

WPN 23.0110
WWTA Standard Details and Specifications for Sewer

APPROVED FOR CONSTRUCTION

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TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

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06/12/2023

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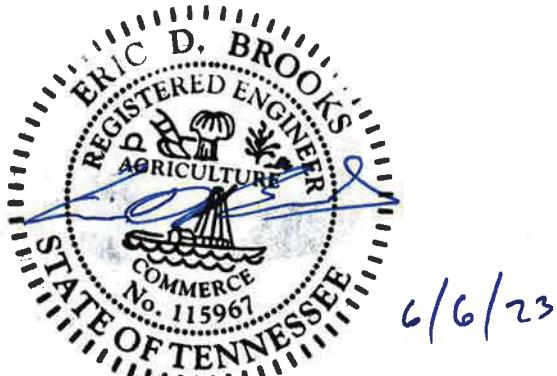


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STANDARD DETAILS & SPECIFICATIONS FOR THE CONSTRUCTION OF SANITARY SEWERS



Effective Date: March 1, 2023
TN0021211, SOP-89044, SOP-13025, SOP-15004

**WWTA STANDARD DETAILS & SPECIFICATIONS FOR THE
CONSTRUCTION OF SANITARY SEWERS**

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**HAMILTON COUNTY WATER & WASTEWATER
TREATMENT AUTHORITY
STANDARD DETAILS AND SPECIFICATIONS FOR THE
CONSTRUCTION OF SANITARY SEWERS**

INTRODUCTION

The purpose of these Standard Details and Specifications is to provide engineers, contractors, developers, and others with the requirements of the Hamilton County Water & Wastewater Treatment Authority (WWTA) that are to be incorporated into the design and construction of sanitary sewage works which will be connected to and/or dedicated to the WWTA wastewater system.

The design of all sanitary sewage treatment and conveyance works must conform to the latest edition of the “Design Criteria for Sewage Works of the State of Tennessee”. In addition, all use of connections to the WWTA wastewater collection system are governed by the “WWTA Sewer Use Rules and Regulations for Wastewater Collection Systems”. All design and construction of extensions to the sewer system must conform to the latest effective edition of those Regulations. Copies of the Regulations may be obtained at the WWTA office located at:

Hamilton County WWTA
1250 Market Street, Suite 3050
Chattanooga, TN 37402-2716
Phone: 423-209-7842
Fax: 423-209-7843

No sanitary sewers shall be constructed in the WWTA Service Area until the design is approved by both the WWTA Executive Director or Chief Engineer and the Tennessee Department of Environment and Conservation.

This document is to serve as the “WWTA Standard Details and Specifications for Sanitary Sewers” referred to in Section 7 (b), Paragraph 1 of the Regulations. It is the intention of these Details and Specifications to meet or exceed the “Design Criteria for Sewage Works of the State of Tennessee”. These Details and Specifications are subject to change from time to time. Therefore, it is best to contact the Hamilton County WWTA office listed above to insure that these are the most current specifications. Failure to comply with the most current Details and Specifications shall not prevent the Hamilton County WWTA from requiring a correction in the design or construction of the sewers.

The Terms used in these Details and Specifications shall have the same meanings as defined in the WWTA Sewer Use Rules and Regulations. Where these Details and Specifications refer to the “Engineer” and to terms such as “approved by, acceptable to,

requested by the Engineer", and other like terms, "Engineer" shall mean the WWTA Chief Engineer, Executive Director, or authorized representative.

Detailed plans and specifications for any special conditions, structures, or methods that are not covered by these Details and Specifications shall be submitted to the WWTA for approval along with other plans, profiles, details, and specifications required by the Regulations.

The design and construction of public sewer extensions shall comply with all applicable Federal, State, and local laws and regulations.

GENERAL CONDITIONS

1. Observation of public sewer extension construction will be arranged by the WWTA. This will involve the appointment of one or more Representatives, of the Owner or Engineer, hereafter called Resident Project Representative (RPR). Observation will extend to all parts of the work and to the materials to be used. The RPR will be placed at the work site to keep the WWTA informed as to the progress of construction and the manner in which it is being done and also to call to the attention of the engineer, contractor, and/or developer any deviation from the approved plans, details, and specifications. The RPR has the authority to reject defective material or work that is being improperly done, subject to the final decision of the WWTA. The RPR is not authorized to revoke, alter, enlarge, or relax the Regulations of the WWTA or the approved plans, details, and specifications. The RPR is authorized to give progressive acceptance of portions of the completed work; however, written acceptance of the completed project will be made by the WWTA.

Any work performed that is not observed by the RPR before covering shall be uncovered at no expense to the WWTA. All testing of work and start-up of equipment that is required by the these Details and Specifications is to be performed in the presence of the RPR.

2. For the purposes of scheduling observation, the engineer, developer, or construction contractor for the public sewer extension shall determine the regular working hours applicable to the project in agreement with the WWTA prior to the start of any work.
3. All grading work that is to take place around and in the vicinity of the sewers to be constructed shall be completed **PRIOR** to the start of construction of the sewers.
4. The construction contractor shall keep on the job a copy of the approved plans, details, and specifications. Anything in the plans and specifications which conflicts with these Details and Specifications shall be brought to the attention of the RPR or the WWTA.
5. Shop Drawings: The developer or construction contractor for the public sewer extension shall submit to the Engineer for review and approval copies of complete drawings and engineering data for all equipment, materials, and products to be incorporated into the work. Sufficient detail shall be submitted to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorage, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and

equipment. Data submitted shall include drawings showing essential details of any changes proposed by the contractor and all required wiring and piping layouts.

The submitted copies shall each be clearly marked with the name of the project and shall bear the contractor's stamp of approval, which shall be construed as certification that he has reviewed, checked, and approved the engineering data and that the data are in conformance with the approved plans, details, and specifications.

When the drawings and data are returned marked "REJECTED" or "REVISE AND RESUBMIT", the corrections shall be made as noted thereon and as instructed by the Engineer and corrected copies resubmitted.

When the drawings and data are returned marked "NO EXCEPTIONS TAKEN" or "EXCEPTIONS TAKEN AS NOTED", fabrication and/or installation can begin and no additional copies need to be furnished.

No work shall be performed in connection with the fabrication or manufacture of materials and equipment, nor shall any accessory or appurtenance be purchased until the drawings and data therefore have been reviewed by the WWTA and returned marked "NO EXCEPTIONS TAKEN" or "EXCEPTIONS TAKEN AS NOTED".

The WWTA's review of drawings and data submitted will cover only general conformity to the approved plans, details, and specifications. The WWTA's review of drawings and data returned marked "NO EXCEPTIONS TAKEN" or "EXCEPTIONS TAKEN AS NOTED" does not indicate a thorough review of all details of the material, equipment, devices, or items shown and shall not in any way relieve the contractor from any responsibility for errors or deviations or complete and accurate performance of the work in conformance with the approved plans, details, and specifications.

6. The construction contractor shall furnish all necessary equipment, materials, and labor at his expense for handling, passing, and disposing of all sewage, seepage, surface, subsurface, and flood flows encountered at any time during the prosecution of the work.
7. The construction contractor will minimize siltation and bank erosion during construction and will conform to all erosion control regulations applicable to the project. All applicable Hamilton County Water Quality permits and TDEC permits shall be acquired and a copy shall be kept on site.
8. Where the work requires the entry into any of the existing wastewater facilities of the WWTA, employees on the work site and other persons affected thereby shall

be subject to WWTA's Confined Space Entry Procedures. No entry into such a facility will be made without a written permit from the WWTA or authorized representative in accordance with those procedures.

9. The construction contractor shall submit samples of materials for testing at the request of the WWTA or authorized representative. The testing of such materials shall be made by a competent laboratory or other person selected by and paid for by the office of the WWTA. The cost of all retests made necessary by the failure of materials to conform to the requirements of the approved plans, details, and specifications shall be paid by the contractor.

Where mill tests of materials are found by the WWTA to be acceptable, the Contractor shall furnish certified copies of such mill tests. The cost of furnishing such certified copies shall be borne by the Contractor.

10. Testing and inspection of the work or any part of it which is required by the approved plans, details, and specifications, or by any public body having jurisdiction shall be the responsibility of the construction contractor who shall furnish all materials and labor and who shall pay all costs in connection therewith. The contractor shall also be responsible for and pay for all costs in connection with any inspection or testing required to determine WWTA's acceptance of the use of substitute materials or equipment other than those required by the approved plans, details, and specifications.

SECTION 01090

REFERENCE STANDARDS AND ABBREVIATIONS

GENERAL

A. All materials, equipment, fabrication, and installation practices shall comply with the following applicable codes and standards, except in those cases where the Contractor's quality standards establish more stringent quality requirements, as determined by the Engineer.

1. Concrete Structures

ACI (American Concrete Institute)

2. General Building Construction

FM (Factory Mutual Fire Insurance Company)

NFPA (National Fire Protection Association)

SBC (SBCC Standard Building Code)

3. Materials

AASHTO (American Association of State Highway and Transportation Officials)

ANSI (American National Standards Institute)

ASTM (American Society for Testing and Materials)

4. Plumbing

AGA (American Gas Association)

NSF (National Sanitation Foundation)

PDI (Plumbing Drainage Institute)

SPC (SBCC Standard Plumbing Code)

5. Pressure Piping and Tubing

ANSI (American National Standards Institute)

API (American Petroleum Institute)

ASME (American Society of Mechanical Engineers)

AWWA (American Water Works Association)

NSF (National Sanitation Foundation)

6. Safety

OSHA (Occupational Safety and Health Act)

7. Subgrades and Pavement

SSRBC (Standard Specifications for Road and Bridge Construction, Tennessee Department of Transportation).

