pressure shall be 150 psi. Each section of pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Before applying the specified test pressure, all air shall be expelled from the pipe. Taps shall be made to provide blow offs.

All exposed pipes and joints will be carefully examined during the open trench test. All joints showing visible leaks shall be made tight. Cracked or defective pipe joints discovered in consequence of this pressure test shall be removed and replaced with sound material. The test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Engineer in certain conditions. The test shall be repeated until satisfactory to the Engineer.

The leakage test shall be conducted after the visual test has been satisfactorily completed. The leakage test shall be made at a pressure of 100 psi and shall have a minimum duration of two (2) hours. The allowable leakage in gallons per hour per 100 joints of pipe is as follows:

Pipe Size

4"	6"	8"	12"	16"	20"	24"	30"	36"
0.74	1.10	1.46	2.20	2.94	3.68	4.42	5.52	6.62

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests and leakage tests shall be satisfactory as specified. All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Owner. Pressure test and leakage test may be conducted concurrently.

DIVISION 2
SITE WORK

02732 SEWAGE FORCE MAINS

GENERAL

Sewage force mains and all appurtenant items shall be constructed of materials as specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for replacement and correction of such defect as directed by the Public Works Commission and at no expense to the Public Works Commission. All materials and workmanship shall be in complete accordance with the standards and specifications of the Public Works Commission and subject to Public Works Commission inspection and approval.

RELATED SECTIONS

A. Section 02222 – Excavation, Trenching and Backfilling for Utility Systems
B. Section 02660 – Water Distribution
C. Section 02730 – Sanitary Sewer System
D. Section 02736 – High Density Polyethylene Pipe
E. Section 02753 – Submersible Lift Stations
F. Section 02754 – Self-Priming Lift Stations

MATERIALS

PVC PIPE

In order to prevent the sanitary sewer force main from being mistaken for a water main, all force main PVC pipe shall be green in color.

Two inch (2") PVC pipe shall be manufactured using Grade 1 PVC compound material as defined in ASTM D-1784 and shall be SDR21, pressure class 200 in accordance with ASTM D 2241 or SDR-17 with a pressure rating of 250 psi, in accordance with ASTM D-2241. Fittings for 2" PVC shall be solvent welded Schedule 80 PVC. The pipe shall be plainly marked with the manufacturer's name, size, material (PVC) type and grade or compound, NSF seal, pressure rating and reference to appropriate product standards.

All PVC pipe (4" thru 12" diameter) and couplings shall be manufactured using virgin compounds as defined in ASTM D-1784, with a 4000 psi HDB rating and designated as PVC 1120 to be in strict accordance with AWWA C-900. The pipe shall be Class 150 and conform to

the thickness requirements of DR18. The pipe and fittings shall be manufactured to withstand 755 psi quick burst pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1000 hours tested in accordance with ASTM D-1598. Couplings shall be compression, twin gasket type in accordance with ASTM D-3139 for push-on joints and ASTM F-477 for elastomeric seals (gaskets). PVC fittings are not acceptable for mains other than 2". The pipe joints shall be of the integral bell type with rubber gaskets shall conform to the requirements of ASTM D-3139 or ASTM F-477. Fittings and specials for mains 4" and larger shall be ductile iron, bell end in accordance with AWWA C-110, 200-psi pressure rating unless otherwise shown or specified, except that profile of bell may have specials of the same material as the pipe with elastomeric-gaskets, all in conformance with the requirements of AWWA C-900. Ductile iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

Mechanical restraining systems shall not be used on PVC pipe.

DUCTILE IRON PIPE

All ductile iron pipe and fittings (6" and above) shall be in strict accordance with ANSI/AWWA C-150/A21.50 and ANSI/AWWA C-151/A21.51, Class 50 in every respect. Four inch (4") ductile iron pipe shall be Class 51. All pipe joints within an encasement shall be furnished with manufactured restrained joints and all pipe joints used in open trench construction shall be furnished with "push-on" joints. Pipe joints for aerial lines 12" and less shall be manufactured restrained joint and aerial lines greater than 12" shall be flanged. All joints and fittings shall be in accordance with ANSI/AWWA C-111/A21.11 and ANSI/AWWA C-110/A21.10, respectively. Mega-lugs, field-lok, and gripper rings are not allowable means of restraint for aerial crossings or in casings.

Transition between ductile iron pipe and HDPE shall be accomplished utilizing mechanical restraints as approved by PWC.

All ductile iron interior surfaces shall be lined with two (2) coats of ceramic epoxy to produce a total minimum dry film thickness of 40 mils or a cementitious (fused calcium aluminate) mortar lining protected with a seal coat to produce a total minimum dry film thickness of 187 mils. The exterior pipe surfaces shall be protected with asphaltic coating as specified in AWWA C151 and C110. Specifications for the ceramic epoxy can be found in Specification Section 09802, and specifications for the cementitious lining can be found in Specification Section 09803 of the PWC Design Manual.

HDPE PIPE

All high density polyethylene (HDPE) pipe and fittings shall be in accordance with PWC Standard Specification Section 02736, most recent edition.

COMBINATION AIR RELIEF AND VACUUM VALVE ASSEMBLIES

Air relief and vacuum valves shall be the combination sewage air valves. Combination air relief valves shall be heavy duty "universal" style, single body units, incorporating the functions of an air and vacuum valve with an air release valve in a single housing.

Combination air relief valves shall release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled, and then by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Combination air valves shall also be designed to permit large volumes of air to enter the pipeline during pipeline drainage.

The tap size shall be a minimum of 2", however if a larger tap is needed it shall be sized accordingly. The valve body, cover flange, and all internal parts shall be 316 stainless steel.

The valve shall incorporate an air release orifice of 3/16" for use at 200 psig, unless otherwise approved by PWC. This orifice will be located in the outlet of the valve and shall be drilled in a 316 stainless steel orifice plate that seals against a Buna-N rubber seat. Valves with seals that flex or "roll" will not be acceptable.

The entire unit may have a maximum height of 26 inches and a maximum weight of 37 pounds.

All air and vacuum combination release valves shall be Crispin Model UX20, ARI D-020, or approved equal. Air relief and vacuum valve manholes shall be 60" diameter precast concrete units conforming to ASTM C-478. The combination air relief vacuum valve manhole shall be lined with a coal tar epoxy, in accordance with manufacturer's instructions. The manholes and valves shall be installed in accordance with the standard PWC detail. The force main shall consist of one full joint of ceramic epoxy coated, ductile iron pipe centered at the air relief valve and a minimum of 4 feet deep.

Combination air relief and vacuum valves shall be installed using stainless steel double strap service saddles, a 2" ball valve, and a 2" x 1" brass tee with a quick connect attachment as shown in the PWC standard detail.

Service saddles for 2 inch taps on 4-inch and larger size iron pipe shall be ductile iron with stainless steel double straps, bolts, nuts and washers

Ball Valves shall be all bronze construction, with a handle operator. Ball valves shall be in accordance with AWWA C507, Class 250. The interior coating of the valve shall be in accordance with AWWA C550. The valve shall be equipped with packing nut, gland, and packing material. Ball valves shall be of an approved type made from approved materials conforming to ASTM specifications and shall also meet the approval of PWC. The turn required to travel from fully closed to fully open on a ball valve shall be 90 degrees.

AIR RELEASE VALVE MANHOLE RING AND COVER

Cast iron manhole frames and covers shall conform to the drawings in all essentials of design with vent holes. The frames and covers shall have a combined weight of not less than 310 pounds and shall conform to ASTM A-48, Class 30 frame and Class 35 cover. Lettering on the cover shall conform to the City of Fayetteville Public Works Commission standards and shall be stamped or cast into all covers so as to be plainly visible. Unless otherwise shown on the drawings, the frames and covers shall be so set that the top of the cover will be flush with finished grade or as directed by PWC.

BY-PASS PUMPING ASSEMBLIES

By-pass pumping assemblies shall be installed in accordance with PWC standard detail S.20. The bypass pumping assembly shall be constructed of ductile iron pipe which meets the requirements of this specification.

INSTALLATION

Pipe installation shall be in strict accordance with Section 02222 - Excavation, Trenching, and Backfilling for Utilities System with the following exception: The force main will not require laser for construction, but a minimum of 3.5 feet of cover over the top of the pipe is required without excessive displacement or misalignment. The maximum offset in alignment between adjacent pipe joints shall be as recommended by the pipe manufacturer and approved by PWC, but in no case shall it exceed five (5) degrees. Except where authorized, pipe shall be laid with the bells facing the direction of pipe installation. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material will be rejected.

Installation of ductile iron pipe with mechanical or push on type joints shall be in accordance with AWWA C-600 and the manufacturer's recommendations.

Installation of PVC pipe shall be in accordance with the manufacturer's recommendations. Threaded PVC and cemented joints will not be permitted. The ends of push on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated and the gasket lubricated to prevent displacement. Care shall be exercised to insure that the gasket remains in proper position in the bell or coupling while marking the joint.

All pipe installations shall be properly restrained, utilizing either thrust blocks or approved restraint systems. The thrust blocking shall be in accordance with PWC standards, and as designed by the Engineer. The approved restraint system shall be installed in accordance with the manufacturer's instructions.

For the purpose of identification of buried pipes during future trenching or location, a continuous "detectable" identification wire shall be installed as well as green, "Sanitary Sewer Force Main" marking tape. The wire shall be a minimum 12 gauge single strand, coated copper wire that is suitable for underground use. The wire shall be buried continuously along the pipe. The wire shall be "stubbed" into marker posts and air release valve manholes and secured such that a "direct"/conductive metal detector may be used to trace the pipe location. The marker posts shall be Rhino TriView TracerPeds which are green with a "Sewer Force Main" warning decal (GD-5314K) and have internal terminals. The marker posts shall utilize the TriGrip Anchor system for direct bury installations. The identification wire shall be attached to the marker posts in accordance with PWC standards. Tracing wire marker posts shall be located no more than 500 feet apart. When the force main is located in unpaved areas such as easements the marker posts shall be installed along the centerline of the force main. When the force main is located in paved areas the marker posts may be offset from the centerline of the force main in a uniform manner. The location inside the marker posts shall be marked with an approved fluorescent paint for easy identification. The wire shall be installed with all non-metallic pipelines.

The "Sanitary Sewer Force Main" marking tape shall be green and labeled to warn of the presence of the sewer main. The tape shall be manufactured for durability and resistance to the elements. The marking tape shall be installed with both PVC and Ductile Iron force mains.

CONNECTION TO EXISTING MANHOLES

Where new mains are to be connected to existing active sanitary sewers, the active sewers shall remain in service by the Contractor. Unless otherwise indicated, where new lines are connected into existing manholes, all or such portion of the manhole invert as is necessary in the opinion of the PWC Project Coordinator, shall be removed and a new invert shall be constructed to accommodate both new and existing effluent pipes and flows. Where force mains enter manholes, pipe and fittings shall be restrained as indicated on the plans with the force main outlet directed toward invert out. All work shall conform to the applicable requirements specified for new manholes including all necessary concrete works, brick work, cutting, shaping and pipe fitting. New and existing manhole walls, inverts, and shelves shall be coated with coal tar epoxy coating in accordance with Specification Section 09800. The Contractor shall coordinate and cooperate with the Public Works Commission Project Coordinator on all connections. Connections to any manhole shall be made using the core and boot method. If necessary, drop or slide structures shall be installed, in accordance with PWC standards.

HYDROSTATIC TESTS

After the pipe has been laid, the valves installed, the taps made and the system has been partially backfilled as specified, all newly laid pipe shall be subjected to a hydrostatic pressure test. Where any section of a force main is provided with concrete thrust blocking for fittings, the hydrostatic test shall not be made until at least five (5) days after installation of the blocking unless otherwise approved. The Contractor will furnish all labor and material, including test pumps, taps, and corporations, for making hydrostatic tests. Cost for said tests shall be included in the Proposal. A PWC Project Coordinator shall be present for all testing. The Contractor shall coordinate with the PWC Project Coordinator for disposing of the test water from the system.

The duration of the pressure test shall be at least one hour or longer, as directed by the PWC Project Coordinator. The hydrostatic pressure shall be 200 psi. The pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the PWC Project Coordinator. Before applying the specified test pressure, all air shall be expelled from the pipe. If blow offs are not available at the high places, taps shall be made to provide blow offs.

The results of the pressure test shall be satisfactory as specified. All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to PWC. All materials and methods used to make repairs shall be approved by PWC. The PWC Project Coordinator shall be present while all repair work is taking place.

DIVISION 2
SITE WORK

02733 WATERTIGHT MANHOLE INSERT

GENERAL

The insert shall be installed in strict accordance with the manufacturer's instructions and recommendations.

MATERIALS

Watertight Insert: The watertight insert and each of its components, the valve bodies, the valve plugs, the valve springs and the gasket shall be manufactured of plastic, stainless steel or other corrosion proof material. The insert shall be manufactured of High Density Ethylene Hexene-1 copolymer, meeting the requirements of ASTM D-2148, Class A, Category 5. The finish thickness shall be 2/16" varying a maximum of 1/16". The insert shall be manufactured to custom fit the manhole frame and cover as shown on the drawings.