- B. In addition, all work shall comply with the applicable requirements of local codes, utilities, and other authorities having jurisdiction.
- C. All material and equipment, for which an AGA approval is established, shall be so approved and labeled or stamped. Label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

END OF SECTION 01090

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 EQUIPMENT DELIVERY AND CONSTRUCTION SCHEDULE

Not later than ten (10) consecutive calendar days after the effective date of Agreement, the Contractor shall submit to the Engineer for review a detailed schedule of major equipment delivery and installation and general construction operations, indicating the sequence of the work, the estimated dates of starting each task, and the estimated time of completion of each task. The schedule shall be broken down with respect to individual structures and facilities, indicating when existing structures or equipment would be taken out of service, (if applicable). The form and content of the schedule shall be satisfactory to the Engineer.

1.02 SHOP DRAWINGS AND PRODUCT DATA

- A. The Contractor shall submit to the Engineer for review and approval three copies of complete drawings and engineering data for all equipment, materials, and products to be incorporated into the work. Shop drawings and engineering data shall be provided and the Engineer's review will be conducted in accordance with the WWTA Standard Specifications, the requirements of the Supplementary General Conditions, and shall be agreed to by the WWTA. Shop drawings and/or engineering data, as appropriate, shall be submitted for the following items, including, but not limited to:
 1. All piping, pipe supports, hangers, couplings, gauges, and insulation.
 2. Miscellaneous iron castings and gratings, manhole frames with certification of traffic bearing capabilities and covers, curb inlets, manhole steps, floor drains and roof drains.
 3. All concrete and masonry accessories and steel reinforcement, including bending diagrams and bar schedules, ties, spreaders, chairs, inserts, form coatings, waterstops, curing and sealing compounds, and epoxy bonding agents.
 4. Premixed grouts and mortars.
 5. Precast concrete items, roof and floor decks, columns, beams, architectural panels, manholes, lintels, sills, and coping.
 6. All paints and protective coatings.
 7. Grass seed, fertilizer, and commercial mulches.

8. All pump station equipment such as dialers, pumps, control panels, and components, etc.
9. Fencing.
10. Certification of traffic bearing capacity for manhole covers.
11. Erosion Control Plan including schedule and methods (Section 02270, Part 3.02).

B. All shop drawings shall include a legend or other suitable means to identify all symbols and abbreviations used on the drawing. Where an accepted, industry-wide drafting standard or symbol has been established for a particular item, information depicted on the shop drawings shall conform to that standard.

C. Shop drawings shall be dimensioned using the U.S. standard unit of measurement (feet and/or inches). Size of drawing shall not exceed 24 inches by 36 inches. All scaled drawings and details shall have the scale clearly noted on the drawing or detail. All information shall be clear and legible.

D. Each shop drawing and each item of engineering data shall bear the Contractor's approved stamp indicating that the Contractor has reviewed the drawing or data for conformance with the Contract Documents.

1.03 MISCELLANEOUS SUBMITTALS

The Contractor shall submit to the Engineer miscellaneous information, procedures, test data, samples, etc., in the manner and at the time specified in the approved Specifications and Contract Documents. Miscellaneous submittals shall include, but not be limited to, the following:

1. Procedures for handling and disposing of sewage flows during construction.
2. Samples of wire and cable, casework, concrete masonry units, quarry tile, roofing and flashing, push-on PVC joint details, and other items as specified in the Specifications.
3. Preliminary concrete mix design reports.
4. Satisfactory written evidence in the form of laboratory or mill test reports indicating that all cement, aggregate, masonry, structural steel, fencing, castings, steel reinforcement, conduit, pipe, grout, grass seed and other items incorporated into the work are in compliance with the requirements of these Specifications.
5. Deep trench shoring design certification.
6. Project record documents.

7. Copies of original invoices of all equipment delivered to the site.
8. Drawings and details of erosion and sediment control structures.
9. Profile cut sheets (see sample in Standard Detail Section of these specifications.)

1.05 SAMPLES

At the Engineer's request, the Contractor shall furnish certified samples of materials utilized in the fabrication or production of equipment, materials, and products supplied under these Contract Documents. Cost of all such samples shall be borne by the Contractor. The samples will be tested by a qualified independent testing laboratory selected by the Owner to determine if the mechanical and chemical properties of the materials supplied are in accordance with the requirements of these Specifications and Contract Documents. The Owner shall pay for the laboratory testing of material samples provided by the Contractor. The Contractor shall pay for all retests made necessary by the failure of materials to conform to the requirements of these Specifications and Contract Documents.

END OF SECTION 01300

SECTION 01610

TRANSPORTATION AND HANDLING

PART 1 - GENERAL

The Contractor shall provide transportation and security of all equipment, materials, and products furnished under these Contract Documents to the site of the work. In addition, the Contractor shall provide preparation for shipment and unloading, and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the work.

PART 2 - TRANSPORTATION

- A.** All equipment/products shall be suitably boxed, crated, or otherwise protected during transportation.
- B.** All equipment/products shall be shipped and delivered in the largest assembled sections practical or permitted by carrier regulations to minimize the number of field connections.
- C.** The Contractor shall be responsible for ensuring that the equipment/product is assembled and transported in such a manner so as to clear buildings, power lines, bridges, and similar structures encountered during shipment or delivery to the site of the work.
- D.** Where equipment/products will be installed using existing cranes or hoisting equipment, the Supplier shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.

PART 3 - HANDLING

- A.** All equipment, materials, and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation. All equipment, materials, and products damaged during transportation or handling shall be repaired or replaced by the Supplier at no additional cost to the Owner prior to being incorporated into the work.
- B.** Under no circumstances shall equipment or products such as pipe, structural steel, casting, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of the trucks onto the ground.

END OF SECTION 01610

SECTION 01615 **STORAGE AND PROTECTION**

PART 1 - GENERAL

Equipment shall be received, inspected, unloaded, handled, stored, maintained, and protected by the Contractor in a suitable location on or off site, if necessary, until such time as installation is required.

PART 2 - STORAGE

- A. The Contractor shall be responsible for providing satisfactory storage facilities which are acceptable to the Engineer. In the event that satisfactory facilities cannot be provided on site, satisfactory warehouse, acceptable to the Engineer, will be provided by the Contractor for such time until the equipment, materials, and products can be accommodated at the site.
- B. Equipment, materials and products which are stored in a satisfactory warehouse acceptable to the Engineer will be eligible for progress payments, after inspection by the Engineer, as though they had been delivered to the job site.
- C. The Contractor shall be responsible for maintenance and protection of all equipment, materials, and products placed in storage and shall bear all costs of storage, preparation for transportation, rehandling, and preparation for installation.
- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.
- E. Unless otherwise permitted in writing by the Engineer, building products and materials such as cement, grout, plaster, gypsum-board, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, electrical controls, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block, and structural tile may be stored outdoors under a properly secured waterproof covering.
- F. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

PART 3 - EXTENDED STORAGE

In the event that certain items of major equipment such as compressors, pumps, and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Engineer. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants, and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

END OF SECTION 01615

SECTION 01740

GUARANTEES AND WARRANTIES

In accordance with Section VII(B) , Paragraph 16 of the "WWTA Sewer Use Rules and Regulations for Wastewater Collection Systems", the applicant for a public sewer extension, or the Contractor working for the WWTA, shall provide an agreement to repair or cause to be repaired at no cost to the WWTA any defects in the work, including but not limited to, defective equipment, materials, or supplies, breaks, leaks, and faulty construction or workmanship occurring within the time frame specified below after acceptance of the project from the Hamilton County WWTA. The warranty for repair shall include all required parts, material, labor, equipment, as well as factory trained technician support on-site as required to make all necessary repairs. This form shall be completed by the applicant and submitted to the WWTA Executive Director along with a copy of the contractor's warranty form submitted by the contractor to the applicant.

WARRANTY PERIOD:

1. Gravity and Low Pressure Sewers: all materials and workmanship shall be covered by warranty for a period of 1 year.
2. Pump Station and Force Mains:
 - a. Force main and all appurtenances: all materials and workmanship shall be covered by warranty for a period of 1 year.
 - b. Pumps and motors: all materials and workmanship shall be covered by warranty for a period of 5 years.
 - c. Pump controllers: all materials and workmanship shall be covered by warranty for a period of 2 years.

Project: _____

Location: _____

Owner: Hamilton County Water & Wastewater Treatment Authority (WWTA)

Applicant: _____

I (We), _____ do hereby warrant all equipment,
(Applicant/Contractor)

materials, products, and workmanship provided in conjunction with the above referenced project from defects as described above occurring within the time frame specified from the date of acceptance of the project in writing by the Hamilton County WWTA.

If, during the warranty period (a) any equipment, materials, or products furnished and/or installed are found to be defective in service by reason of faulty construction process, structural and/or mechanical design or specifications, or (b) any equipment, materials, or products furnished and/or installed are found to be defective by reason of defects in material or workmanship, or (c) any portions of the work or materials are damaged in any way whatsoever by other work or activities in the vicinity over which I (we) have direct or indirect responsibility or authority, I (we) shall, as soon as possible after receipt of written notice from the WWTA Executive Director or authorized representative, and at no cost to the WWTA, repair or cause to be repaired such defective equipment, materials or products, or replace such defective equipment, materials or products.

In the event of multiple equipment failures of major consequence prior to the expiration of the warranty described above, the affected equipment shall be disassembled, inspected, and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered nonserviceable as a consequence of the equipment failure shall be replaced. A twelve (12) month extension to the warranty against defective or deficient design, workmanship, and materials shall commence on the day that the item of equipment is reassembled and placed back into operation and accepted by the WWTA. As used herein, multiple equipment failures shall be interpreted to mean two (2) or more successive failures of the same kind in the same item of equipment or failures of the same kind in two (2) or more items of equipment. Major equipment failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts or structural members, broken or chipped gear teeth, overheating, premature bearing failure, excessive wear, or excessive leakage around seals. Equipment failures which are directly and clearly traceable to operator abuse, such as operating the equipment in conflict with published operating procedures, or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over-or-under-lubrication, and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the warranty. Should multiple equipment failures occur in a given item or type of equipment, all equipment of the same size and type shall be disassembled, inspected, modified or replaced, as necessary, and rewarranted for an additional year.

This warranty commences on the date of acceptance of the above referenced project by the Hamilton County WWTA, and expiration occurs in the specified year from said date, for the type of work as specified herein.

Signature: _____
(Owner-Applicant/Contractor)

Date: _____

NOTARY:

On this _____ day of _____, 20____, before me personally appeared _____ and _____, to me known to be the person(s) described in and who executed the foregoing instrument, and acknowledged that they executed the same as their free act and deed.

IN WITNESS WHERETO, I have hereunto set my hand and Notarial Seal.

NOTARY PUBLIC

My Commission Expires: _____

END OF SECTION 01740

SECTION 02220

EARTHWORK

PART 1 - GENERAL

1.01 SCOPE

- A. This Specification section includes earthwork and related operations, including, but not limited to, clearing and grubbing the construction site, dewatering, excavating all classes of material encountered, pumping, draining and handling of water encountered in the excavations, handling, storage, transportation, and disposal of all excavated and unsuitable material, construction of fills and embankments, backfilling around structures and pipe, backfilling all trenches and pits, compacting, all sheeting, shoring and bracing, preparation of subgrades, surfacing and grading, and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing a complete work as shown on the Drawings or specified in these Contract Documents.

1.02 GENERAL

- A. The elevation shown on the Drawings as existing are taken from the best existing data and are intended to give reasonable, accurate information about the existing elevations. They are not precise, and the Contractor should satisfy himself as to the exact quantities of excavation and fill required.
- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- D. If soil borings are available for the area of this work, they will be on file at the Owner's address where they will be made available for review. This information is made available to the Contractor for such use as he may choose to make of it in the preparation of his bid, but the Owner gives no guarantee, either expressed or

implied, that it represents a true or complete cross section of all the material to be encountered in performing the excavation and earthwork on this project.

- E. Earthwork within the rights-of-way of the State Department of Transportation, Hamilton County Government, and the respective cities shall be done in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these Specifications.
- F. The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Material in public roads for protection of excavation from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference and nuisance to the public. Free access must be provided to all fire hydrants, watergates, meters, and private drives.
- G. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.
- H. Tests for compaction and density shall be conducted by the Engineer or by an independent testing laboratory selected by the Engineer. Costs of compaction tests performed by an independent testing laboratory shall be paid for directly by the Owner and not as a part of this Contract. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests. The cost of all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents shall be paid by the Contractor.
- I. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations.
- J. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. The Contractor shall be

responsible for providing all services, labor, equipment, and materials necessary or convenient to him for completing the work within the time specified in these Contract Documents.

PART 2 - EXECUTION

2.01 INITIAL SITE PREPARATION

- A. Preparatory to beginning of construction operations, the Contractor shall remove from the site all vegetative growth, trees, brush, stumps, roots, debris, and any other objectionable matter, including fences, buildings, and other structures shown on the Drawings in the construction areas which are designated for removal or which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Stumps and roots shall be grubbed and removed to a depth not less than 5 feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be filled with compacted layers of crushed rock or earth backfill conforming to the requirements specified here for backfill. Organic material from clearing operations shall not be incorporated in excavation backfill or embankment material.
- C. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, buildings, and other structures which are located in the construction area but not within designated clearing limits as shown on the Drawings or within the limits of embankments, excavations, or proposed structures. The Contractor shall be responsible for the repair and/or replacement of any of the aforementioned items damaged by his operation or construction activities.
- D. The Contractor shall remove and dispose of all excess material resulting from clearing or site preparation operations.

2.02 DEWATERING

- A. The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Methods of dewatering may include sump pumps, well points, deep wells, or

other suitable methods which do not damage or weaken structures, foundations, or subgrades. Shallow excavations may be dewatered using open ditches provided such ditches are kept open and free-draining at all times.

- B. Unless specifically authorized by the Engineer, no concrete or mortar shall be placed in water nor shall water be allowed to rise over newly-placed concrete or mortar for at least 24 hours after placement. No concrete structure shall be exposed to unequal hydrostatic forces until the concrete has reached its specified 28-day strength. Water shall not be allowed to rise above bedding during pipe laying operations. The Contractor shall exercise care to prevent damage to pipelines or structures resulting from flotation, undermining, or scour. Dewatering operations shall commence when ground or surface water is first encountered and shall be continuous until such times as water can safely be allowed to rise in accordance with the provisions of this section. Excavations shall be protected from the entrance of surface water to the extent possible by the use of dikes and/or covers.
- C. Standby pumping equipment shall be on the jobsite. A minimum of one standby unit (a minimum of one for each ten in the event well points are used) shall be available for immediate installation should any pumping unit fail. The design and installation of well points or deep wells shall be suitable for the accomplishment of the work. Drawings or diagrams on proposed well point or deep well dewatering systems shall be submitted to the Engineer for review.
- D. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with crushed rock at no cost to the Owner.
- E. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. Conveyance of the water shall be such as to not interfere with traffic flow or treatment facilities operation. No water shall be drained into work built or under construction without prior consent of the Engineer. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
- F. Sedimentation and desilting basins shall be provided as necessary or when directed by the Engineer to prevent the entrance of excessive or injurious amounts of sand and silt from surface runoff or dewatering operations into storm drains or receiving waters. The system used for desanding or desilting the water shall be a baffled structure and shall provide not less than five minutes detention time and shall be designed to have a "flowthrough" velocity not exceeding 0.2 feet per

second at the anticipated peak flow. The method of desanding or desilting and the point of disposal shall be subject to the approval of the Engineer.

G. Water shall be disposed of in such a manner as not to be a menace to the public health and in accordance with applicable Environmental Protection Agency, Corps of Engineers, and State Water Quality Control Division standards and permits.

2.03 SHEETING, SHORING, AND BRACING

A. The sides of all excavations shall be sufficiently sheeted, shored, and braced as necessary to prevent slides, cave-ins, settlement or movement of the banks, to maintain the excavation clear of all obstructions, and to provide safe working conditions. Wood or steel sheeting of approved design and type shall be used in wet, saturated or flowing ground. All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain shape and position under all circumstances.

B. The responsibility for correctly assessing the need for sheeting and analyzing the stresses induced shall be the total responsibility of the Contractor. Since the Engineer does not dictate or determine the Contractor's sequence or limits or excavation, the Engineer assumes no responsibility for sheeting and shoring. The Contractor must employ or otherwise provide for adequate professional structural and geotechnical engineering supervision to assess the need for sheeting and shoring and design same. Results of sheeting and shoring analysis and design shall be submitted to the Engineer on request.

C. Excavation adjacent to existing or proposed buildings and structures, or in paved streets or alleys shall be sheeted, shored, and braced adequately to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition. Any damage to structures or pavements occurring through settlements, water or earth pressures, slides, caves, or other causes; due to failure or lack of sheeting or bracing, or due to improper bracing; or occurring through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.

D. Sheet, shoring, or bracing materials shall not be left in place unless otherwise specified or shown on the Drawings or ordered by the Engineer in writing. Such materials shall be removed in such manner that no danger or damage will occur to new or existing structures or property, public or private, and so that cave-ins or slides will not take place. Trench sheeting shall be left in place until backfill has

been brought to a level 12 inches above the top of the pipe. It shall then be cut off and the upper portion removed. Sheeting for structures shall be left in place until backfill has been brought to a level of 12 inches above the top of the bottom footing. It shall then be cut off and the upper portion removed.

- E. All holes and voids left in the work by the removal of sheeting, shoring, or bracing shall be filled and thoroughly compacted.

2.04 EXCAVATION

A. General

1. Excavation shall include the removal of all material from an area necessary for the construction of a pipeline, structure, basin, flume, or building. Excavations shall provide adequate working space and clearances for the work to be performed therein.
2. Except where otherwise shown on the Drawings, specified herein, or authorized by the Engineer, all material excavated below the bottom of concrete walls, footings, and foundations shall be replaced, by and at the expense of the Contractor, with Class B concrete to the lines and grades shown on the Drawings.
3. Where quicksand, soft clay, spongy, swampy or other materials unsuitable for subgrade or foundation purposes are encountered below the excavation limits, they shall be removed and disposed of to the level of suitable material. Areas so excavated shall be backfilled with Class B concrete or with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill to the lines and grades shown on the Drawings.
4. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until the excavations are backfilled. All excavations shall be barricaded in such a manner as to prevent persons from falling or walking into any excavation.

B. Rock Excavation

1. Rock encountered in the process of excavation for structures shall be uncovered and stripped of all loose materials over the entire limits of

excavation. Rock encountered for removal in a trench section shall be uncovered for a distance of not less than 50 feet.