Gasket: The gasket shall be manufactured of closed cell radiation cross-linked polyethylene foam and in accordance with ASTM D-395, D-1564, D-624 and D-1667. The gasket shall be heat welded to the insert to conform to irregularities in the frame and to form a leak proof seal.

Relief Valves: The gas relief valve and the vacuum relief valve shall be designed to release at a pressure differential equivalent to approximately 1/2 psi and 2.25 psi respectively. The valve body shall be manufactured of formulated plastic polymers and the valve plug shall be neoprene confined within a stainless steel spring. Both valves shall be self-cleaning.

Depth of Bowl: The depth of the insert shall be such that the manhole cover does not come in contact with the valves when flipped during removal or replacement.

Testing: After installation, the seal and valves shall be water tested and shall not allow more than 1 gallon of inflow during a 24 hour period.

Certification: Certification shall be furnished to the Engineer by the manufacturer that all inserts are in accordance with the project specifications. Shop drawings are required, see Special Conditions.

DIVISION 2
SITE WORK

02734 CLEANING AND TESTING SANITARY SEWER SYSTEMS

GENERAL

Sanitary sewer lines and all appurtenant items shall be cleaned, tested, and inspected as specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Engineer at no expense to the Owner.

CLEANING

Every sanitary sewer lateral and every sewer main on the collection system shall be flushed and cleaned of all dirt and debris. Inverts in manholes with standing water will not be acceptable. During the flushing operation, the downstream manhole shall be closed with a watertight plug to protect the existing sewer main. All water shall be removed and properly disposed of by the Contractor

MANDREL TESTING

Deflection tests shall be performed on all pipe installations. PVC (Poly Vinyl Chloride) pipe's maximum deflection after backfilling shall not exceed 5 percent. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on the type of pipe manufactured and the applicable ASTM Specification. The pipe shall be measured in compliance with ASTM D2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. Installation shall be in accordance with the recommended practice specified in ASTM D-2321. Mandrel testing shall be required and the Contractor shall supply all labor, equipment and materials necessary to perform the test in the presence of the Engineer or Owner's representative. The test shall be performed without mechanical pulling devices. The deflection/mandrel test shall not be performed until a minimum of 30 days after backfill operations are completed and the area graded to final contours or upon verification by an independent testing lab the entire trench has been compacted to at least the maximum density as shown in the detail and in no case less than 95% maximum density. If the deflection exceeds the allowable, the Contractor shall remove and replace the pipe at no additional costs to the Owner.

LEAKAGE/INFILTRATION TESTING

Completed sewers shall be tested for leakage in sections, to be determined by the Engineer, but in no case will a section to be tested exceed 900 feet in length. All visible flowing leaks shall be repaired by the Contractor prior to testing. The Contractor will furnish all weirs and other equipment, labor or materials necessary for testing as approved by the Engineer. Leakage exceeding 100 gallons per 24 hours per inch diameter of pipe per mile will not be acceptable. When leakage exceeds the above maximum, satisfactory corrections shall be made and re-testing accomplished. Testing, correction and re-testing shall be done at no additional cost to the Owner.

EXFILTRATION

Where leakage testing is not performed due to lack of ground water, and at the Engineer's option, exfiltration testing shall be performed to determine acceptability. The length of sewer subject to an exfiltration test shall be the distance between two adjacent manholes as a minimum, but shall be left to the discretion of the Engineer. No test shall exceed 900 feet. The exfiltration test performed shall be with air and coordinated with the Engineer or Owner's representative. The Contractor is required to supply all equipment, labor, and materials and pay all costs associated with the testing. All exfiltration tests shall be performed after installation of the sewer laterals. All lines and laterals will be tested unless determined otherwise by the Engineer.

A low-pressure air test may be substituted in lieu of the water test as outlined above. The test shall be performed with satisfactory results in accordance with ASTM C-828 for clay pipe and ASTM C-924 for concrete and other materials. The pipe shall be plugged and air added until the internal pressure of the line is raised to at least 4.0 psi. The test shall not begin until at least 5 minutes after the test pressure is achieved to allow stabilization of air temperatures. If the pressure drops 1.0 psi during the test time, the line fails. The test time shall be as follows:

NOMINAL PIPE SIZE, INCHES	TIME, MINUTES PER 100 FEET
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4

The Contractor shall observe all safety precautions to include allowing no one in the manholes during testing; securing all plugs and providing additional plug bracing. The Contractor may be required to furnish, install and remove after testing at no additional cost, a temporary rubber cap/plug to be airtight for all cleanout stacks to accomplish air testing. The air pressure shall never exceed 8 psi. All gauges shall be accessible outside of the manholes.

HYDROSTATIC TESTS (Ductile Iron Pipe)

After the ductile iron pipe has been laid within the "protected" area and partially backfilled as specified, all newly laid pipe, shall be subjected to a hydrostatic pressure test. All sewers subject to Hydrostatic Testing shall include (1) sewers entering or crossing streams. (2) sewers located less than 100 feet from any public or private water supply source including any WS-I Waters or Class I or Class II Impounded Reservoirs, (3) within a distance less than 25 feet from a private well or 50 feet from a public water supply well (4) minimum 18 inch vertical and 10 feet horizontal separation can not be maintained between sewers and water mains (see DEM Regulations), (5) as specified and/or indicated on the drawings. The Contractor will furnish all labor and material, including test pumps, taps, and corporations, for making hydrostatic tests.

The duration of the pressure test shall be at least one hour or longer, as directed by the Engineer. The hydrostatic pressure shall be 150 psi. Each section of pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Before applying the specified test pressure, all air shall be expelled from the pipe. Taps shall be made to provide blow offs.

All exposed pipes and joints will be carefully examined during the open trench test. All joints showing visible leaks shall be made tight. Cracked or defective pipe, joints discovered in consequence of this pressure test shall be removed and replace with sound material, and test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Engineer in certain conditions. The test shall be repeated until satisfactory to the Engineer.

The leakage test shall be conducted after the visual test has been satisfactorily completed. The leakage test shall be made at a pressure of 150 psi and shall have a minimum duration of one (1) hour. The leakage shall be observed or measured for approval.

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests and leakage tests shall be satisfactory as specified. All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Owner. Pressure test and leakage test may be conducted concurrently.

MEASUREMENT AND PAYMENT

Payment for exfiltration tests, air tests, and mandrel tests will be measured and paid for at the unit price bid per linear foot of sewer pipe. The quantity indicated is exclusive of the length of the individual lateral, but inclusive of testing the lateral for the unit price and length contained in the Proposal. Payment shall be full compensation for furnishing, installing all materials, including water, pumps, mandrels, and all equipment, tools, labor necessary to conduct and assist the Owner's Representative to conduct test and all other incidentals necessary to complete the testing.

Payment for these items of work is contingent upon successful tests performed and certifications submitted by the Contractor to the Owner. All certificates shall be signed or initialed by the Owner's representative.

DIVISION 2
SITE WORK

02753 SUBMERSIBLE PUMP LIFT STATION

GENERAL

This section includes all pumps, piping; fittings, valves, structures and other appurtenances that form an integral part of a submersible pump lift station. All work shall be accomplished in a neat, workmanlike manner meeting the requirements of the City of Fayetteville Public Works Commission. The Engineer shall be supplied with shop drawings of all equipment and materials for approval prior to installation. The Contractor shall supply six (6) sets of O & M Manuals, for the lift station, including support literature, shop drawings and O & M instructions before final approval and acceptance of the operational station. The lift station start up shall be performed by a qualified factory representative capable of supervising the Owner's personnel in proper operation and maintenance.

PUMPS

The pumps shall be 4-inch non-clog, explosion proof, submersible units capable of passing a three-inch (3") sphere, with a minimum capacity of ____ gpm at a TDH of ___ feet and shall use a __ hp motor operating at _____ rpm with an _____inch impeller. The motor shall be set up for a __ phase, 230-volt electrical service, sealed, submersible and watertight. The pump shall be specifically designed to handle raw, unscreened sanitary sewage.

The pump shall be provided with an oil-filled cast iron, watertight enclosure sealed with O-rings. Heat sensors shall be attached to the windings and shall be wired for auto-shut off. The pump motor shall be provided with tandem seal arrangements incorporating two completely separate seals. Each seal shall be held in contact by its own spring system. The seal faces shall be tungsten carbide. The mechanical seal chamber shall be oil filled and equipped with a moisture detection device.

All areas of the pump casing and volute, which are exposed to sewage, shall be constructed of cast iron meeting the requirements of ASTM A-48, Class 30.

The pump assembly shall be provided with a guide "rail" system to permit ease of installation. The system shall consist of two - 2-inch diameter stainless steel guide rail pipes, 4-¼ inch stainless steel lifting chains and accessories. The guide rails shall align the pump with the discharge elbow as it is lowered into place. A rail guide bracket shall be used to support and align the rails at the top of the sump.

The pumps shall be provided a rigid discharge base-elbow to support the total weight of the pumping unit. The base shall be bolted directly to the wet well floor with a 90° elbow having a 125-pound ANSI flange discharging vertically.
The pump shall rotate on a minimum of two bearings permanently lubricated but capable of being re-greased, suitable for a minimum L10 bearing life of 40,000 hours.

MOTOR

Each submersible solids handling pump shall be driven by a completely sealed, electric submersible squirrel cage induction motor of __ hp, ___ service factor, ___ rpm, __ phase, 230 volt. The motor nameplate horsepower rating shall not exceed the brake horsepower requirements of the specified head and capacity conditions. The motor shall be UL listed for Class 1, Division 1, Group C and D explosion-proof hazardous locations. The windings and lead shall be insulated with moisture-resistant Class F insulation and shall be designed along with the motor, for continuous duty. The motor shaft shall be one piece 416 stainless steel along with all appurtenant hardware. The rotor shall be dynamically balanced to meet NEMA vibration limits. Heavy duty lifting lugs shall be cast into the motor housing and shall be of adequate strength to lift the entire pump and motor assembly.

PIPING

All piping in the lift station and valve pit shall be ductile iron, Class 50, ANSI B 16.1 125 pound standard flanged fitted with ceramic epoxy interior coated and the outer surface shop primed. All flange gaskets shall be 1/8-inch full-face serrated rubber material. All valves shall be in accordance with AWWA Standards with standard 25-pound flange ends. Check valves shall be furnished with outside spring and lever and gate valves shall be outside spring and yoke resilient seat gate valves.

IMPELLER

The impeller shall be two vane one piece, single suction, enclosed, non-clog cast in ductile iron. The impeller shall be of a radial flow design with well-rounded leading vane edges and thick hydrofoil shape with large openings. The impeller shall be balanced and secured to a straight fit on the shaft by means of a key and fastener. The impeller waterways and clearance between the impeller periphery and volute cutwater shall be capable of passing a 3-inch sphere. The impeller is to be matched to a constant velocity equalizing pressure volute.

WET WELL/VALVE VAULT

The wet well and valve pit structures shall be precast concrete sections with epoxy coating. The structures shall be manufactured and installed in accordance with ASTM C-890, ASTM C-891, ASTM C-913 and ASTM C-478. Joints between precast sections shall be sealed with one-inch diameter butyl rubber sealant conforming to SS-S-00210-A and AASHTO-198. Flexible rubber pipe

wall penetrations and/or connections shall be in accordance with ASTM C-923. The wet well shall be watertight.

The wet well base shall be manufactured specifically for direct mounting to an open top, 6 feet diameter manhole and shall be provided with all mounting hardware and anchor bolts.
Access hatches shall be provided as shown on the drawings. Hatches shall be 3/16-inch aluminum checker plate with a stainless steel hardware frame. The frame shall be 1/4-inch thick aluminum reinforcement cast into the concrete top. The hatch shall be designed for H-2O loading and shall provide for a latch with locking device. The locks for both the hatches and the control panel shall be keyed alike.

The wet well level shall be controlled by 4 sealed S40NO mercury tube float switches provided with 25 feet type SUO flexible cord. The floats shall be adequately attached with a stainless steel float switch-mounting bracket. The cable junction box shall be provided in an NEMA 3 or NEMA 4 enclosure mounted outside of the wet well. The float switch wires shall be run continuously from the panel through the valve vault in a conduit and then to the wet well through a conduit.

CONTROL PANEL

The lift station shall be provided with a duplex control panel mounted in an NEMA 4 x enclosure, UL approved with outside dead front design and hasp for padlocking. The panel shall be equipped for each pump with H-O-A selectors, starters, circuit breakers, time meters, overloads, running lights indicator, seal failure indicator, thermal overload lights, manual resets, individual disconnect switches, N-T-S select switch for a red alarm light, horn and silencer, auxiliary alarm contacts and an alternating relay to reverse the lead pump selected on each successive start. An override circuit shall start both pumps if the wet well level rises to the "lag" start elevation or shall start the second pump if the lead pump fails.

The utility company shall provide the underground power supply to the lift station. The Electrical Contractor shall mount the control panel and disconnect switch on a ¾ inch exterior grade plywood support panel as shown. The plywood panel shall receive exterior paint and shall be mounted on galvanized supports by galvanized through bolts. The disconnect panel and control panel and associated wiring are to be installed by a certified and licensed Electrical Contractor and are to meet all the appropriate N.C. Electrical Code Requirements.