2. Rock and large boulders in trenches shall be excavated over the horizontal limits of excavation and to depths as shown on the Drawings.
3. The space below grade for pipe lines shall then be backfilled to the proper grade with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill. Where pipe sewers are constructed on concrete cradles, rock shall be excavated to the bottom of the cradle as shown on the Drawings.
4. Rock under structures shall be excavated to lines and grades shown on the Drawings. Unless specified otherwise, where rock excavation has been carried below grade the Contractor shall backfill to grade with Class B concrete at his own expense.
5. Where rock foundation is obtained at grade for over 50 percent of the area of any one structure, the portion of the foundation that is not rock shall be excavated below grade to reach a satisfactory foundation of rock. The portion below grade shall be backfilled with Class B concrete.
6. Where rock foundation is obtained at grade for less than 50 percent of any one structure and satisfactory rock cannot be found over the remaining area by reasonable additional excavation, the rock shall be removed for a depth of 12 inches below grade and the space below grade shall be backfilled to the proper grade with compacted layers of crushed rock conforming to the requirements specified herein for backfill.
7. Drilling and blasting operations shall be conducted with due regard for the safety of persons and property in the vicinity and in strict conformity with requirements of all ordinances, laws and regulations governing blasting and the use of explosives. Rock excavation near existing pipelines or other structures shall be conducted with the utmost care to avoid damage. Injury or damage to other structures and properties shall be promptly repaired to the satisfaction of the Owner by the Contractor at his own expense.
8. Rock excavation for all structures and adjacent trenches under this Contract and any other rock excavation directed by the Engineer shall be completed before construction of any structure is started in the vicinity.

C. Borrow Excavation

1. Wherever the backfill of excavated areas or the placement of embankments or other fills requires specified material not available at the site or material in excess of suitable material available from the authorized excavations, such materials shall be obtained from other sources. This may require the opening of borrow pits at points not immediately accessible from the work. In such cases the Contractor shall make suitable arrangements with the property owner and shall pay all costs incident to the borrowed material including royalties, if any, for the use of the material. Before a borrow pit is opened, the quality and suitability of the material to be obtained therefrom shall be approved by the Engineer.
2. Borrow pits shall be cleared, grubbed, and finish graded in accordance with the requirements specified herein.

D. Roadway Excavation

Roadway excavation shall consist of excavation for roadways and parking areas in conformity with lines, grades, cross sections, and dimensions shown on the Drawings. After shaping to line, grade, and cross section, the subgrade shall be rolled until compacted to a depth of at least 6 inches to 100 percent of the maximum density at optimum water content as determined by AASHTO T99, Method A. This operation shall include any reshaping and wetting required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

E. Trench Excavation

1. Trench excavation shall consist of the removal of materials necessary for the construction of water, sewer, and other pipelines and all appurtenant facilities including manholes, inlets, headwalls, collars, concrete saddles, piers and pipe protection called for on the Drawings.
2. Excavation for pipelines shall be made in open cut unless shown otherwise on the Drawings. Trenches shall be cut true to the lines and grades shown on the Drawings or established by the Engineer on the ground. The banks of trenches shall be cut in vertical, parallel planes equidistant from the pipe centerline. From an elevation 12 inches above the top of the pipe to the bottom of the trench, the horizontal distance between vertical planes for different sizes of pipe shall not exceed those shown on the Drawings. When sheeting is used, the width of the trench shall be considered as the distance

between the inside faces of the sheeting. The bottom of the trench shall be cut carefully to the required grade of the pipe except where bedding materials or cradles are shown, in which case the excavation shall extend to the bottom of the bedding or cradles as shown on the Drawings or specified in these Contract Documents.

3. The use of a motor-powered trenching machine will be permitted but full responsibility for the preservation, replacement, and/or repair of damage to any existing utility services and private property shall rest with the Contractor.
4. Bell holes for bell and spigot pipe and/or mechanical joint pipe shall be excavated at proper intervals so the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of all joints in the pipe. Bell holes shall not be excavated more than 10 joints ahead of pipe laying. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.
5. Excavation for manholes, outlets, collars, saddles, piers, and other pipeline structures shall conform to the additional requirements specified herein for structural excavation.
6. Pipe trenches shall not be excavated more than 400 feet in advance of pipe laying and all work shall be performed to cause the least possible inconvenience to the public. Adequate temporary bridges or crossings shall be constructed and maintained where required to permit uninterrupted vehicular and pedestrian traffic.
7. Unless otherwise specified herein or shown on the Drawings, wherever pipe trenches are excavated below the elevation shown on the Drawings, the Contractor, at his own expense, shall fill the void thus made to the proper grade with Class B concrete or with compacted layers of crushed rock or sand conforming to the requirements specified here for backfill.

F. Structural Excavation

1. Structural excavation shall consist of the removal of all materials necessary for the construction of structures, including tanks, foundations, footings, wetwells, dry wells, box culverts, flumes, channels, buildings, and other miscellaneous structures.

2. The bottom of structural excavations shall be true to the lines and grades shown on the Drawings. Faces of excavations shall not be undercut for extended footings. Except as provided herein for excavation of unsuitable material or rock, where the excavation is carried below the grade elevation shown on the Drawings, the Contractor shall backfill the void this made to the proper grade with Class B concrete at his own expense.

2.05 BACKFILLING

- A. Materials for backfilling shall conform to the following requirements:

1. Select Earth Backfill:

Fine, sound, loose earth containing optimum moisture content for compaction to 90 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete less than 2 inches in maximum dimension except that the maximum particle size shall be 3/4 inch when used with PVC or other flexible thermoplastic pipe.

2. Common Earth Backfill:

Sound, loose earth containing optimum moisture content for compaction to 90 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete and pavement less than 6 inches in maximum dimension.

3. Sand:

Natural or imported sand conforming to ASTM D 1073.

4. Crushed Rock:

Crushed rock conforming to Section 903.05, Class A, Grade D of the Tennessee Department of Highways Standard Specifications for Road and Bridge Construction.

5. Class B Concrete:

Class B concrete as specified in Section 03200, "Cast-in-Place Concrete" of these Specifications.

B. Compaction

1. Unless otherwise specified herein, earth backfill shall be compacted to not less than 90 percent of the maximum density at optimum water content as determined by AASHTO T-99, Method A. Crushed stone and sand shall be compacted or consolidated to not less than 83 percent of the solid volume density as determined from the bulk specific gravity by AASHTO T-84 and T-85 and the dry weight of the aggregate.
2. Material that is too dry for adequate compaction shall receive a prior admix of sufficient water to secure optimum moisture content. Material having excessive water content shall not be placed at any time.
3. Unless otherwise specified herein backfill material required to be compacted shall be placed in horizontal layers not to exceed 6 inches in thickness (before compaction) and compacted in place by ramming, tamping, or rolling. Compaction shall be accomplished by power driven tools and machinery wherever possible. Compaction and consolidation of sand and crushed rock backfill shall be accomplished using vibrating equipment.

C. Backfilling Trenches

1. The backfilling of sewer, water, and other pipeline trenches shall be started immediately after the construction of same has been inspected and approved by the Engineer. Select backfill or bedding material if specified shall be placed in the trench under and on each side of the pipe in 6-inch layers for the full width of the trench and thoroughly and uniformly compacted by ramming and/or tamping to a minimum of 90 percent of the maximum density determined as specified herein. Select earth backfilling shall start above the class of pipe bedding as specified or shown on the Drawings. Sufficient select earth backfill shall be placed around the pipe and compacted to provide a cover of not less than 12 inches over the top of the pipe. Mechanical compactors or tampers shall not be used within 12 inches of pipe. Compaction in this area shall be accomplished by hand methods. Backfilling shall proceed simultaneously on both sides of the pipe to prevent lateral displacement.
2. Caution shall be used during backfill operations for PVC or other flexible thermoplastic pipe (non-pressure or sewer pipe) to prevent pipe deformation. Backfill shall be hand compacted on each side of the pipe only to a minimum of 12" of cover. PVC or other flexible thermoplastic pipe (sewer pipe) shall not be subjected to roller or wheel loads until a minimum of 36 inches of

backfill has been placed over the top of the pipe and a hydrohammer shall NOT be used until a minimum depth of 48 inches backfill has been placed over the top of the pipe.

3. Backfilling of PVC pressure pipe or other flexible thermoplastic pipe (water pipe) shall be as described in Paragraph 1 above.
4. In streets, alleys, across sidewalks and driveways, and at any other places subject to vehicular traffic or other superimposed loads, crushed rock backfill (33-P) shall be placed in lifts of 48 inches maximum and compacted by the use of a hydrohammer, approved vibratory compactor or roller. The subgrade shall meet the requirements of Subsection 2.06 H. of this specification.
5. Trenches under concrete slabs and footings of structures shall be completely backfilled with crushed rock or filled with Class B concrete as shown on the Drawings.
6. In all other areas not affected by superimposed loads, common earth backfill may be placed from a level of 12 inches above the top pipe upward for the full depth of the trench without compaction. At these places, backfill shall be neatly rounded over the trench to sufficient height to allow for settlement to grade after consolidation.
7. All backfilling shall be done in such a manner that the pipe or structure over or against which it is being placed will not be disturbed or injured. Any pipe or structure injured, damaged, or moved from its proper line or grade during backfilling operations shall be removed and repaired and then rebackfilled.

D. Backfilling Around Structures

1. Backfilling around structures shall consist of common earth backfill placed in 6-inch layers and compacted by tamping to a minimum of 90 percent of the maximum density determined as specified herein for the full depth of the excavation from the bottom to the finished grade. No backfill shall be placed against concrete structures until the concrete has reached its specified 28-day compressive strength. Where practical, compaction of structural backfill shall be accomplished by power-driven tamping equipment.
2. Where crushed rock mats under slabs and foundations are called for on the Drawings, the Contractor shall excavate below grade to the depth of the crushed rock mat as shown on the Drawings and shall install a compacted crushed rock bed. This shall be finished to a true line or plane and even with

the subgrade of the concrete foundations, piers, footings, or slabs. Before placing any crushed rock, all loose earth or debris shall be removed. This crushed rock mat shall extend 12 inches beyond all slabs and foundations or to edges of sheet piling.

3. Crushed rock mats, 12 inches or less in thickness, shall be constructed of compacted layers of crushed rock conforming to Section 903.05, Class A, Grade D, of the Tennessee Department of Highways, Standard Specifications for Road and Bridge Construction.
4. Crushed rock mats of thickness greater than 12 inches shall have the top 12 inches constructed of compacted layers of crushed rock as specified above. That portion below the top 12 inches shall be constructed of compacted layers of crushed rock conforming to Section 903.05, Class A, with a modified gradation of 6 inches to dust as received from the crusher.
5. Unless otherwise shown on the Drawings, the use of earth backfill to support footings, foundations, and structures shall not be permitted.

2.06 FILLS AND EMBANKMENTS

- A. Fills and embankments shall consist of all earth fills except backfills in trenches or around structures. Unless special material is specified or shown on the Drawings, material for fills and embankments shall consist of excavated material from structures or of a mixture of such excavated materials and materials borrowed from other sources by the Contractor. All material used for fills and embankments shall be free from wood, vegetable matter, debris, soft or spongy earth or clay, large rock, or other objectionable material and shall be acceptable to the Engineer.
- B. Materials shall be placed in the fill or embankment in successive layers 6 inches or less in thickness before compaction, each layer being approximately horizontal and extending to the full limit of the required cross section and shall be compacted at optimum water content over the entire surface to not less than 95 percent of the maximum density as determined by AASHTO T-99, Method A. The process shall be repeated for each layer of material until the fill or embankment conforms to the plan lines, grades, and cross sections.
- C. The area over which the fill or embankment is to be constructed shall first be cleared of all vegetation, debris, and other objectionable material and, if the ground is in a loose, uncompacted condition, it shall be compacted to a minimum 95 percent of maximum density determined as specified herein.

- D. No material shall be placed beyond the sloping lines of embankment unless so ordered by the Engineer. Material allowed to be placed beyond the lines of embankment shown on the Drawings will be compacted as required above unless otherwise authorized by the Engineer.
- E. Material for embankments or roadway fills shall be placed in 6-inch maximum lifts and shall be compacted by rolling with power rollers weighing not less than 10 tons, with sheepfoot rollers, with vibrating rollers, or with pneumatic tire rollers, as required to accomplish the work. While and as each layer is deposited, water shall be applied in sufficient amount to ensure optimum moisture to secure the compaction specified.
- F. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make the use of the compaction afforded thereby as an addition to compaction by the use of rollers.
- G. Wherever a pipe is to pass through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 12 inches above the top elevation of the pipe before the trench is excavated.
- H. On subgrades for all roadbeds, the density for the top 6 inches of the finished subgrade shall be equal to not less than 100 percent of the maximum density as determined by AASHTO T-99, Method A. When field tests show failure to meet the density requirement, the subgrade shall be loosened by disking, harrowing or other approved methods to a depth of not less than 6 inches, then reshaped and recompacted as indicated in this paragraph.

2.07 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. All materials removed by excavation, which are suitable for the purpose, shall be used to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes shall be considered as waste materials and the disposal thereof shall be made by the Contractor. All on-site disposal of waste materials shall be made in a manner and at locations approved by the Engineer.
- B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands.

- C. Unsuitable materials, consisting of wood, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material so designated by the Engineer shall be removed from the work site and disposed of by the Contractor. Burning of brush shall be permitted on site only at the approval of the Engineer. Contractor shall obtain the necessary burning permit from the Air Pollution Control Bureau for the burning site and shall provide a copy of the permit showing date of expiration to the Engineer at least five days before any burning is to take place. Contractor shall comply with all regulations of the applicable burning permit.
- D. No unsuitable or waste material shall be dumped on private property unless written permission is furnished by the owner of the property and unless a dumping permit is issued from the local jurisdiction.

2.08 FINAL GRADING

- A. After other earthwork operations have been completed, the sites of all structures, roads, and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in smooth and uniform planes such as are normally obtainable from the use of hand tools. If the Contractor is able to obtain the required degree of evenness by means of mechanical equipment he will not be required to use hand labor methods. Slopes and ditches shall be neatly trimmed and finished to slopes shown on the Drawings.
- B. Unless otherwise specified or shown on the Drawings, all finished ground surfaces shall be graded and dressed to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions.

END OF SECTION 02220

SECTION 02270
SLOPE PROTECTION AND EROSION CONTROL

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall provide temporary control measures as shown in the plans or as necessary during the life of the Contract to control erosion and water pollution, through the use of berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.
- B. The temporary pollution control provisions contained herein shall be coordinated with any permanent erosion control features, to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

PART 2 - PRODUCTS

2.01 TEMPORARY BERMS

- A. A temporary berm is constructed of compacted soil, with or without a shallow ditch, at the top of fill slopes or transverse to centerline on fills.
- B. These berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

2.02 TEMPORARY SLOPE DRAINS

A temporary slope drain is a facility consisting of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, sod or other material that may be used to carry water down slopes to reduce erosion.

2.03 SEDIMENT STRUCTURES

Sediment basins, ponds, and traps are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the construction areas from excessive siltation.

2.04 CHECK DAMS

- A. Check dams shall be flowable fill and located approximately every 500 feet. Refer to standard detail SD-GEN-2.

2.05 TEMPORARY SEEDING AND MULCHING

Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion.

2.06 BRUSH BARRIERS

- A. Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operation.
- B. Brush barriers are placed on natural ground at the bottom of fill slopes, where the most likely erodible areas are located to restrain sedimentation particles.

2.07 BALED HAY OR STRAW CHECKS

- A. Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing five (5) cubic feet or more of material.
- B. Baled hay or straw checks shall be used where the existing ground slopes toward or away from the embankment along the toe of slopes, in ditches, or other areas where siltation erosion or water run-off is a problem.

2.08 TEMPORARY SILT FENCES

Silt fences are temporary measures utilizing filter fabric and woven wire fence or other approved material. Filter cloth, composed of burlap, plastic filter fabric, etc., is attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

PART 3 - EXECUTION

3.01 PROJECT REVIEW

Prior to the pre-construction conference the Contractor shall meet with the Engineer and go over in detail the expected problem areas in regard to the erosion control work. Different solutions should be discussed so that the best method might be determined. It is the basic responsibility of the Contractor to develop an erosion control plan and to prevent erosion damage to the project or to adjacent property. Any damage is the responsibility of the Contractor.

3.02 PRE-CONSTRUCTION CONFERENCE

At the pre-construction conference the Contractor shall submit for acceptance his schedule for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, bridges and other structures at watercourses, construction, and paving. He shall also submit for acceptance his proposed method of erosion control on haul roads and borrow pits and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Engineer. Acceptance by the Engineer does not relieve Contractor of responsibility for any erosion damage that may occur.

3.03 CONSTRUCTION REQUIREMENTS

- A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other water impoundment. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds.
- B. The Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in his accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion

control features can follow immediately thereafter if the project conditions permit, otherwise erosion control measures may be required between successive construction stages.

- D. The Engineer will limit the area of excavation, borrow, and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

- E. Under no condition shall the amount of surface area or erodible earth material exposed at one time be excavation or fill within the project area exceed 750,000 square feet without prior approval by the Engineer.
- F. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions.
- G. In the event of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State, or Local agencies, the more restrictive laws, rules, or regulations shall apply.

3.04 CONSTRUCTION OF STRUCTURES

A. Temporary Berms

A temporary berm shall be constructed of compacted soil, with a minimum width of 24 inches at the top and a minimum height of 12 inches with or without a shallow ditch, constructed at the top of fill slopes or transverse to centerline on fills. Temporary berms shall be graded so as to drain to a compacted outlet at a slope drain. The area adjacent to the temporary berm in the vicinity of the slope drain must be properly graded to enable this inlet to function efficiently and with minimum ponding in this area. All transverse berms required on the downstream side of a slope drain shall extend across the grade to the highest point at approximately a 10-degree angle with a perpendicular to centerline. The top width of these berms may be wider and the side slope flatter on transverse berms to allow equipment to pass over these berms with minimal disruptions. When practical and until final roadway elevations are approached, embankments should be constructed with a gradual slope to one side of the embankment to permit the placement of temporary berms and slope drains on only one side of the embankment.

B. Temporary Slope Drains

1. Temporary slope drains shall consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water, accumulating in the cuts and on the fills, down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.
2. Fiber matting and plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.
3. All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain. Energy dissipaters, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipater would be dumped rock or a small sediment basin which would slow the water as well as pick up some sediment. All temporary slope drains shall be removed when no longer necessary and the site restored to match the surroundings.

C. Sediment Structures

1. Sediment structures shall be utilized to control sediment at the foot of embankments where slope drains exit, at the bottom as well as in the ditchlines atop waste sites, and in the ditchlines or borrow pits. Sediment structure may be used in most drainage situations to prevent excessive siltation of pipe structures. All sediment structures shall be at least twice as long as they are wide.
2. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed, and all excavation backfilled and properly compacted. The existing ground shall be restored to its natural or intended condition.

D. Check Dams

1. Check dams shall be utilized to retard stream flow and catch small sediment loads. Materials utilized to construct check dams shall be flowable fill. Refer to standard detail SD-GEN-2.