An interlocked 115 volt GFI UL Standard 943 Class A disconnect for transferring line power to a portable generator shall be provided in the event of power failure.

An automatic telephone dialer in a separate NEMA 4 enclosure shall also be provided.

SITE LIGHTING

The lift station site shall be provided with area lighting. The lighting shall meet the requirements of the local power company and should be sited as shown on the drawings.

SITE FENCING

The lift station site shall be fenced as shown on the drawings. Fencing shall be installed as specified in SECTION 02831, CHAIN LINK FENCING.

SITE ACCESS

Site access to the lift station shall be provided by a gravel access road. This road shall be a minimum 12 feet wide and shall consist of a minimum of 6 inches compacted ABC stone base. The road shall be graded to drain and shall be installed in such a way as to minimize the runoff and erosion potential.

DIVISION 2
SITE WORK

02831 CHAIN LINK FENCING

GENERAL

Where shown on the plans there shall be installed a "chain link" fence with all necessary posts, braces, top rail, gates, fabric, extension arms, and three strand barbed wire.

The erected fence shall meet the following requirements:

> The enclosing fence shall have an overall fabric height of six feet (6') and an additional one foot (1') of three strand barbed wire, for a total height of seven (7'). The gates shall be seven feet (7') in overall height.

MATERIALS

Fabric: Fencing shall be chain link #9 gauge aluminized continuously woven wire 2" uniform square mesh without knots or ties, except for knuckling and barbing. Both the top and bottom edges of the fabric shall be barbed unless otherwise shown on the plans. The Contractor shall not piece together a number of short pieces of fence fabric.

Tensile Strength Test: Wire pickets of which this fabric is made to stand a tensile strength test of approximately 70,000 pounds per square inch based on the cross sectional area of the galvanized wire.

Framework: All posts and other appurtenances used in construction shall be hot-dipped, galvanized with a minimum of 1.8 oz. per square foot surface.

Line Posts: Hot dip galvanized "H" column (2" x 2 1/4") weight 4.1 pounds per linear foot, minimum carbon content 0.355. No used or open seam material will be permitted in posts or rails. (Alternate 2 1/2" O.D. galvanized pipe weight 3.65 pounds per linear foot or C-section line posts of the same dimension as H-post, 0.120 in wall thickness and fabricated from steel conforming to ASTM A-570, Grade E.) Intermediate posts shall be evenly spaced no more than 10 feet apart on center.

Top Rail: Hot dip galvanized pipe 1 5/8" O.D., weight 2.27 pounds per linear foot protected with outside sleeve type couplings at least 7 inches long. No used or open seam material will be permitted.

Terminal Posts: End, corner and pull posts hot dip galvanized pipe 3" O.D. - 5.79 pounds per linear foot. Gate posts hot dip galvanized pipe of "H" construction as specified.
Tension Wire: A bottom tension wire 7 gauge, alzd. (0.4 oz./s.f.), 6 inches above grade. Wire shall be fastened to fabric with aluminum rings at 24" on center and to each intermediate post.

Extension Arms: Hot dip galvanized. Line post arms of pressed steel malleable base; end, and corner post arms of malleable iron; gate posts to have ornamental top. Each extension arm to carry three strands of barbed wire approximately 12 inches out from fence line. Barbed wires to be securely fastened in by means of self-locking grooves. The barbed wire shall support a minimum of 400 lbs. vertical dead load from tip of arm. The barbed wire shall be 4-point pattern composed of two strands of No. 12 1/2 gauge galvanized wire.

Gates: Frame to be galvanized pipe 2.0 inches O.D. weighing 2.27 pounds per foot. Each frame to be equipped with 3/8-inch diameter adjustable truss rods. Gateposts and corner posts shall be 3 inches O.D. weighing 5.11 pounds per foot. Gates are to be manufactured using 2" aluminum tubing in lieu of the specified Schedule 40 steel pipe. Gateposts and corner posts shall be 6 5/8" O.D. for swing gates (greater than 20 feet in length and 4" O.D. for slide gates, weighing minimum of 5.11 pounds per foot. Corner fittings to be heavy pressed steel or malleable castings. Fabric to be same as in fence. Gates to be completed with malleable ball and socket hinges, catch, stops and rest. Hinges to permit gate to swing back against fence, 180 degrees if required. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate regardless of the latching arrangement.

Braces: Brace material to be hot dip galvanized and same as top rail, to be spaced midway between top rail and ground, and to extend from terminal post to first adjacent line post. Braces to be securely fastened to post by suitable connections, and then trussed from line post back to terminal post with 3/8 inch round rod equipped with a turnbuckle for adjusting.

Fittings: Hot dip galvanized. All fittings to be malleable, cast iron or pressed steel.

Fabric-Bands: Fabric to be fastened to line post with (9 gauge) fabric bands spaced approximately 18 inches apart, and to top rail with wires (9 gauge) spaces approximately 24 inches apart.

Locks: Locks will be provided by the Owner.

INSTALLATION

General: Installation shall be made in a workmanlike manner by skilled workers experienced in the erection of this type of fence and in accordance with the manufacturer's recommendations. The fence shall be erected on a previously prepared surface to the lines and grades indicated on the plans.

Post Setting: All posts shall be set plumb and in alignment into a 36-inch concrete footing of proper size and shape so as to furnish sufficient support to withstand any strain or shock ordinarily brought to bear on a fence of this character. The concrete strength shall be 3000 psi (ASTM C-94) and the foundations a minimum of 9 inches in diameter for line post and 12 inches for terminal post. Concrete shall be thoroughly compacted so as to be free of voids and finished in a dome. Straight runs shall not exceed 500 feet between brace posts. Concrete shall cure a minimum of 72 hours before any further work is done on the posts.

Fabric: The fabric and barbed wire shall be stretched to the proper tension as recommended by the manufacturer and securely fastened to the framework members to result in a straight fence line without sagging. The bottom of the fabric shall be held as uniformly as is practicable to the finished grade.

DIVISION 2
SITE WORK

02930 LAWNS AND GRASSES (Utility)

GENERAL

All exposed ground surfaces that have been disturbed during construction shall be graded to original contours as practicable, shaped to drain, and free of trash and debris. Grassing shall be accomplished as soon as practicable after sections of work are completed. Such sections shall not exceed one mile, without prior approval by the Engineer. Grassing shall be in accordance with the following specifications:

PREPARATION OF SOIL

The soil shall be loosened and mixed to the depth of 4". Suitable equipment (Cultipackers, harrows, drags) meeting the approval of the Engineer shall be used. This operation shall be accomplished by cutting on 1-foot centers parallel to the contour of the slopes. On slopes that are steeper than 2:1, both depth of preparation and degree of smoothness may be reduced, if approved by the Engineer, but in all cases the slope surface shall be scarified groove, trenched or punctured so as to provide pockets, ridges, or trenches in which seeding material can lodge. Soil preparation shall not be performed when the soil is frozen extremely wet or in an otherwise unfavorable working condition.

Lime shall be applied at the rate of 1 - 1/2 tons per acre. 10-10-10 commercial fertilizer shall be applied at the rate of 1000 lbs. per acre and well worked into the top inch of topsoil.

SEED MIXTURE AND SOWING THE SEED

The following seed mixture shall be used:

POUNDS OF SEED PER ACRE

	K-31 Fescue	Abruzzi Rye	Korean Lespedeza	Sericea Lespedeza	Common Bermuda (Un-Hulled) (May substitute)
April 15 to Sept. 1	75	-	25	25	25
Aug. 15 to Nov. 15	120	-	-	50	-

(Continued)

Nov. 1 to March 1	120	50	-	50	-
March 1 to May 1	120	-	-	50	25

Once the seed is applied the area shall be very lightly raked, either by hand or by mechanical means.

Where construction crosses a pasture that has been grassed, the Contractor shall re-seed the area with the same type of grass as found on the site. All highway rights-of-way, and private yards disturbed shall also be re-seeded or sodded with the same type of grass previously found. The seed mixture specification shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass existing.

All seeded areas will be mulched with 1 1/2 tons small grain straw spread uniformly; approximately 1/4 of ground should be visible to avoid smothering seedlings. Asphalt emulsion shall be used to anchor the straw applied at 150 gallon per ton of straw. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind; water or other causes and promptly remove any blockage, which may occur.

SPECIAL CONSIDERATIONS

Shrubbery shall be expertly removed and carefully preserved for replanting. Adequate earth ball shall be removed to guard against damage to the root system. Shrubbery shall be replanted only after all construction is complete. The excavation made for replanting shall be 6 inches larger in every dimension than the root ball removed. This additional space shall be filled with a mixture of one half topsoil and one half peat moss. Care shall be taken to set the top of the ball slightly above or flush with the surrounding surface. Any shrubbery damaged or that dies shall be replaced with an equal or better plant material at his expense.

MAINTENANCE AND GUARANTEE

The Contractor shall protect and maintain grassed areas as necessary to establish a uniform turf composed of the grasses specified. The Contractor shall re-seed any bare areas and repair all eroded areas.

The Contractor shall guarantee a live and vigorous stand of permanent grass at the time of acceptance of the work consisting of 80% coverage minimum for seeded grass with no bare spots greater than 5 square feet.

DIVISION 2
SITE WORK

02931 SOD

GENERAL

Restoration of existing lawn areas disturbed by construction activities shall be by installation of new sod. Restoration and sod shall be performed as soon as practical, but the time period between initial disturbances, the utility installation and sod placement shall not exceed 60 days. Sod is defined as blocks, squares, and strips of turf grass and adhering soil used for vegetative planting. Sodding and preparation of the sod bed shall be performed by an experienced landscape subcontractor specializing in this type of operation unless otherwise approved by the Engineer in writing. The Contractor shall adhere to the standards set forth by the American Association of Nurseryman and the Associated Landscape Contractors of America. All personnel shall be appropriately trained with regard to the degree of involvement so to assure the owner of the highest level of workmanship. Sod species suitable in this area are Hybrid Bermuda, Centipede and Zoysia; however the sod placed for each individual's lawn shall be the same species of sod as existing. Sodding may be performed at any time of the year except frozen sod shall not be placed nor shall sod be placed on frozen ground. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of a vigorous, disease free and weed free sod lawn.

MATERIAL

Materials, equipment and products incorporated in the work shall be approved by the Engineer. The Contractor shall submit a list of the proposed materials with samples, if required. Package materials should be delivered in unopened original containers showing weight, analysis and name of manufacturer. Protect material from deterioration.

Sod shall contain 95 percent permanent grass; not more than 5 percent weeds and undesirable grasses, good texture and free from obnoxious grasses, roots, stones and foreign materials. Sod shall be uniformly 1 ½ to 2 inches thick with a well-developed fibrous root mat system in topsoil with clean-cut edges. The sod shall be sufficiently dense and cut to the minimum required thickness such that if the sod is suspended by one corner, the sod will not tear apart. The sod shall be recently mowed to a height of not more than 3 inches prior to harvest. The sod shall be supplied and maintained in a healthy condition as evidence by the grass being a normal green color in appearance, dense, and free from insects, pests, disease or injury. Sod shall be delivered to the job site within 24 hours after being cut and shall be installed with 24 hours after delivery. Any sod, which is torn, broken or too dry, will be rejected.

SOIL BED PREPARATION

Before landscape construction is to begin, the site shall be cleaned and disposed of brush, rubbish, stones, gravel and other foreign material within the area to be landscaped. Exposed ground surfaces disturbed during construction activities shall be graded to the original contours (allowing for the thickness of the sod) or as in the case of an altered contour such as a fill slope, graded as directed by the Engineer to finish grade, or typical cross section. The sod bed shall be excavate to such a depth that after sod placement the top of the sod shall be flush with surrounding grade or contours. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions. Do not start work until conditions are satisfactory and do not work during increment or impending increment weather.

The surface area to receive sod shall contain a minimum of 4 inches of good, fertile, friable, organic natural topsoil loam as a base for laying the sod. Topsoil shall be free of clumps, brush, sticks, weeds, stones, roots, trash or other objectionable material. Contractor shall insure all topsoil to be free of plants or plant parts of Quackgrass, Johnson grass, nut sedge, poison ivy or other noxious weeds. The Contractor shall furnish and supplement the existing topsoil at no additional costs to the Owner providing a minimum 4-inch thickness as specified. Soil preparation shall not be performed in frozen or extremely wet conditions. The finished topsoil bed shall be uniform in grade, with a yard like appearance. All changes in grade shall have a smooth, rounded peaks and valleys.

The soil shall be scarified or otherwise loosened to a depth of not less than 5 inches and all clods shall be broken. The top 4 inches shall be worked into an acceptable smooth, friable and uniformly fine texture sod bed by use of soil pulverizes, drags, harrows or by other methods approved by the Engineer. Commercial grade fertilizer (8% Nitrogen, 8% Phosphate, 8% Potash) shall be applied at a rate of 20 pounds per 100 square feet, Super-Phosphate at 12 pounds per 1000 square feet and lime (Dolomite limestone containing not less than 85% total carbamates) shall be applied at a rate of 25 pounds per 1000 square feet or at a rate recommended for the type of sod being placed. Apply soil amendments within 24 hours after raking topsoil base surface and not more than 48 hours prior to laying sod. Mix thoroughly a minimum depth into the upper 4 inches of topsoil and lightly water to aid in dissipation. Sod placement shall not begin until the soil preparation is inspected and approved by the Engineer. During application of soil amendment fertilizer ect. adequate precautions shall be taken to prevent damage to existing features such as traffic, structures, landscape, trees, vegetation, utilities or any other appurtenances. The Contractor shall be required to repair or clean any damages.

PLACING SOD

The Contractor and his landscape subcontractor shall coordinate the placing of the sod to begin within 24 hours after the topsoil base preparation is completed and accepted by the Engineer. Sod shall be brought to the site as near to the time of placing as possible. Store sod in the shade, and

keep watered particularly in extreme hot and dry condition to insure vitality and to prevent the dropping off of soil during handling. During wet weather, the sod shall be allowed to dry sufficiently to prevent tearing. Handling shall be done in a manner, which will prevent tearing, breaking, drying or other damage. Carefully place sod in rows with the longer side perpendicular to slopes and the ends staggered in each successive row in a brick-like pattern. Butt the ends and sides together tightly and do not overlap or stretch the sod. Do not leave any voids or gaps. Unavoidable gaps shall be closed with small pieces of torn or broken sod if kept moist and approved by the Engineer. After the sod is laid, irrigate thoroughly to allow water to penetrate a minimum 6 inches into the soil below the sod. Sod shall not be placed when the atmospheric temperature is below 32° F.

Tamp and roll completed with a manual roller or approved equipment to eliminate minor irregularities and to form close contact with the soil bed immediately after placing and watering. The type of rolling and tamping equipment to be used shall be submitted to the Engineer for approval prior to construction. On steep slopes 3:1 (horizontal and vertical) or greater, in drainage ditches or any areas where sod slipping may occur, anchor sod with approved wooden stakes (½"x ¾" x 12") or staples spaced not over 2 feet apart in any direction and/or in sufficient number to prevent slippage or displacement. The anchors shall be driven flush with the surface of the sod. The wide flat side of the stake shall be driven parallel to the slope. Staking shall be done concurrently with sod placement and prior to tamping. Sod shall be laid with the long horizontal edge of the strips parallel to the contour starting at the bottom of the slope. The edge of the sod shall be turned slightly in the ground at the top of a slope and a layer of earth placed over it and compacted so as to conduct the surface water over and onto the top of the sod. Upon completion of the above described work, the surface of the sodded areas shall coincide with the finished grade and not exceed ¼" plus or minus variation to adjoining grade or proposed contour. Extreme care shall be taken to prevent the installed sod from being torn or displaced.

MAINTENANCE

The Contractor shall, at no additional cost to the Owner, make whatever arrangements necessary to insure an adequate supply of water to meet the needs of this Contract. The Contractor shall supply water of suitable quality and purity to sustain and encourage vigorous plant growth, and supply all equipment for proper delivery and application to planted areas. Water obtained from PWC fire hydrant shall be metered and properly protected with an approved backflow prevention device. PWC must inspect and approved any connections to their water system to include the proposed water application and storage equipment. The Contractor shall not use private resident's water. The Contractor is solely responsible to provide watering of the sod. The method of application of water shall be approved by the Engineer. Limit watering to early morning or late afternoon to enable to soil to absorb maximum amount of water.

Maintenance shall begin immediately after sodding operation. The Contractor shall maintain all sodded areas until sod is firmly established and as outlined below. Maintenance will include

watering, fertilizer, pest control, soil amendments, disease control, erosion repair, mowing, protecting turf area from traffic (i.e. temporary fences, barriers, signs, etc.) and replacement of any dead or damaged sod.

Watering

- Water lawn areas once a day with minimum ½ inch water for the first 3 weeks after area sodded.

- After the 3-week period, water twice a week with a ¾ inch of water each time unless a comparable amount of rainfall has occurred.

- Make weekly inspections to determine moisture content of soil and supplement the above watering schedule as needed.

- Excessive runoff puddling and wilting shall be prevented.

Fertilizer and Pest Control

- Evenly spread fertilizer composite at a rate of 40 pounds per 5000 square feet or as recommended by the manufacturer. Fertilizer shall not be applied until 2 weeks after initial placement of the sod or prior to the advent of winter dormancy.

- Treat areas of weed and insect infestation as recommended by the treatment manufacturer.

Mowing

- The Contractor shall do mowing operations, (in yards not being mowed by residents) until provisional acceptance.

- Mowing shall be done only when the grass is dry with a rotary type mower having a blade height set not lower than 1½ inches nor higher than 3 inches.

- Mowing operations shall be conducted at intervals, which insure grass height does not exceed 4 inches between mowing.

- The Contractor shall complete at least one mowing operation before the work will be considered for provisional acceptance.

The Contractor shall protect and not allow access of vehicular traffic into any newly sodded areas and shall repair any damaged turf to original grade. Maintenance shall continue for a period of 90 days after placement or until provisional acceptance by the Engineer. A written record shall be

furnished to the Engineer of the maintenance work performed. At least two weeks shall elapse after chemical control is applied before a request of inspection.

ACCEPTANCE

Fifteen (15) days prior to the end of the 90-day maintenance period, the Contractor shall make written request to the Engineer for an inspection and provisional acceptance of the sod. Failure to notify the Engineer will not relieve the Contractor of the maintenance provisions required and the Contractor will continue to be responsible for the maintenance of the sod.

Replacement of dead sod shall be performed within 7 days after notification by the Engineer and the maintenance period for these areas or individual lawns shall be extended for the 90-day maintenance period. Failure to replace dead sod within the specified 7 day period will result in the Owner having the work performed and deducting the cost from the Contract, however, the Contractor shall be responsible for the maintenance.

Final acceptance will be given upon satisfactory contract performance exhibited at final inspection and acceptance. Sodded areas are to be fully rooted prior to acceptance. The Engineer shall be the sole judge as to whether or not the lawns are acceptable. Should any deficiencies be disclosed at final inspection, the Contractor shall make the necessary corrections in a timely manner and request re-inspection.

GUARANTEE

The Contractor shall guarantee a dense, vigorous stand of turf free of weeds, disease, pests or any dead areas more than one half of a square foot in size for a period of 90 days from initial placement or replacement whichever is greater. Total dead area shall not exceed 1% of total square footage for each individual resident's lawn.

DIVISION 2
SITE WORK

02933 LAWNS AND GRASSES (SEEDING)

GENERAL

All exposed ground surfaces that have been disturbed during construction shall be graded to original contours as practicable, shaped to drain, and free of trash and debris. Grassing shall be accomplished as soon as practicable after sections of work are completed. An experienced subcontractor specializing in this type of operation shall perform seeding and/or planting, unless otherwise approved by the Engineer in writing. Disturbed sections shall not exceed one mile, without prior approval by the Engineer. Grassing shall be in accordance with the following specifications:

PREPARATION OF THE SOIL

The topsoil shall be loosened and mixed to the depth of 4". Suitable equipment (Cultipackers, harrows, drags) meeting the approval of the Engineer shall be used. This operation shall be accomplished by cutting on 1-foot centers parallel to the contour of the slopes. On slopes that are steeper than 2:1, both depth preparation and degree of smoothness may be reduced, if approved by the Engineer, but in all cases the slope surface shall be scarified groove, trenched or punctured so as to provide a textural plane of cut forming pockets, ridges, or trenches in which seeding material can lodge. Soil preparation shall not be performed when the soil is frozen, extremely wet or in an otherwise unfavorable working condition. The soil shall be free of clay lumps, brush, weeds, stones, roots, stumps or any other substance that might inhibit plant growth. Assistance of the local agricultural agent is recommended.

Lime shall be applied at the rate of 1/2 tons per acre. 10-20-20 commercial fertilizers shall be applied at the rate of 1000 lbs. per acre and well worked in to the top 4 inches of topsoil. If Hydroseeding, use 500 pounds of 10-10-10 fertilizer on slopes steeper than 1/2 horizontal to 1 vertical.

SEED MIXTURE AND SOWING THE SEED

Seed shall be seed certified to be the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures and pure live seed. The producer's seed label shall indicate it the minimum percent of pure live seed (which shall be 82.45 for Bermuda, 88 for Rye Grain, 87 for Tall Fescue, 83 for Millet, and 56 for Pensacola Bahia), the minimum percent of germination in hard seed and maximum percent of weed seed (no more than 1 percent for Bermuda and Tall Fescue, 0.5 percent for Bahia and Rye Grain). Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable State seed laws. Seed that has become wet, moldy, or otherwise damaged will not be acceptable.

The following seed mixture shall be used:

POUNDS OF SEED PER ACRE

	K-31 Fescue	Rye Grain	Common Bermuda (Un-Hulled)
April 15 - Sept. 1	75	-	60
Aug. 15 - Nov. 15	120	-	25
Nov. 1 - April 1	120	120	-

Where construction crosses a pasture that has been grassed, the Contractor shall re-seed the area with the same type of grass as found on the site. All highway rights-of-way, and private yards disturbed shall also be re-seeded or sodded with the same type of grass previously found. The seed mixture specification shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass existing.

Seed shall be broadcast uniformly by hand or by approved sowing equipment. One half of the seed shall be sown in one direction and the remaining shall be sown at right angles to the first. Do not seed when the wind velocity exceeds 5 miles per hour. Rake lightly into top 1/8 inch of the soil prior to compacting, with a roller not exceeding 100 pounds.

All seeded areas will be mulched with 2 tons small grain straw or wood cellulose fiber spread uniformly; approximately 1/4 of ground should be visible to avoid smothering seedlings. Asphalt emulsion (ASTM D-977 and ASTM D-2028) shall be used to anchor the straw applied at 150 gal. per ton of straw, or crimped to stabilize. Asphalt emulsion shall be required from November 1 to March 31. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind; water or other causes and promptly remove any blockage, which may occur.

SPECIAL CONSIDERATIONS

Shrubbery shall be expertly removed and carefully preserved for replanting. Adequate earth ball shall be removed to guard against damage to the root system. Shrubbery shall be replanted only after all construction is complete. The excavation made for replanting shall be 6 inches larger in every dimension than the root ball removed. This additional space shall be filled with a mixture of one half topsoil and one half peat moss. Care shall be taken to set the top of the ball slightly above or flush with the surrounding surface. Any shrubbery damaged or that dies shall be replaced with an equal or better plant material at his expense.

MAINTENANCE AND GUARANTEE

The Contractor shall protect and maintain grassed areas as necessary to establish a uniform turf composed of the grasses specified. The Contractor shall re-seed any bare areas and repair all eroded areas.

Watering of seeded areas will be required during periods of dry weather to promote maximum growth. The Contractor shall supplement natural rainfall to insure a minimum of one inch of rainfall weekly.

Maintenance of lawns begins immediately after the area is planted and continues for the period required to establish acceptable lawns, but not less than 60 days after substantial completion. Maintain seeded areas by watering, fertilizing, mowing, weeding and other operations such as rolling, regrading, replanting, aerating, mulching as required to establish an acceptable lawn free of eroded or bare areas.

ACCEPTANCE

The Contractor shall guarantee a stand of turf is considered acceptable when a live vigorous stand of permanent grass is established with growing sprouts visible at the surface showing not less than 9 seedlings of permanent grass at least 2 inches long in each square foot, and where no gaps larger than 4 inches in diameter occur anywhere in the lawn area. Permanent grass is defined as Common Bermuda and Fescue and Pensacola Bahia.

DIVISION 2
SITE WORK

02934 SEEDING WETLANDS

GENERAL

All exposed ground surfaces that have been disturbed during construction shall be graded to original contours, reasonably smooth, and free of trash and debris. Grassing shall be accomplished as soon as practicable after sections of work are completed. Seeding shall be performed by an experienced subcontractor specializing in this type of operation, unless otherwise approved by the Engineer in writing. Disturbed sections shall not exceed one half mile, without prior approval by the Engineer. Grassing shall be in accordance with the following specifications:

PREPARATION OF THE SOIL

The topsoil shall be loosened and mixed to the depth of 4" to 8". Suitable equipment meeting the approval of the Engineer shall be used. The soil shall be free of clay lumps, brush, weeds, stones, roots, stumps or any other substance that might inhibit plant growth. Assistance of the local agricultural agent is recommended.

Provide agricultural lime at rate required to bring soil acidity to slightly acid - ph 6, according to soil test report.

Lime and fertilizer shall be applied uniformly and mixed with the soil during seedbed preparation. Apply 10-20-10 commercial fertilizers at the rate of 20-lbs./1000 s.f. for warm season mix and 10-20-10 commercial fertilizer at a rate of 20 lbs./1000 s.f. for cool season mix.

Apply 10-10-10 commercial fertilizers at the rate of 20-lbs./1000 s.f. for temporary cover crops. In addition, provide 15-lbs./1000 s.f. of superphosphate.