E. Temporary Seeding and Mulching

Seeding and mulching shall be performed in accordance with section 02933, "Seeding."

F. Brush Barriers

Brush barriers shall consist of brush, tree trimmings, shrubs, plants and other approved refuse from the clearing and grubbing operation. The brush barriers shall be constructed approximately parallel to original ground contour. The brush barrier shall be compressed to an approximate height of 3 to 5 feet and approximate width of 5 to 10 feet. The embankment shall not be supported by the construction of brush barriers.

G. Baled Hay or Straw Erosion Checks

Hay or straw erosion checks shall be embedded in the ground 4 to 6 inches to prevent water flowing under them. The bales shall also be anchored securely to the ground by wooden stakes driven through the bales into the ground. Bales shall be removed after they have served their purpose and the area is stabilized. The Contractor shall keep the checks in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris clean-out will be considered routine maintenance.

H. Temporary Silt Fences

1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem. Silt fences are constructed of wire mesh fence with a covering of burlap or some other suitable material on the upper side of the fence and anchored into the soil.
2. The Contractor shall be required to maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by the Engineer. The silt accumulation at the fence shall be leveled and seeded upon removal of the fence. The silt fence becomes the property of the Contractor whenever the fence is removed.

3.05 MAINTENANCE

- A. The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Contractor.
- B. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled such work shall be performed by the Contractor at his own expense.
- C. Where the work to be performed is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls and falls within the Specifications for a work item that has a contract price, the units of work shall be paid for at the proper contract prices.

3.06 EROSION CONTROL OUTSIDE PROJECT AREA

Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads and equipment storage sites. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed.

END OF SECTION 02270

SECTION 02500
PAVING AND SURFACING

PART 1 - GENERAL

1.01 SCOPE

- A. The work specified by this section shall consist of repairing or replacing all damaged pavement, whether public or private. Dirt shoulders, roads, streets, drives, curbs, and walks are to be restored to their original condition as an incidental part of the installation of utilities. Repair damaged base on either side of a trench wherever necessary. Trim the oxidation surface to neat lines outside of the trench wall, and repave the entire area as specified below and as shown on the project drawings or on the WWTA's standard drawings.

1.02 STANDARD

- A. Both these specifications and the drawings make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT). Even though the weather limitations, construction methods, and materials specifications contained in the TDOT specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.
- B. All existing pavement in streets, driveways, or parking areas which is removed, destroyed, or damaged by construction of sewage or water works shall be replaced as specified below, and as shown on the Drawings. Unless otherwise shown or specified, all paved surfaces shall be replaced using the applicable pavement replacement detail.
- C. Where sewage or water lines and appurtenances are constructed in or across unpaved, chert, or crushed stone surfaced streets, roadways, driveways or parking areas, the surface removed or damaged shall be repaired or replaced with a minimum of 6 inches of crushed stone in accordance with TDOT specifications.
- D. Temporary paving shall consist of a single application of bituminous surface treatment. The bituminous surface treatment shall conform to TDOT specifications except the second application of bituminous material and mineral aggregate shall be eliminated.

PART 2 - PRODUCTS

All references to TDOT specs shall refer to "Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction", 1981 or latest edition.

- 2.01 Mineral Aggregate Base: Class A, Grading D crushed stone (TDOT specs, Section 303, Subsection 903.05)
- 2.02 Bituminous Prime Coats: cutback asphalt, Grade RD-250, or emulsified asphalt, Grade AE-P (TDOT specs, Section 402, Subsections 904.02 and 904.03)
- 2.03 Crushed Stone Chips: Size 6 or Size 7 (TDOT specs, Subsection 903.14)
- 2.04 Double Bituminous Surface: for both courses, either cutback asphalt, Grade RC-800 or RC-3000, or emulsified asphalt, Grade RS-2 (TDOT specs, Subsections 904.02 and 904.03)
- 2.05 Asphaltic Concrete Binder: Grading B or C, as directed by the ENGINEER (TDOT specs, Section 307)
- 2.06 Bituminous Tack Coat: Grade AE-3 (TDOT specs, Section 403, Subsection 904.03)
- 2.07 Asphaltic Concrete Surface: Grading E (TDOT specs, Section 411)
- 2.08 Quick Dry Traffic Marking Paint (White and Yellow): (TDOT specs, Subsection 910.05)
- 2.09 Concrete: Class A (TDOT specs, Sections 604 and 703)

PART 3 - EXECUTION

3.01 REPLACING PAVEMENT

- A. The existing street pavement or surface shall be removed along the line of the work for the allowable width specified on the standard drawings for the trench or structure. All edges of the existing pavement shall be cut to a straight, vertical

edge and care shall be used to get a smooth joint between the old and new pavement and to produce an even surface on the completed street.

B. Trench backfill along streets shall be covered with a temporary paving as specified above. This temporary paving shall be applied level with the existing paved surface. Prior to the application of the temporary paving the crushed stone backfill shall be maintained carefully at grade and dust free. Additionally, immediately prior to application of permanent paving, Contractor shall again compact the top of all trench backfill in the streets with a hydrotamper and add sufficient crushed stone to bring surface back to bottom of permanent paving as shown on Drawings.

C. Where pavement is specified for trench width only, any additional pavement or street surface removed or damaged beyond the limits shown on the Drawings shall be replaced or repaired by the Contractor at the Contractor's expense.

D. Where pavement is for the complete width of the street, the following procedures shall be used:

1. After the crushed stone backfill and temporary surface have settled thoroughly, the entire width of the street to be paved shall be cleaned of loose materials as specified in Section 407, "Bituminous Plant Mix Pavements", Tennessee Department of Transportation, Standard Specifications for Road and Bridge Construction, latest edition. All areas which have settled shall be filled and leveled as described above in Paragraph B. Manholes shall be raised to match finished grade using tapered adjustment rings. Before paving, a tack coat shall be applied to the full width of the street, as specified in Section 403 "Tack Coat", TDOT, Standard Specifications for Road and Bridge Construction, latest edition.
2. During the time that the full width of the street is being paved, the Contractor shall extend the paving from the street into existing paved driveways in order to provide a smooth transition from the street to the existing driveway grade. This work shall be completed with no separate payment being allowed.

E. Wherever sewer or water lines are constructed in state highway right-of-ways, the Contractor shall comply with all requirements and provisions of the Tennessee Department of Transportation. All such work shall be subject to inspection and approval by the TDOT.

F. Contractor shall remove all surplus excavation materials and debris from the street surfaces and right-of-way and shall restore street, roadway or sidewalk surfacing

to its original condition. This work shall be considered as cleanup and no separate payment will be made for this item.

3.02 NEW PAVEMENTS

- A. Access roads, parking areas, and other roadways shall be surfaced as shown on the Contract Drawings. The material shall be placed sufficiently thick to produce, after compaction, a uniform surface with a minimum thickness as shown on the Drawings and shall be shaped to the required line and grade. Materials, equipment and construction methods used for paving work shall conform to the Specifications for the particular surface required.
- B. The completed crushed stone road base shall be maintained by the Contractor in a smooth, first-class condition to required line, grade and cross section until the entire surface area has become stabilized and compacted. Roadway materials shall not be placed on soft, wet or frozen subgrade.

3.03 SUBGRADE

- A. Before any base material is installed, compact the subgrade of the area to be paved to 95% of optimum density as determined by ASTM D698 (Standard Proctor).
- B. The backfill material shall be thoroughly compacted crushed stone from the top of bedding to finished grade unless otherwise specified on the Drawings. For all areas where subgrade has been prepared, test for uniformity of support by driving a loaded dump truck at a speed of 2 to 3 mph over the entire surface. Make further improvements on all areas that show a deflection of 1" or more. When completed, the finished subgrade shall be hard, smooth, stable, and constructed in reasonably close conformance with the lines and grades that existed prior to beginning construction.
- C. For tennis courts, the finished surface of the leveling course shall not vary from the specified grade more than one-fourth inch (1/4") in ten feet (10') when measured in any direction. the finished surface of the surface course shall not vary from the specified grade more than one-eighth inch (1/8") in ten feet (10') when measured in any direction.

3.04 BASE

- A. Install a mineral aggregate base of the type specified above in accordance with layer shall be 6", and the total thickness of the base shall be that indicated by the standard drawings or as shown on the plans.

B. When a base course is compacted, cut back the surface course of the existing pavement a minimum of 12" beyond the limit of the joint between the old and new base course or as shown on the standard drawings. Take special care to ensure good compaction of the new base course at the joint. Apply and compact the surface to conform to the existing pavement so that it will have no surface irregularity.

3.05 CHIP SEAL SURFACE

Uniformly apply a bituminous prime coat of either emulsified asphalt, Grade AE-P, Grade RC-250, over the entire width of the area to be surfaced at a rate of 0.3 gallon per square yard. Immediately after application, uniformly cover the entire area with Size 7 crushed stone chips at a rate of 12 pounds per square yard.

3.06 DOUBLE BITUMINOUS SURFACE

A. Apply the first course at a rate of 0.38 to 0.42 gallon per square yard with either emulsified asphalt, Grade RS-2, Grade RC-800 or RC-3000, and then immediately cover with Size 6 crushed stone chips at a rate of 33 to 37 pounds per square yard. After this is rolled, apply the second course at a rate of 0.30 to 0.35 gallon per square yard, and at once uniformly cover them with Size 7 chips at a rate of 20 to 25 pounds per square yard. Then roll the entire area.

B. After the application of the cover aggregate, lightly broom or otherwise maintain the surface for a period of 4 days. Maintenance of the surface shall include the distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. Sweep excess material from the entire surface.