The following is for the warm season mix:

a. All warm grass seed shall be debearded or conditioned by brushing to create a product nearly the same as debearding. This does not apply to Switchgrass.

b. Disk two times to break-up crop residue and dirt clods prior to seeding.

c. Pack soil to create a firm seedbed with a cultipacker or roller.

d. If a rain shower should fall after the seedbed is prepared but before planting break-up any crust formation.

e. Seeding shall be installed to a depth of 1/4" utilizing a rangeland drill or conventional grass drills. It is extremely important that seed not be planted deeper than 1/2" depth. Do not disc or harrow after seeding. This will put the seed too deep. A Brillion seeder will be acceptable.

The following seed mixture shall be used:

Dates	Types	Rate
April 1 - July 15	***Warm Season Mix*** Switchgrass, Cave-in-rock, Alamo	8 pls #/acre or 4 oz./1000 s.f.
	Smartweed; and	2 bulk #/acre or 1 oz./1000 s.f.
	Japanese Millet or Sorghum Sudan Grass Hybrids (Mow prior to maturity)	20-lb/acre or ½ lbs/1000 s.f.
July 16 - Sept 1	Temporary crop of Japanese Millet or Sorghum Sudan Grass Hybrids (To be followed by permanent mixture)	20-lb/acre or ½ lbs/1000 s.f.
Sept 2 - Nov 1	***Cool Season Mix*** Reed Canary Grass	12 bulk #/acre or 6 oz./1000 s.f.
	Smartweed	2 bulk #/acre or 1 oz./1000 s.f.
Nov 2 - March 31	Temporary Crop of Wheat (To be followed by permanent mixture	40 lbs/acre

All highway rights-of-way, and private yards disturbed shall also be re-seeded or sodded with the same type of grass previously found. The seed mixture specification shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass existing.

Seed shall be broadcast uniformly by hand or by approved sowing equipment. One half of the seed shall be sown in one direction and the remaining shall be sown at right angles to the first. Do not seed when the wind velocity exceeds 5 miles per hour. Rake lightly into top 1/8 inch of the soil prior to compacting, with a roller not exceeding 100 pounds.

All seeded areas will be mulched with 75 pounds to 100-lbs./1000 s.f. of clean wheat straw, spread uniformly, approximately 1/4 of ground should be visible to avoid smothering seedlings. If hydro-

seeded, use virgin paper mulch only. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind; water or other causes and promptly remove any blockage, which may occur.

MAINTENANCE AND GUARANTEE

The Contractor shall protect and maintain grassed areas as necessary to establish a uniform turf composed of the grasses specified. The Contractor shall re-seed any bare areas and repair all eroded areas.

Maintain seeded areas by watering, fertilizing, mowing, weeding, and other operations such as rolling, regrading, replanting, aerating, mulching as required to establish an acceptable lawn free of eroded or bare areas.

ACCEPTANCE

The Contractor shall guarantee a stand of turf is considered acceptable when a live vigorous stand of permanent grass is established with growing sprouts visible at the surface showing not less than 9 seedlings of permanent grass at least 2 inches long in each square foot, and where no gaps larger than 4 inches in diameter occur anywhere in the seeded area.

DIVISION 2
SITE WORK

03301 CONCRETE CONSTRUCTION (UTILITY)

GENERAL

Concrete construction specified in this section shall be applicable to all "site work" and is not intended to cover general building specifications. The concrete work shall include all furnishing, hauling, fine grading and subgrade, form work, etc. and all incidentals necessary for completion of the work as it pertains.

MATERIALS

The Contractor shall furnish and place concrete in strict accordance with the requirements of ACI 318 Ready-mixed concrete from an approved mixing plan to be used throughout the work and to conform to the requirements of ASTM C-94 for batch, mixing, and transporting. Concrete shall be in accordance with the following requirements:

Under Ground - Regular Weight Concrete

28-day compressive strength	3000 psi
Coarse aggregate	1 ½" max. size stone
Slump	2" minimum, 4" maximum
Air Entrainment	No requirement

Admixtures used to produce entrained air shall be sulforated hydrocarbons or neutralized vinsol resins conforming to ASTM C-260, used without written approval by the Engineer.

GRADING

The Contractor shall use every effort to observe any possible misalignments in line or grade and will call such to the attention of the Owner promptly. The Contractor is cautioned that he shall be responsible for any damage to utility lines caused by his negligence. The Owner or his representative shall then inspect the forms and if approved, pouring operations may begin. Where unstable material to a depth required to provide a stable subgrade at no additional cost to the Owner.

FORM WORK

Metal forms shall be used throughout the work except for short, odd length sections and in accordance with Chapter 4, ACI 301 and ACI 347. Earth cuts may be used as forms for unexposed vertical surfaces on footings, provided the soil and workmanship allow an accurate and curable

excavation. Forms shall be kept in good condition at all times. Any forms which have become out of shape or otherwise unsuitable shall be removed from the work. Forms shall be of such section and design that they will adequately support the concrete and any construction equipment used in the work. Form sections shall be provided with interlocking joints to insure that the forms are tightly jointed together free from movement. Forms shall be held in place by metal pins, not less than eighteen (18) inches in length, with fastenings of metal and wedges to insure a correct, rigid setting.

Forms shall be of the dimension required for the designed cross-section shown on the plans. Built up sections to attain the required depth will not be permitted.

Forms shall be set true to the lines and grades established by the Engineer or indicated on the plans. Forms shall be held rigidly in position and shall be of sufficient strength to resist springing out of line when concrete is placed.

PLACING CONCRETE

Prior to placing concrete, the subgrade shall be moistened and the contact side of the forms shall be cleaned and coated with heavy oil. The Contractor shall not place any concrete without the forms; reinforcing steel and subgrade are inspected and approved by the Engineer. Placing of concrete is to be in accordance with ACI 304. Water shall be removed from excavation before placing concrete and flowing water shall be diverted without washing over freshly deposited concrete.

Concrete shall be placed is as not to disturb concrete already in place and in such a manner as to require the minimum amount of lateral movement. Concrete shall be deposited in the forms without segregation. A tremie shall be used when the fall exceeds 5 feet. Care shall be taken not to upset any forms during the concreting operations. Any concrete showing misalignment due to form movement shall be removed and replaced at no additional costs to the Owner.

All concrete shall be consolidated in accordance with ACI 309. Experienced workmen shall operate mechanical vibrators. Spading and rodding may be required to supplement mechanical vibration. Consolidation shall be adequate to remove any voids and after removal of the forms, no honeycomb shall be present. Should any honeycomb be present, the Engineer shall determine if the honeycomb is of a minor nature, the voids may be filled with mortar as approved by the Engineer.

All concrete within forms shall be brought to true section by the use of an approved straight edge and shall be tamped with straight edge to bring mortar to the surface, after which it shall be floated smooth by means of wood floats. No steel floats will be permitted. After true surface of section has been obtained, and after initial set has taken place, the entire surface shall be brushed with a dampened brush. All joints and all exposed edges shall be rounded off with approved jointing and edging tools. The type of finish required will be specified in the specific item of work specified or indicated on the drawings. All exposed surfaces of retaining walls, structures, etc. shall be given a Class 2 finish with ¼ inch chamfered edges.

No more concrete shall be laid than can be properly finished and covered during the daylight, unless adequate artificial light satisfactory to the Engineer is provided.

Immediately after finishing operations have been completed, the entire surface of the concrete shall be sprayed. The use of liquid retarding agents shall conform to standards specified by current AASHTO or ASTM Specifications.

Cold weather concreting is to be in accordance with ACI 306 and hot weather concreting is to be in accordance with ACI 305. Concreting shall be done when weather conditions are favorable unless otherwise directed by the Engineer. Concrete operations shall be discontinued when the temperature of 40 degrees Fahrenheit is reached on a falling thermometer. No concreting shall be attempted when local weather bureaus indicate temperatures below freezing within the ensuing 24 hours unless proper precautions are made to protect concrete by covering with straw or other thermal insulation satisfactory to the Engineer. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather or hot weather and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Engineer at the Contractor's expense.

Forms shall not be removed from the concrete until after 7 days, unless approved by the Engineer. The Contractor shall apply a curing compound or provide measures to maintain moisture for proper curing at his expense, if early form removal is approved. Immediately after the forms have been removed, all honeycomb areas shall be repaired (with one part cement and two parts sand) and earth backfill material shall be placed adjacent to the finished concrete and smoothed off to prevent an accumulation of standing water, subgrade saturation or under wash in the event of rain.

Both pedestrian and vehicle traffic shall be excluded from crossing the concrete for a period of approximately 14 days by erection and maintenance of suitable barricades. Contractor shall be responsible for any damage resulting from traffic within the 14-day period and he shall remove and replace any concrete damaged as directed by the Engineer.

Any construction debris present shall be removed in order to keep the site neat.

MASONRY MATERIALS

Brick shall be in accordance with ASTM C-32 Grade MS laid in full beds of mortar with shove joints.

Concrete masonry blocks shall be in accordance with ASTM C-139. Blocks shall be at least 5", but not more than 8" in thickness nor less than 8" in length and of such shape that the joints can be effectively sealed and bonded with cement mortar.

Cement mortar for brickwork shall be in accordance with ASTM C-270, Type M. Use Type 11A

cement in accordance with ASTM C-150.

TESTING

The requirements of ACI 318 shall be used to control the evaluation of all concrete strengths. The strength is to be checked during construction by four (4) cylinders at the option and cost of the Owner, of which 1 shall be broken at 7 days, 2 at 28 days. If the specified strength is not achieved in 28 days, 1 reserved shall be stored and broken as specified by the Engineer. Cylinders shall be made and stored in accordance with ASTM C-13. Cylinders shall be for each day pour in excess of 10 cubic yards of each different type of concrete, as determined by the Engineer. All additional expenses required because of the failure of the materials to meet routine testing requirements, or poorly scheduled concrete deliveries, shall be borne by the Contractor.

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DIVISION 2
SITE WORK

09800 SPECIAL COATINGS (COAL TAR EPOXY LINING MANHOLES)

GENERAL

The interior surfaces of all reinforced concrete precast manhole units shall be fully coated with a two-component coal tar epoxy lining compound. The prime coat shall consist of 4 to 6 mils dry film thickness and the finish coat shall be applied to yield a minimum dry film thickness of 24 mils for a complete lining.

MATERIALS

The lining compound shall meet the following material requirements:

Epoxy Content	Minimum 34% by weight of binder
Epoxy Material	Minimum 74% of volume solid content

The epoxy material shall meet the following minimum performance requirements:

- Permeability Rating: 0.15 perms at 24 mils dry film thickness
- Direct Impact Resistance: 100 inch-pounds in accordance with ASTM D-2794 with no cracking on 18 mil (minimum) - 24 mil (maximum) dry film thickness material applied on 0.25 inch standard steel panel.
- Abrasion Resistance: 20 liters of sand per mil in accordance with ASTM 968.
- Elongation Test: 5% minimum.
- Dielective Strength: Performed the following tests on steel panels with a maximum of 18 mils dry film thickness without failure of any kind.

TEST	DURATION
Tap water @ 160 degrees F.	300 days
25% Sodium Hydroxide @ 140 degrees F.	300 days
3% Sulfuric Acid @ 125 degrees F.	60 days
5% Sodium Hypochlorite @ 77 degrees F.	60 days
5% Sodium Acid Sulfate @ 77 degrees F.	30 days

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Engineer, certified by the Supplier.

APPLICATION OF LININGS

Surface Preparation: All interior surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance form oil and other loose, foreign or deleterious materials which would adversely affect the bond of the lining compound of the pipe surface. Specifically, surface preparation shall consist of sandblasting and clearing surface areas on which coatings will be applied.

Qualification of Applicator and Workmen: a competent firm with a five-year history of lining sewer pipe shall apply the lining compound. The workmen employed by the Applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Owner shall have the right to require the Applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment (including a special high speed centrifugal airless device) shall be as recommended by the suppliers of the lining compound.

Atmospheric and Substrate Conditions: The surface areas to be lined shall be blown off with air to remove all sand, dust, and other loose materials immediately prior to application of the lining compound. The lining compound shall not be applied when the ambient temperature is below 40 degrees F. or the substrate shows over a 14% moisture reading. The compound shall not be applied under adverse atmospheric conditions that will cause detrimental blistering, pin holing, or porosity of the film.

Application Technique: The lining compound shall be thoroughly mixed according to the supplier's recommendations. Application shall be in two (2) coats. The first coat (prime coat) shall consist of 4 to 6 mils minimum dry film thickness and the finish coat shall be applied as necessary to yield a total minimum dry film thickness of 24 mils. After application, the coated surfaces shall be protected from damage or contamination until tack free. The drying time shall be as long as required (drying temperature), but in no case less than 5 days.

INSPECTION

Holiday Detection: All interior surfaces shall be thoroughly inspected for holidays, utilizing an electrical instrument especially designed for the purpose. The output voltage and sensitivity of the instrument shall be adjustable for the moisture content and other test conditions. Each day that such test work is performed, the instrument shall be tested for proper operation by "finding" a known holiday made in the lining. All detected holidays shall be marked for easy location and patching. The dielectric testing shall be performed at the factory prior to shipping and installation.

Thickness Inspection: A minimum of 5% of the manholes shall be inspected each day of application for thickness of the interior coat by taping two thin steel coupons of each joint prior to the coating application. These coupons shall be taped in the manhole at opposite ends along the sides and in opposing quadrants. After the coating application is completed, the coupons shall be removed and the coating thickness shall be measured.

Repair: All damaged areas, holidays, thickness test areas and cored areas shall be repaired in accordance with the manufacturer's recommendation, and so the repaired areas are equal to the undamaged lined areas in all respects.

Markings: Each manhole unit shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined manhole shall be suitably designed and operated not to damage the lining. Any damage, which does occur, shall be repaired prior to the installation of the manhole in accordance with the manufacturer's recommendations, so the repaired area is equal to the undamaged lining in all respects.

Test Cost: All testing required in connection with coal tar epoxy linings shall be performed by a reputable commercial testing laboratory and all expenses therein shall be borne by the Contractor.

DIVISION 2
SITE WORK

09802 SPECIAL COATINGS - CERAMIC EPOXY

GENERAL

The interior surfaces of all ductile iron pipe and fittings shall be full coated with a ceramic epoxy lining. The ceramic epoxy lining shall be applied to ductile iron pipe free of any other interior lining material. The finish coat shall be applied to yield a minimum dry film thickness of 40 mils for a complete lining.

MATERIALS

The lining material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quarts pigment.

The epoxy material shall meet the following minimum performance requirements:

Permeability Rating: 0.00 perms when tested according to ASTM E-96 Procedure A with test duration of 30 days.

ASTM 6-95 Cathodic Disbandment: 1.5 volts at 77 degrees F.

ASTM B-117 Salt Spray: 0.00 undercutting after one year.

Immersion Testing ASTM D-714	Duration
20% Sulfuric Acid	1 Year
25% Sodium Hydroxide at 140° F	1 Year
160° F Distilled Water	1 Year
120° F Tap Water	1 Year

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Engineer, certified by the Supplier.

APPLICATION OF LININGS

Surface Preparation: All interior barrel and joint surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance form oil and other loose, foreign or deleterious materials which would adversely affect the bond of the lining compound of the

pipe surface. All areas to receive the protective coating shall be abrasive blasted using compressed air nozzles with sand or grit media. The entire surface to be lined shall be struck with blast media so that all rust, loose oxides, etc., are removed from the surface. Any area where rust appears before lining must be re-blasted.

Qualification of Applicator and Workmen: The lining shall be applied by a competent firm with a five-year history of lining sewer pipe. The workmen employed by the applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Owner shall have the right to require the applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment shall be as recommended by the suppliers of the lining compound.

Application Technique: After the surface has been thoroughly prepared for application, the interior of the pipe shall be coated with the ceramic epoxy to a minimum dry film thickness of 40 mils. No lining shall take place when the substrate or ambient temperature is below 40 degrees F. The surface must be dry and dust free. The number of coats of lining material applied shall be as recommended by the lining manufacturer, but in no case shall it be applied above the dry film thickness per coat recommended by the lining manufacturer. The time between coats shall be that specified by the lining manufacturer.

Repair: All damaged areas or test areas shall be repaired in accordance with the manufacturer's recommendation, so that the repaired areas are equal to the undamaged lined areas in all respects.

Inspection: All pipe linings shall be checked for thickness using a magnetic film thickness gauge, the thickness testing shall be done in accordance with the method outlined in SSPC-PA-2 film thickness rating. The interior linings shall also be tested for pinholes with a non-destructive 2500-volt test. Any defects found shall be repaired as noted above.

Markings: Each joint, manhole unit, or pipe bend special shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined pipe shall be suitably designed and operated not to damage the lining. Any damage, which does occur, shall be repaired prior to the installation of the pipe in accordance with the manufacturer's recommendations, so the repaired area is equal to the undamaged lining in all respects.

DIVISION 2
SITE WORK

09803 SPECIAL COATINGS - CEMENTITIOUS LINING

GENERAL

The interior surfaces of all ductile iron pipe and fittings shall be full coated with a cementitious lining. The cementitious lining shall be applied to ductile iron pipe free of any other interior lining material except for a black epoxy coating extending 4" from both the bell and spigot ends. The finish coat shall be applied to yield a minimum dry film thickness of 187 mils for a complete lining.

MATERIALS

The lining material shall be a pure fused calcium alluminate mortar comprised of fused calcium aluminate cement combined with fused calcium aluminate aggregates. A seal coat shall be applied to the lining.

The cementitious material shall meet the following minimum performance requirements:

Permeability Rating: 0.00 perms when tested according to ASTM E-96 Procedure A with a test duration of 30 days.

ASTM 6-95 Cathodic Disbandment: 1.5 volts at 77 degrees F.

ASTM B-117 Salt Spray: 0.00 undercutting after one year.

Immersion Testing ASTM D-714	Duration
20% Sulfuric Acid	1 Year
25% Sodium Hydroxide at 140° F	1 Year
160° F Distilled Water	1 Year
120° F Tap Water	1 Year

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Engineer, certified by the Supplier.

APPLICATION OF LININGS

Surface Preparation: All interior barrel and joint surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance form oil and other loose,

foreign or deleterious materials which would adversely affect the bond of the lining compound of the pipe surface. All areas to receive the protective coating shall be abrasive blasted using compressed air nozzles with sand or grit media. The entire surface to be lined shall be struck with blast media so that all rust, loose oxides, etc., are removed from the surface. Any area where rust appears before lining must be re-blasted.

Qualification of Applicator and Workmen: The lining shall be applied by a competent firm with a five-year history of lining sewer pipe. The workmen employed by the applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Owner shall have the right to require the applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment shall be as recommended by the suppliers of the lining compound.

Application Technique: After the surface has been thoroughly prepared for application, the interior of the pipe shall be coated with the cementitious lining to a minimum dry film thickness of 187 mils. No lining shall take place when the substrate or ambient temperature is below 40 degrees F. The surface must be dry and dust free. The number of coats of lining material applied shall be as recommended by the lining manufacturer, but in no case shall it be applied above the dry film thickness per coat recommended by the lining manufacturer. The time between coats shall be that specified by the lining manufacturer.

Repair: All damaged areas or test areas shall be repaired in accordance with the manufacturer's recommendation, so that the repaired areas are equal to the undamaged lined areas in all respects.

Inspection: All pipe linings shall be checked for thickness using a magnetic film thickness gauge, the thickness testing shall be done in accordance with the method outlined in SSPC-PA-2 film thickness rating. Any defects found shall be repaired as noted above. Cracks and/or fine crazing shall not be acceptable.

Markings: Each joint, manhole unit, or pipe bend special shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined pipe shall be suitably designed and operated not to damage the lining. Any damage, which does occur, shall be repaired prior to the installation of the pipe in accordance with the manufacturer's recommendations, so the repaired area is equal to the undamaged lining in all respects.

16231 STANDBY POWER SYSTEMS, LIFT STATIONS

PART 1 - GENERAL

1.1 THE REQUIREMENTS

A. This section shall consist of providing a packaged standby power system with all required accessories as specified and shown on the drawings. The equipment supplier must be the authorized distributor for each component of the products specified herein. The work includes the furnishing of all labor, materials, equipment, and testing to provide a complete and workable system, including the generator set, generator set controls, sub-base fuel tank system, weatherproof generator enclosure, transfer switch, transfer switch controls, and installation as shown on the drawings and specifications herein. It is the intent of these specifications to have a single source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

B. It is the intent of this specification to secure a standby power system that has been tested during design verification, production and at the final job site. All finished equipment shall be of the lasted commercial design and will be complete with all of the necessary accessories for complete installation as shown on the drawings and specifications herein.

C. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who ISO 9001 certified for the design, development, production, installation, and service of their complete product line. The manufacturer and its distributor shall maintain a 365 day 24-hour parts and service organization within 150 miles of the project site. This organization shall be regularly engaged in a maintenance contract program to perform preventive maintenance and service on equipment provided.

D. The specifications contained herein represent minimum requirements. Actual sizing of the engine-generator shall be coordinated with the loads of the equipment supplied for this project.

E. When required, engine-generator internal loads shall be provided with external power supply circuits of appropriate rating from circuit breakers dedicated to generator loads. These circuits shall be coordinated with the supplied generator, sized per the NEC, and provided whether shown on the contract drawings or not. Depending on the generator, supplied provisions for power supply circuits may be required for, but not limited to, the following:

1. Engine-generator starting system battery charger.

2. Engine jacket water heater.

3. Alternator heater.

4. Enclosure lights.

5. Sub-base tank fuel system.

6. Enclosure intake and exhaust louvers/dampers.

1.2 CODES AND STANDARDS:

A. The Standby Power System shall be designed and constructed in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, ASTM, NEMA, IEEE, EEI, HEI, ISO, NFPA, SAE, and other such regularly published and accepted standards as well as state and local codes. In addition, the Standby Power System shall comply with following codes and standards as stated:

1. IEC8528 part 4. Control Systems for Generator Sets

2. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

3. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

4. NEMA Standard IC10 (formerly ICS 2-447) Automatic Transfer Switches.

5. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

7. UL 508 – Standard for industrial Control Equipment

8. UL 1008 - Standard for Automatic Transfer Switches

9. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed

B. In the event of any conflict between these codes, regulations, standards, and Contract Documents, the most restrictive shall apply.

1.3 SUBMITTALS:

A. The Standby Power System submittal shall include contact information for the 24-hour parts and service organization. Submittals without this information will be rejected.

B. Submit sizing calculations for the engine-generator and automatic transfer switch with respect to the actual pumps approved. Submittals will not be accepted for review until pumps are approved.

C. Complete assembly and installation drawings, together with detailed specifications and data covering materials, drive unit, parts, devices and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals specification section. The data and specifications for each unit shall include, but shall not be limited to, the following:

1. Manufacturer, model, and type:
    a. Engine.
    b. Alternator.
    c. Enclosure.
    d. Battery charger and battery.
    e. Fuel oil cooler (if required by engine design).
    f. Silencer.
2. Engine output horsepower and efficiency curves at rated capacity.
3. Fuel consumption at rated capacity.
4. Ratings at specified conditions:
    a. Engine (net horsepower).
    b. Engine (maximum performance horsepower bare engine).
    c. Generator kW at specified power factor.
    d. Volts.
    e. Amperes.
5. Overall dimensions and weight:
    a. Length.
    b. Width.
    c. Height.
    d. Net weight.
6. Wiring diagrams and schematics, including the engine control panel and generator line circuit breaker.

7. Alternator insulation class and temperature ratings.

8. Alternator winding pitch.

9. Generator line circuit breaker rating.

10. Control panel layout, identifying location of all instrumentation being supplied.

11. Engine drawing to include location of all piping connections.

12. Operation instructions.

13. Battery sizing calculations.

14. Battery charger sizing calculations.

15. Maximum output short circuit kvA available.

16. Exhaust gas emission data, maximum valves at loads of 1/2, 3/4, and full:

    a. Carbon Monoxide (CO), lb/hr

    b. Nitrogen Oxides (NOx), lb/hr

    c. Temperature, F

    d. Flow, acfm

17. Letter from the engine-generator manufacturer confirming that the unit is in full compliance with Federal EPA and local emission requirements.

18. Equipment skid drawing including material list.

19. Conformation confirming that the exhaust through the exhaust silencer does not exceed the specified maximum pressure loss at the specified power outage capacity of the unit and that the exhaust silencer provides sound attenuation equal to or greater at the specified frequencies.

20. Letter from the engine-generator manufacturer confirming that the enclosure is suitable for the specified wind velocity and is designed as specified for rain penetration when the unit is operating.

21. Color chart showing available options for the enclosure color. The color of the enclosure shall be as directed by PWC during shop drawing review.

22. Drawings showing engine-generator inside the enclosure that shows location of all enclosure mounted and engine-generator mounted equipment. Drawings to indicate maintenance access clearances for electrical and mechanical equipment. Drawing to show location of all enclosures bracing and location of doors and removable panels.

23. Automatic transfer switch prototype test certification and specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set and the transfer switch.

PART 2 - PRODUCTS

2.1 TOOLS, SUPPLIES, AND SPARE PARTS

A. The following spare parts and accessories for each shall be furnished in substantial cardboard boxes sealed in plastic wrap with identifying labels and delivered to the vicinity of the project site or PWC as directed:

1. Two (2) of each type of fuel, oil, or air filter provided.

2. Two (2) of each accessory belt provided.

2.2 GENERAL REQUIREMENTS:

A. Standby Power Systems shall be designed to operate under the following service conditions:

1. Seismic zone: per NC Building Code and site location

2. Ambient air temperature range: -5 to 105 °F

3. Design wind speed: 110 mph

4. Site elevation: 500 ft

B. Standby Power Systems will be used as a power unit for selected electrical loads when the utility supplied power fails. Standby Power Systems shall be suitable for “black start” conditions. Each engine-generator shall automatically start, and connect to the electrical loads when initiated from the automatic transfer switch.

C. Each engine-generator shall be a current production model. The engine-generator shall be manufactured by the supplier Caterpillar, Kohler, Cummins, or equal.