3.07 ASPHALTIC CONCRETE BINDER

A. Apply a bituminous prime coat of emulsified asphalt, Grade AE-P, Grade RC-250, at a rate of 0.38 to 0.42 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc.; if such plashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.

B. Carefully place the material to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.

3.08 ASPHALTIC CONCRETE SURFACE

If the asphaltic concrete surface course is to be placed directly on the mineral aggregate base, place a bituminous prime coat as described above. If, however, the surface course is to be placed on a binder course, then apply a bituminous tack coat of the sort specified above under PRODUCTS at a rate of 0.05 to 0.10 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately after the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.

3.09 SMOOTHNESS

The finished surfaces shall conform to the lines and grades that existed prior to construction. No deviations, variations, or irregularities exceeding 1/4" in any direction when tested with a 12' straightedge will be permitted in the finished work, nor will any depressions that will not drain. Correct all such defects.

3.10 SAMPLING AND TESTING

- A. Submit to the Engineer test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, and asphaltic concrete design mixes, and obtain his/her approval of these reports before starting paving operations.
- B. Tests shall be made by Owner on the completed elements of the pavement to ascertain the compacted thickness of the base and surface courses. If sections with deficient thicknesses are found, the full section for a reasonable distance on each side of the deficiency shall be refused. All such sections shall be removed and reinstalled at the Contractor's expense. Patch all test holes in connection with thickness tests.

PART 4 - MAINTENANCE

- A. The Contractor shall maintain the surfaces or roadways built and pavements replaced until the acceptance of the project. Maintenance shall include such dragging, reshaping, refilling, wetting, rerolling, and reapplication of the single penetration surface as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces and repair of damaged or unsatisfactory surfaces to the satisfaction of the Engineer. Maintenance shall also include sprinkling as may be necessary to abate dust.

PART 5 - SIDEWALK AND CURBS

5.01 SIDEWALK REPLACEMENT

A. Materials

1. All concrete sidewalks shall be built and/or replaced with Class "A" concrete which shall conform with requirements of section 03300, "Cast-in-Place Concrete" of these Specifications.
2. Preformed joints shall be 1/2-inch thick conforming to the latest edition of AASHTO Standard Specifications, M59, for preformed bituminous fiber joints.
3. Concrete forms shall be of wood or metal, shall be straight and free from warp, and shall be of sufficient strength when in place to hold the concrete true to line and grade without springing or distortion.

B. When a section of sidewalk is removed the existing sidewalk shall be cut to a neat line perpendicular to both the centerline and the surface of the concrete slab. Existing concrete shall be cut along the nearest existing contraction joints unless such joints do not exist in which case the cut shall be made a minimum distances shown on the Drawings.

C. Existing concrete sidewalks that have been cut and removed for construction purposes shall be replaced with sidewalks of the same width and surface as the portion removed and shall have a minimum uniform thickness of 4 inches. The new work shall be neatly joined to the old concrete so that the surface of the new work shall form an even unbroken plane with the old sidewalk.

D. The subgrade for concrete sidewalks shall be formed by excavating to a depth equal to the thickness of the concrete plus 2 inches. Subgrade shall be of such width as to permit the proper installation and bracing of the forms. Subgrade shall be compacted by hand tamping, or rolling. Soft, yielding, or unstable material shall be removed and backfilled with satisfactory material. Two inches of porous compacted crushed stone base shall be placed and shall be compacted thoroughly and finished to a smooth, unyielding surface at proper line, grade, and cross section.

E. Expansion joints shall be required to replace any existing expansion joints that are removed with the sidewalk or in new construction wherever shown on the Drawings. Expansion joints shall be true, even, shall present a satisfactory

appearance, and shall extend to within 1/2 inch of the top of finished concrete surface.

F. Concrete shall be suitably protected from freezing and excessive heat. It shall be kept covered with burlap or other suitable material and kept wet until cured.

G. If existing concrete that is removed contains reinforcing steel, replace with new steel of same diameter and of equal or better quality.

5.02 CURB REPLACEMENT

A. All existing curbs which are removed, damaged, or destroyed during construction of sewage or water works shall be replaced in accordance with the following:

1. Asphaltic concrete curbs shall be constructed with the same dimensions as the existing curb using asphaltic concrete pavement Grading E, conforming to the paragraph entitled "Asphaltic Concrete Surface".
2. Prior to constructing curbs on pavement, the pavement shall be dry and cleaned of loose material and a tack coat of RS-2 asphalt shall be applied to the curb area of the pavement at the rate of 0.08 to 0.20 gallons per 15 linear feet of curb area.
3. Portland cement concrete curbs shall be constructed with the same dimensions as the existing curb using Class A concrete in accordance with the Section 604, "Concrete Structures" and with Section 702, "Cement Concrete Curb", Tennessee Department of Transportation, Standard Specifications for Road and Bridge Construction, latest edition.

END OF SECTION 02500

SECTION 02546

STEP PUMPING ASSEMBLIES

PART 1 – GENERAL

1.01 SCOPE

- A.** The work covered by this section shall include furnishing all labor, equipment and materials required for the construction and installation of STEP pumping assemblies, complete, including pump vault, screen, controls, electric services, testing and other appurtenances as described herein.

1.02 QUALITY ASSURANCE

- A.** The work and materials of this section shall be furnished, coordinated, and guaranteed by one supplier who shall be experienced in the design, manufacture, coordination installation, and servicing of the equipment specified herein. The supplier of the STEP pumping assembly shall have a permanent organization of office and field technical personnel and facilities necessary for fulfilling all requirements of this specification. The supplier shall be an authorized representative of the STEP pumping assembly components and be capable of providing fully knowledgeable, experienced service personnel and replacement parts no later than 72 hours after requested.

1.03 SHOP DRAWINGS AND ENGINEERING DATA

- A.** Complete shop drawings and engineering data shall be submitted to the WWTA in accordance with the requirements of Section 01300, “Submittals”, of these Specifications.
- B.** The Contractor shall submit to the WWTA copies of the manufacturer’s written installation instructions and operation and maintenance information for all major equipment comprising the STEP pumping assemblies, including but not limited to, pumps, controls, filters and pump vaults.
- C.** The Contractor shall submit to the Engineer, manufacturer’s manuals for all major equipment.

1.04 STORAGE AND PROTECTION

- A. Pump, controls, filter, vault and appurtenances shall be stored and protected in accordance with the requirements of Section 01615, "Storage and Protection", of these Specifications.

1.05 GUARANTEE

- A. The Contractor shall provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, "Guarantees and Warranties", of these Specifications.
- B. The Contractor shall provide to the Engineer proof of five (5) year warranty extension on the effluent pumps.

PART 2 – PRODUCTS

2.01 GENERAL

- A. The pump and motor shall have the manufacturers name, model number, serial number and any other pertinent information engraved or embossed on a nameplate securely affixed to the pump in a conspicuous place. The name plate shall be of a corrosion resistant material for the use intended with wastewater.
- B. All STEP pumping systems shall be as manufactured by Orenco Systems, Inc. or approved equal.
- C. Tank shall be made completely waterproof, including any inlets or outlets. Concrete vaults shall be constructed and installed in accordance with WWTA's Manhole specifications (Section 02605).
- D. Tanks shall be a minimum of 1,500 gallons in size.

2.02 PUMPS

- A. STEP pumps shall be of the turbine type manufactured for wastewater applications.
- B. Pumps shall be of all stainless steel construction and UL listed for use with septic tank effluent.

C. The design engineer must specify the pump size for each connection from 0.5 hp to 2 hp. Pumps shall be an Orenco Systems, Inc. or approved equal.

D. Pumps shall have a 1/8-inch bypass orifice in the discharge head and a built-in bronze check valve.

2.03 SCREENED PUMP VAULT

A. The screened pump vault assembly shall be a Biotube screened pump vault as manufactured by Orenco Systems, Inc. or approved equal.

B. The pump vault shall consist of a 12-inch diameter by 48-inch deep PVC vault with eight (8) 1 1/8-inch diameter holes evenly spaced around the perimeter, located at approximately 70% of minimum liquid level to allow for maximum sludge and scum accumulation before requiring pumping. The pump vault shall also have a drain port with flap check.

C. Housed inside the PVC vault shall be the Biotube assembly and a 4-inch diameter flow inducer to accept the high-head effluent pump. The Biotube shall consist of polypropylene mesh Biotubes having a minimum effective screen area of 22.5 square feet. The flow inducer shall be epoxied and riveted to the sidewall of the vault. The whole assembly shall have an encapsulated base with flow thru port at the bottom of the filter cartridge for screened effluent to have access to the effluent pumps and corresponding external flow inducer.

2.04 DISCHARGE HOSE AND VALVE ASEMBLY

A. The discharge hose and valve assembly shall consist of a PVC ball valve, PVC flex hose, Schedule 40 PVC pipe and a 12-inch long PVC flex hose with fittings to be installed outside the riser. The discharge hose and valve assembly shall have a minimum working pressure rating of 150 psi and shall be as manufactured by Orenco Systems, Inc. or approved equal.

B. When pumping downhill, an antisiphon assembly and 6 GPM flow controller shall be used. The antisiphon assembly and flow controller shall be manufactured by Orenco Systems, Inc. or approved equal.

2.05 FLOAT SWITCH ASSEMBLY

A. The pumps shall be controlled by a mechanical weighted switch float assembly as manufactured by Orenco Systems, Inc. or approved equal. The float assembly shall consist of three (3) mechanical weighted switch floats mounted on a fixed

PVC stem attached to the screened pump vault. Float fasteners shall be PVC or stainless steel. The floats shall be adjustable without removing the screened pump vault, have high/low alarms on/off functions, and be UL listed.