D. The manufacturer of the engine-generator unit shall have a full-time, fully factory trained technical staff and an equipped 24 hour service facility having all personnel and all equipment required to maintain, repair, or overhaul the engine-generator unit and associated equipment. The repair facility shall be within 150 miles from the installation location.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Each engine-generator unit shall be designed for the operating conditions and requirements as follows:

Generator		
Minimum power rating capacity with accessories, for generator voltage output and service conditions specified herein.	___	kW
Output frequency.	60	Hz
Output voltage.	Service Dependent	VAC
Output power factor.	0.80	
Output phase and configuration.	Three phase, 4 wire, wye configuration	
Maximum voltage dip.	20	%
Engine		
Fuel supply.	No. 2 diesel	
Maximum speed.	1800	rpm
Minimum piston displacement.	___	In^3
Black start required.	Yes	
Maximum engine generator length.	{Refer to Drawings}	ft
Maximum engine generator width.	{Refer to Drawings}	ft

B. Each engine-generator shall be designed to operate during a power outage for a minimum of 24 continuous hours and a maximum of 100 hours per year.

C. Engine-generators submitted with ratings in excess of current published data will not be acceptable.

D. The engine-generator shall at a minimum meet the required Environmental Protection Agency New Source Performance Standards emission regulations. The engine-generator supplier shall coordinate with the local air quality management authority to ensure the equipment meets all current local air emissions requirements.

E. Engine-generator supplier shall guarantee the equipment supplied meets all local air emission requirements in place at the time of startup.

F. Each engine-generator unit, including any air intake or discharge plenums furnished shall be of a design that can be accommodated in the space as indicated on the drawings.

G. Fuel for the engine-generator will be furnished from a sub-base double walled fuel storage tank.

H. Each engine shall be 4-stroke cycle type and shall be equipped with the following:

1. Electronic governor for isochronous regulation of engine speed from no load to full load alternator output.

2. Dry type air cleaner with replaceable elements.

2.4 ALTERNATOR

A. Each engine-generator alternator shall be a 4 pole, revolving field design with temperature compensated solid state voltage regulator, brushless rotating rectifier exciter system, and drip-proof construction with amortisseur windings. The alternator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semi-flexible driving flange to ensure permanent alignment.

B. Frequency regulation shall be isochronous ±0.15 Hz from no load to rated load. Voltage regulation shall be within ±2 percent of rated voltage, steady state, from no load to full load. The momentary voltage drop shall not exceed the specified percent without starter coils dropping out or stalling the engine at any time when applying or starting the specified loads. Recovery to stable operation shall occur within 2 seconds.

C. The alternator shall have Class F insulation (or better) as defined by NEMA MG1-1.65 and temperature rise shall be within NEMA MG1-22.40 definition at rated condition.

2.5 FUEL SYSTEM

A. Each engine-generator unit shall be furnished with a complete fuel system including engine-driven fuel pump, double wall sub base fuel storage tank, engine supply and return lines, and all accessories required for proper operation. All items shall be suitable for the specified fuel, located inside the enclosure, and serviceable from inside the enclosure. The engine driven fuel pump shall transfer the fuel from the sub-base fuel storage tank to the engine-generator.

B. The flexible connectors for fuel supply and return which are located in close proximity to the engine shall be stainless steel. The remaining flexible connectors shall be the standard rubber with embedded wire mesh style.

C. The shutoff valve shall be of firesafe design and shall utilize secondary metal seating surfaces to ensure shutoff if the primary seats are destroyed by fire. The valve shall be manually operated and shall be of three piece design ball valves with carbon steel body and end caps, stainless steel or hard chrome plated ball and stem, reinforced teflon seats and seals, and socket welding ends. Firesafe ball valves shall be Contomatics "C-1122-BB-FS" or Jamesbury "4C2236XT-1".

D. The combination fuel filter/separator shall be located inside the enclosure and upstream from the flexible connectors. The combination fuel filter/separator shall be a manifold unit with shutoff valves and shall permit servicing the filter/separator without engine shutdown. Filter/separator shall be manufactured by Racor or equal. (This requirement is only necessary on large lift stations which will run at near capacity and will not allow for extended periods of downtime for maintenance. PWC will advise when a fuel filter/separator will be required.)

E. The diesel fuel piping shall be extra strong (schedule 80) black steel, ASTM A53 seamless (Type S), Grade B or ASTM A106, Grade B with threaded fittings.

F. Fuel oil coolers shall be provided if the engine fuel system absorbs heat from the unit injectors and surrounding jacket water. The fuel cooler shall be a radiator mounted, air cooled unit that uses the air flow from the radiator for the cooling air flow. To prevent over heating for the fuel in the fuel tank, the fuel oil cooler shall be adequately sized to cool the return fuel from the engine to the required fuel usage inlet temperature.

G. The fuel storage tank shall be sub-base type double wall, located below the engine-generator. The tank shall be UL listed, vented, meet all EPA, state and local requirements and shall normally be used to store diesel fuel at atmospheric pressure.

H. The fuel storage tank shall have a minimum usable capacity to provide storage for 24 hours of continuous operation of the engine generator when operating at 100 percent capacity. The sub-base tank shall be constructed to permit access to the electrical stub up area.

I. The fuel storage tank shall be provided with the following:

1. Secondary containment tank.

2. Vent cap.

3. Primary tank emergency vent.

4. Secondary tank emergency vent.

5. Blind flange for tank access.

6. Spill containment box.

7. Immersion level gauge capable or measuring the fuel level without the engine running that is visible from the manual fill connection.

J. The fuel storage tank shall be provided with the following connections

1. Engine fuel supply.
2. Engine fuel return.
3. Manual fill with dry type quick fill coupling.
4. Level gauge with transmitter for level indication on control panel.
5. Vent.
6. Primary tank emergency vent.
7. Secondary tank emergency vent.
8. Low level switch.
9. Leak detection.
10. High level switch with externally mounted alarm horn and silence button to be located near the fill connection.
11. High High level switch.
12. Secondary tank testing with cap.
13. Minimum 12 inch flange across with blind flange.

K. The fuel storage tank shall have instrumentation that includes, but is not limited to the following:

1. Level switch with electrically isolated dry contacts for remote low level annunciation on the engine control panel. The Low Fuel alarm shall be set to annunciate when the tank contents above the engine supply connection drop below 25 percent or less of the tank's capacity or at a setting above the tank heater elements to prevent the heater elements from being exposed and to de energize the heater which ever occurs first.
2. Level indication readout on local control panel. Power, if required, shall be pre-wired and fed from the engine-generator local control panel.
3. Level switch with electrically isolated dry contacts for remote leak detection on the engine control panel.

4. High level switch for annunciating audible alarm at 90 percent capacity in the fuel storage tank. Audible alarm shall be an externally mounted alarm horn with silence button that is located near the fill connection.

5. One common isolated dry type contact to be monitored by control system and shall close for any fuel system alarm.

L. The secondary tank shall be closed top, encircle the tank, prevent the containment area from being contaminated, and be sized to contain minimum 110 percent of the tank's capacity. All connections required for field-testing the secondary tank shall be furnished.

M. The manual fill connection shall include a dry type quick disconnect coupling sized to accommodate the local fuel distributor.

N. At 90 percent capacity an audible alarm shall sound to alert the fill operator to prevent overfill or the fuel storage tank. A silence button shall be provided to silence the alarm horn, automatically resetting when the fuel tank level has dropped below the high level condition.

O. Tank fill connection and level gauge shall be accessible at ground level through a lockable access door in the enclosure. A fill spill containment box shall be provided for containment of spillage during tank fill.

P. A suitably sized vent connection and vent cover shall be provided for the storage tank vent. The vent cover shall be installed outside the enclosure. The cover shall have an aluminum body, screen over the outlet, and shall prevent rain from entering the vent line.

Q. Suitable sized emergency vent connections for the primary and secondary tank and emergency vents shall be provided for the fuel storage tank. Each emergency relief vent shall be installed outside the enclosure and shall be designed as required to relieve excessive internal pressure caused by fire exposure. The vent line and each emergency relief vent line shall terminate just above the enclosure.

2.6 EXHAUST SYSTEM

A. Each engine-generator unit shall be furnished with a complete exhaust system including an exhaust silencer, exhaust piping, stainless steel bellows expansion joints, and accessories required for a complete operating system.

B. The silencer shall be chamber type, all welded AISI Type 304L stainless steel construction. Exhaust piping shall be Schedule 10S, AISI Type 304L stainless steel with butt-welded fittings. The exhaust silencer shall be furnished with suitable stainless steel bracket supports for horizontal mounting on top of the enclosure. As an alternate, the exhaust silencer and mounting brackets may be aluminized steel instead of stainless steel construction provided they are installed within the generator

enclosure. The silencer shall be sized so that the back pressure at rated capacity of the engine does not exceed one half the manufacturer's maximum allowable back pressure. The exhaust from the engine shall enter either the bottom or side. Silencers shall be Maxim “M51”, Nelson “300” or equal.

C. The exhaust shall discharge vertically at the silencer outlet. A rain cap shall be provided to prevent rain from entering the exhaust pipe. The rain cap shall open from exhaust pressure from the engine and shall close when exhaust flow stops. The cap shall be stainless steel counter-balancing with vertical discharge.

2.7 STARTING SYSTEM AND CONTROL POWER

A. Each engine-generator unit shall be furnished with a complete electric motor start system including starting motors, battery pack with rack, cables, and battery charger.

B. The batteries shall be of the high-rate, lead acid type and have a 12 or 24 volt output. The batteries shall be sized for five 10 second cranks with battery and engine oil temperature of 30°F, and a battery end voltage of 70 percent of system voltage.

C. The battery charger shall float-charge the battery pack and shall be solid state, full wave bridge rectified type, utilizing silicon controlled rectifiers for power control.

D. The battery charger shall be suitable for the lead acid battery pack. The charger shall have a minimum DC output as recommended by the manufacturer. The battery charger shall be provided with a NEMA 2 corrosion resistant enclosure and shall be provided with the following: on/off switch, DC ammeter, DC voltmeter, AC input and DC output circuit breakers or fuses, floating voltage equalization, and relays with form C contacts for remote annunciation of loss of AC power, low battery voltage, and high battery voltage.

E. The battery rack frame shall be constructed of corrosion resistant material. A battery compartment (tray) shall prevent failed batteries from leaking acid outside of the compartment.

F. The engine-generator shall automatically supply power to the remote bus that powers the battery charger when it is operating and when utility power is not available.

2.8 COOLING SYSTEM

A. Each engine-generator unit shall be cooled with unit-mounted radiator cooling system complete with radiator, expansion tank, water pump, belt-driven fan, fan guard, thermostatic temperature control, high-water temperature cutout, electric jacket water heater and all accessories required for proper operation. The radiator shall be sized with sufficient capacity for cooling of the engine and all other accessories required for proper operation. The fan shall draw air over the engine and discharge through the radiator.

B. The cooling system shall be filled with a permanent antifreeze mixture of the ethylene glycol type with rust inhibitor.

C. The electric jacket water heater shall be furnished to maintain jacket water at 90°F [32°C] with a winter ambient temperature as specified herein. The jacket water heater shall be thermostatically controlled.

2.9 ENGINE-GENERATOR ENCLOSURE

A. Each engine-generator unit, including its control panel, battery rack, battery charger, power panel, and other ancillary equipment, shall be housed in a steel or aluminum weatherproof enclosure, of the non-walk-in type. The enclosure shall be shop mounted on the engine generator skid.

B. Steel enclosures shall be constructed with a support frame of not less than 14 gage steel and roof panels of 16 gage Aluminum enclosure shall be formed sheet aluminum construction, made of modular panels and louvers. Posts, rails, channels, and roof bows shall be 6061-T6 extruded aluminum. The panels shall be 0.040 inch thick minimum.

C. The enclosure shall consist of two side walls, two end walls, and roof. The roof shall be braced as necessary to support the exhaust silencer. The enclosure shall be designed to withstand the specified wind velocity without damage. All bracing and reinforcing members shall be integral to the enclosure. Roof penetrations for the installation of the silencer shall be gasketed to prevent the entrance of rain.

D. Doors shall be provided and located for easy access to the engine-generator, controls, accessories and to provide easy accessibility for maintenance. Doors shall be lockable with stainless steel hardware

E. Engine oil and coolant drains shall be piped to outside of enclosure, with lockable shutoff valves and caps. All enclosure penetrations shall be gasketed or sealed to prevent the entry of rodents.

F. The enclosure shall be provided with intake and exhaust louvers which are fixed, air activated, or function by other means as approved by PWC. Louvers and dampers shall be sized for 120 percent of the cooling air requirements. The louvers shall be screened from the inside to prevent the entry of birds.

G. The enclosure shall be rain tight type and shall be designed to prevent the entrance of rain at the specified wind velocity when the unit is operating and the wind direction at 90 degrees to the intake louvers. "Rain Resistant" louvers, vertical air turning plenums, or a combination of the two shall be provided.

H. AC/DC operated maintenance lights, controlled with a 1 hour, wind-up timer switch shall also be provided.

I. The enclosure shall be pre-wired, requiring only external connection to the power panel and the control panel outputs.

J. If required by the manufacturer, the enclosure shall be provided with vertical air turning plenums for cooling air intake.

K. If required by the manufacturer, the enclosure shall be provided with vertical air tuning plenums for radiator discharge air. The radiator discharge plenum shall direct the air and mechanical noise upwards away from the unit, and shall be supplied with a bottom sump area, with a one inch drain and shutoff valve to remove any moisture.

L. The entire enclosure, except for the louvered openings, shall be provided with noise suppression insulation and be designed to limit mechanical noise to not more than 80 dB(A) at 25 feet from any point of the enclosure when operating at full capacity. Field sound tests shall be performed on each unit as specified in the installation section of this specification.

M. The enclosure shall be thoroughly cleaned after assembly and etched to allow both the interior and exterior surfaces to be shop painted.

N. The enclosure shall be as manufactured by Pritchard-Brown or equal.

2.10 CONTROL PANEL

A. Each engine-generator unit shall have a control panel mounted inside the enclosure with panel mounted controls accessible when the enclosure doors are open. The panel shall be provided with vibration isolators to prevent damage to the instruments from engine-generator vibration.

B. The control panel shall be automatic and safety type and shall, at a minimum, include all items required by NFPA 110, Level 1.

C. The control panel shall be provided with a three-position selector switch with the following positions: “RUN-OFF-AUTO”. In the “RUN” position, the engine starting sequence shall be initiated providing local control for maintenance. In the “AUTO” position, the engine-generator will be remotely started and stopped by a run contact from the automatic transfer switch as described herein. Isolated contacts for when the unit is not in the “AUTO” position shall be provided for remote indication.

D. Adequate clearance shall be provided between the panel and the engine to allow engine maintenance without moving the control panel. The control panel shall be provided with the following instruments and control devices in addition to those required by NFPA 110, Level 1.

1. Tachometer.

2. Non-resettable hour meter.

3. AC voltmeter, AC ammeter, voltmeter/ammeter selector switch with “off” position.

4. Two normally open dry contacts which close when the engine is running and open with it is stopped.

5. Dry contact that closes for remote common alarm.

6. Dry contact that closes when the control selector switch is in “auto” mode.

7. Indicating lights with common alarm for the following:

   a. Fuel storage tank low fuel level.

   b. Fuel storage tank leak detection.

   c. Fuel storage tank high high fuel level.

   d. Fuel storage tank high fuel level.

2.11 GENERATOR LINE AND COMPONENT OVERCURRENT PROTECTION

A. A generator line circuit breaker rated for the generator output voltage, having the trip rating indicated on the drawings, shall be provided on the output terminals. The line circuit breaker shall be pre-wired to the generator output terminals, and shall be provided within the generator enclosure.

B. Overcurrent protection devices shall be provided as needed by the system design to protect generator rotor and excitation system components.

2.12 SHOP PAINTING

A. All steel, and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, engine, alternator, enclosure, piping, and valves shall be shop primed and finish painted prior to shipment to the site.

B. Stainless steel, nonferrous, and nonmetallic surfaces shall not be painted.

2.13 SHOP TESTS

A. The manufacturer shall shop test each engine-generator set with its control panel and unit mounted radiator to demonstrate that the equipment conforms to specified requirements for load capacity.

B. All items included on the control panel shall be assembled, wired, and tested in the manufacturer's shop.

C. The tests shall consist of repeated starts and stops, operation under a load bank at specified capacity frequency, voltage, phase, and power factor for a minimum of 1 continuous hour, and tests to demonstrate that each safety shutdown device is working properly. Contractor shall submit certified copies of the shop test results prior to shipping the unit.

2.14 OPERATION INSTRUCTION

A. Step-by-step instructions shall be furnished by each engine manufacturer for each unit. The instructions shall include, but not be limited to, the following procedures or information:

1. Startup of the unit.

2. Normal shutdown of the unit.

3. Emergency shutdown of the unit.

4. Normal operation of the unit, typical temperatures, pressures, speed, etc., for gauges and instruments which are displayed on the panel.

B. The operation instructions shall be submitted for review in accordance with the submittals section. When the review is complete, the instruction sheets shall be printed on heavy paper or cardboard stock and laminated with clear plastic. Two copies of the laminated instructions shall be furnished with the unit. One copy shall be located or displayed at the control panel for the unit. The reserve copy shall be delivered to PWC. The instructions specified here are in addition to the operation and maintenance manuals required by the submittals section.

2.15 AIR EMISSIONS PERMIT

A. Contractor shall be responsible for preparing and submitting air emission permit application on behalf of PWC to the local air quality authority for the unit specified herein. The air emission permit shall be based on the maximum number of operating hours and the guaranteed emissions specified herein.

B. The permit shall include provisions for PWC to contact the local air quality authority for permission to operate the unit in the event the permit hours may be exceeded due to unforeseen emergency conditions.

2.16 AUTOMATIC TRANSFER SWITCHES

A. The automatic transfer switch shall be UL listed for use in standby power systems in accordance with Article 701, Legally Required Standby Systems, as service entrance equipment and, as required. The automatic transfer switch shall be a product of a manufacturer who has supplied such equipment for at least 5 years. The automatic transfer switch shall be manufactured by Automatic Switch Co. (ASCO), GE Zenith

Controls, Russelectric Inc., or an approved equal switch as manufactured by the generator manufacturer.

B. The automatic transfer switch shall be an electrically operated double throw switch. Switches composed of molded case breakers, contactors, or similar components not specifically designed for automatic transfer switch applications will not be acceptable. The automatic transfer switches shall transfer electric loads from the normal source of electric power to an emergency source of power as indicated on the drawings. The transfer switches shall automatically transfer the electrical load circuits upon an interruption or a decrease in the voltage of the normal source of power and shall transfer the loads back to the normal source when it becomes available. The automatic transfer switches shall be so designed that the load circuits cannot be connected to more than one source of power at a time.

C. The transfer switches shall be furnished without integral overcurrent protection. The switches shall be electrically operated but mechanically held in both the normal and emergency positions. The operating mechanism shall be momentarily energized from the source to which the load is being transferred. All main and arcing contacts and control elements shall be removable from the front of the switches without removing the switch from the enclosure and without removing the power cables. The automatic transfer switches shall be magnetic contactor type. Main contacts shall be silver composition. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance. A manual handle shall be provided for maintenance.

D. Automatic transfer switches shall be rated for continuous duty in both normal and emergency positions. The switches shall have the number of poles, as required, and shall be double-throw. Ampere ratings, and 3-cycle closing and withstand ratings shall be as required. Switches shall have a solid neutral.

E. The Automatic transfer switch and controls shall be enclosed in NEMA 12 metallic enclosure in dry indoor locations; otherwise it shall be enclosed in a NEMA 4X metallic enclosure. A thermostatically controlled space heater, sized to prevent condensation within the enclosure, shall be provided. A disconnect switch shall be provided for the heater circuit. The space heater shall be rated for 120 volts ac and will be powered from an external power source.

F. The control system shall consist of all control devices necessary to operate the switch as described herein. The system shall incorporate a microprocessor control module connected to the power transfer components by a wire harness and keyed disconnect plugs. The control module shall be completely enclosed with a protective cover and shall be mounted separately from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on plug-in circuit boards. All interface relays shall be identical and shall be control grade, plug-in type, with dust covers. All control components shall meet or exceed the voltage withstand capability in accordance with IEEE 472 and NEMA ICS 1-109.

G. The automatic transfer switch shall be designed to function in accordance with the following requirements:

1. The voltage of each phase of the normal source shall be monitored and the pickup voltage shall be adjustable from 85 percent to 100 percent of nominal, and the dropout voltage shall be adjustable from 75 percent to 98 percent of the pickup value. The transfer to emergency will be initiated upon reduction of the normal source to 85 percent of the normal voltage, and retransfer to normal shall occur when the normal source restores to 90 percent of the normal voltage.

2. A time delay to override momentary normal source outages to delay all transfer switch and engine starting signals shall be provided. The time delay shall be field adjustable from 0.5 to 6 seconds and shall be factory set at 1 second.

3. A time delay to retransfer to the normal source shall be provided. The time delay shall be automatically bypassed if the emergency source fails and the normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

4. An in-phase monitor shall be provided to control transfer so motor load inrush currents do not exceed normal starting currents. The monitor shall compare the phase relationship and frequency difference between the normal and emergency sources and shall permit transfer only at acceptable values of voltage, phase relationship, and frequency differential.

5. An unloaded running time delay for engine-generator cool-down shall be provided. The time delay shall be field adjustable from 0 to 60 minutes and shall be factory set at 5 minutes.

H. The automatic transfer switch shall include indication features in accordance with the following requirements:

1. A detailed step-by-step operating instruction plate shall be provided on the front of the switch.

2. Indicating lights shall be provided for, but shall not be limited to, the following:

   a. Normal source available.

   b. Emergency source available.

   c. Automatic transfer switch in normal position.

   d. Automatic transfer switch in emergency position.

   e. Automatic transfer switch in test mode.

3. An auxiliary contact shall be provided that is closed when the automatic transfer switch is connected to normal and one contact that is closed when the automatic transfer switch is connected to emergency.

4. A contact, which will close when the normal source fails, shall be provided to initiate engine starting. The contact shall be rated 10 amperes, 32 VDC and shall be gold plated for low voltage service.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Standby Power Systems shall be installed in accordance with Specification Section 16050.

B. Installation checks and start-up shall be performed by the manufacturer's local representative to ensure proper installation and readiness for operation.

3.2 TESTING

A. The complete system (engine, generator, fuel system, fuel tank, controls, automatic transfer switch, etc.) shall be field tested together by the manufacturer's local representative as a complete system to assure compatibility. Load and performance tests shall be performed. Load testing shall be performed with a reactive load bank or with a resistive load bank and the installed pumps. Performance testing shall be performed with the actual equipment loads. PWC and the Engineer shall be notified at least 2 weeks prior to the date of each test. The tests shall include but not be limited to the following:

1. Each engine-generator set shall be tested to demonstrate that the equipment conforms to specified requirements for load capacity, and starting duty. The load test shall consist of repeated starts and stops, operation under a reactive load bank at the specified power rating for a minimum of four continuous hours. Contractor shall furnish the lubricants, load bank, and the fuel for the tests. The following items shall be measured, recorded at 15 minute intervals, and submitted in a field test report:

a. Outdoor ambient temperature

b. Indoor ambient temperature

c. Barometric pressure

d. Generator output in volts, amps, kw, frequency

e. Engine speed, rpm

f. Engine jacket water temperature

g. Engine oil pressure

h. Engine start / stop times

i. Test start and completion times

2. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building/enclosure, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.

3. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination.

4. Each unit shall be mechanically checked for proper operation. Each alarm and safety shutdown shall be checked by artificially simulating an alarm condition. Defective equipment and controls disclosed by the tests shall be replaced or corrected, and the packages placed in satisfactory operating condition.

B. All costs of modifications and retesting to prove the Standby Power System meets specified requirements shall be at no cost to PWC.

C. Test reports shall verify that the specified tests have been performed and shall state results. Test results shall be submitted as required in the Submittals section and be included in the O&M manuals.

3.3 WARRANTY & MAINTENANCE

A. A one year service agreement and warranty shall be provided and shall include complete corrective and preventative maintenance for one year from the date of substantial completion. The service agreement shall include adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in PWC's maintenance log of repairs made and proper functioning of all systems. All required materials and labor shall be provided. A contract shall be submitted to PWC for extending the service agreement and warranty to five (5) years.

B. **The generator set manufacturer and its distributor shall maintain a 365 day 24-hour parts and service organization within 150 miles of the project site.** This organization shall be regularly engaged in a maintenance contract program to perform preventive maintenance and service on equipment provided.

DIVISION 2
SITE WORK

16768 FIBER OPTIC CONDUIT

GENERAL

This section includes the furnishing of piping and incidentals required for the construction of a complete fiber optic system as shown on the drawings and as specified herein.

Unless otherwise noted, the materials listed below are acceptable to the Owner for use in fiber optic system. Should the Contractor desire to use other materials not listed in these specifications, written permission must be obtained from the Owner's Engineer.

All material shall be free from defects that may impair 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.

MATERIALS

Thin wall 4" PVC Pipe: PVC pipe shall be SDR-21, pressure rating 200 psi, as called for on the plans or scheduled in the bid items. The pipe shall be plainly marked with the following information: manufacturer's name, size, material (PVC) type and grade or compound, NSF Seal, pressure rating and reference to appropriate product standards.

PVC Pipe used for construction shall comply with the following standards:

1. Standard dimension ratio: 200-PSI Pipe SDR-21 ASTM D-2241

2. Material: Grade 1 PVC Compound Material ASTM D-1784

3. Rubber Coupling Rings: ASTM D-1869

4. Warning Tape:

   A 6" wide Polyethylene Marking Tape shall be installed 12" above the top of the 4" PVC conduit to warn excavators of a buried utility line below. Heavy gauge 6-mil polyethylene film shall be highly resistant to acids, alkalies and other soil components. The tape shall be orange with the words "Buried Fiber Optic Cable Below" or equivalent wording.

5. Burst Pressure Test: 200 psi, SDR-21 minimum quick burst pressure 800 psi

6. Impact Strength: ASTM D-2444

PIPE INSTALLATION

Pipe shall be installed in strict accordance with SECTION 02222, with the following additions: the manufacturer's recommendations and as specified in Section IX of these specifications.