2.06 ELECTRICAL SPLICE BOX

- A. The electrical splice box shall be as manufactured by Orenco Systems, Inc. or approved equal. The splice box shall provide easy access for inspection and servicing and be of corrosion resistant materials. The electrical splice box shall be UL approved for wet locations, equipped with four (4) electrical cord grips and a $\frac{3}{4}$ -inch outlet fitting, and include UL listed butt splice connectors.

2.07 CONTROLS AND ALARMS

- A. Control panels and alarms shall be a Model S series with a redundant off/disconnect assembly as manufactured by Orenco Systems, Inc. or approved equal.
- B. Control panels shall be UL listed and furnished to meet the following criteria:
 - 1) Rating: 1HP/115V, 2HP/230V, single phase, 60 Hz.
 - 2) Motor Start Contactor: rated for 24 FLA (full load amps), single phase, 60 Hz.
 - 3) Audible Alarm: Panel mount with a minimum 80db. Sound pressure at 24 inches as a continuous warble tone.
 - 4) Visual Alarm: NEMA 4, 7/8-inch diameter, red lens, oil-tight, with push-to-silence feature.
 - 5) Audio-alarm Reset Relay: 115V, automatic reset, with DIN rail mount socket base.
 - 6) Toggle Switch: 20 amp motor rated, single-pole, double-throw with three positions: Manual (MAN), (OFF) and Automatic (AUTO).
 - 7) Fuse Disconnect: DIN rail mount socket base with 5 amp, 10,000 AIC fuse.
 - 8) Current-Limiting Circuit Breaker: Rated for 20 amps, OFF/ON switch, DIN rail mount with thermal magnetic tripping characteristics.
 - 9) Enclosure: NEMA 4X, fiberglass with stainless steel screws and padlockable latch, 10" high x 8" wide x 5 1/8" deep.
 - 10) Alarm Circuit: Wired separately from the pump circuit so that, if the pump internal overload switch or current-limiting circuit breaker is tripped, the alarm system remains functional.
 - 11) Elapsed Time Meter: 115 VAC, 7-digit, nonresettable.

- 12) Power disconnect assembly toggle switch; 20 amp power disconnect assembly toggle switch to de-energize entire control panel, to permit servicing panel without access to the breaker switches.
- 13) Pump Run Light.
- 14) Redundant-off relay: 115V, automatic, single pole.
- 15) All wiring systems shall be installed in accordance with the National Electrical Code (NEC) and the manufacturer's specifications.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All pumping systems shall be installed in accordance with the manufacturer's recommendations.
- B. WWTA shall approve the location of tank installations. Tanks shall be installed no more than 50' off the roadway.
- C. The pump control panel shall be mounted on the side of the building nearest to the tank and shall be accessible to the WWTA. NEC requires that the control panel be located within 50 feet of and within sight of the pump. The control panel shall be mounted between four and five feet to the center of the control panel above finished grade. All variances to this location requires approval by the WWTA. All STEP systems serving single family residences shall be wired to a dedicated 30 amp breaker which supplies power to the STEP system control box only. This is required to avoid damage or overload to system. Power to the STEP control box shall be provided to and maintained by the Owner of the building that the system serves.
- D. Underground wiring shall be installed a minimum of 8 inches deep in schedule 40 conduit with warning tape located above the conduit or as required by applicable regulatory standards.
- E. All buried power shall be installed with warning tape installed 6 inches above the buried power. The warning tape shall be plastic non-biodegradable marked "Power".
- F. Wiring from the pump control panel to the splice box in the pump tank riser shall be a minimum #14 stranded wire and colored insulation matching the manufacturers diagram. Connections in the riser junction box shall be installed as per the manufacturer's specification. A good quality heat shrink shall be used on all leads except that the "common" connection may be an approved wire nut.

Splices shall be capable of lifting out of the junction box a minimum of six inches.

- G. Positions on the PVC 3 float assembly are to be set at the following levels. High tank level alarm is to be set 9 inches below underside of tank top, "on" at 3-1/2 inches below high tank alarm "off" (in same float as "on") at 3-1/2 inches below "on", and redundant off with low /level alarm set 4 inches below "off".
- H. Excess float and power cables shall be tied with ABS ties or other approved corrosion resistant material to keep the cables from interfering with the float switches.
- I. Fiberglass control panel enclosure padlock will be installed by the WWTA at time of acceptance of the completed installation and shall signify final acceptance.
- J. All electrical work shall conform to the State and local electric codes.
- K. All electrical inspections and tests shall be completed and passed before acceptance of the STEP system.

END OF SECTION 02546

SECTION 02605

MANHOLES

PART 1 - GENERAL

1.01 SCOPE

The work covered by this Section relates to the furnishing of all labor, equipment, and materials required to install cast-in-place and/or precast concrete manholes and concrete junction chambers for use in sanitary sewers as described herein and/or shown on the Drawings.

1.02 DESIGN CRITERIA

- A. Manholes shall be constructed of specified materials to the sizes, shapes, and dimensions and at the locations shown on the Drawings. The height or depth of the manhole will vary with the location, but shall be such that the top of the manhole frame will be at the finished grade of the pavement or ground surface and the invert will be at the designated elevation, unless indicated on the Drawings.
- B. Where the difference in the invert elevation of a sewer 18 inches in diameter or smaller and any other sewer intersecting in one manhole is 2 feet or more, a drop manhole shall be constructed as shown on the Drawings. They shall be similar in construction to the standard manhole except that a drop connection of pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by Class B concrete.
- C. Drop manholes must be approved by WWTA. Refer to standard detail SD-MH-6.

1.03 QUALITY ASSURANCE

- A. Prior to delivery all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory or, if approved by the Engineer, certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. All materials which fail to conform to these Specifications shall be rejected.
- B. After delivery to the site, any materials which have been damaged in transit or are otherwise unsuitable for use in the work shall be rejected and removed from the site.

C. All materials must be inspected by an inspector designated by WWTA before being used for construction.

1.04 SHOP DRAWINGS AND ENGINEERING DATA

Complete shop drawings and engineering data on frames, covers, steps, and precast manhole sections shall be submitted to the Engineer in accordance with the requirements of section 01300, "Submittals" of these Specifications.

1.05 GUARANTEE

Provide a guarantee against defective materials and workmanship in accordance with the requirements of section 01740, "Guarantees and Warranties" of these Specifications.

PART 2 - PRODUCTS

2.01 CONCRETE AND REINFORCEMENT

- A. Concrete used in manhole and junction chambers shall be Class A concrete conforming to the requirements of section 03300, "Cast-In-Place Concrete" of these specifications.
- B. Steel reinforcement shall conform to the requirements of Section 03200, "Cast-In-Place Concrete Reinforcement" of these Specifications.

2.02 BRICK

Brick shall not be used in manhole construction.

2.03 MORTAR

- A. Mortar shall be sand-cement mortar composed of one part cement to two parts clean sand conforming to ASTM C144. Twenty pounds of hydrated lime per sack of cement may be added. No retempered mortar shall be used.
- B. Non-shrink mortar shall be premixed, Master Builders "Masterflow 713" Sonneborn "Ferrolith G-D.S. Redi-Mixed", or equal.

2.04 PRECAST CONCRETE MANHOLES

- A. Precast concrete manholes shall consist of precast reinforced concrete sections, a conical section, and a base section conforming with the typical manhole details as shown on the Drawings.
- B. Precast manhole sections shall be manufactured, tested and marked in accordance with the latest provisions of ASTM C478, and interior shall be smooth finished.
- C. The minimum compressive strength of the concrete for all sections shall be 4,000 psi.
- D. The maximum allowable absorption of the concrete shall not exceed 8 percent of the dry weight.
- E. The circumferential reinforcement in the riser sections, conical top sections, and base wall sections shall consist of one line of steel and shall not be less than 0.17 square inches per lineal foot.
- F. The ends of each reinforced concrete manhole riser section and the bottom end of all manhole top sections shall be so formed that when the manhole risers and the top are assembled, they will make a continuous and uniform manhole.
- G. Joints of the manhole sections shall be of the tongue and groove type as shown on the standard drawings. Sections shall be filled with two approved pre-formed plastic gaskets meeting the requirements of Federal Specifications SS-S-00210, "Sealing Compound, Pre-formed Plastic for Pipe Joints," Type 1, Rope Form, and coated outside with coal-tar epoxy or approved equal, and one strip of masking wrap. Inside joints shall not be grouted.
- H. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall penetrate no closer than 2-inches from inside surface. These holes shall be mortared.
- I. Flat-top slabs may only be used in special cases with prior approval from the Engineer. Slabs shall be designed for H-20 loading.

2.05 FRAMES AND COVERS

- A. Frames and covers shall be cast iron conforming to the minimum requirements of Federal Specifications WW-I-652 or to ASTM A48 for Class 30 Gray Iron Castings. All castings shall be made accurately to the required dimensions, fully interchangeable, sound, smooth, clean, and free from blisters and/or other defects. Defective castings which have been plugged or otherwise treated shall not be

used. All castings shall be thoroughly cleaned at the plant by shot blast and shipped with no paint or coating which could hide any defect. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.

- B. Manhole frames and covers shall be of the size and weight shown on standard detail SD-MH-5, or on construction plans.
- C. The contact surfaces of all manhole covers and the corresponding supporting rings in the frames shall be machined to provide full perimeter contact.
- D. All sanitary sewer manhole covers shall be standard manhole covers as shown on standard detail SD-MH-5.

2.06 PLASTIC GASKET FOR PRECAST MANHOLES

- A. Pre-formed plastic gasket shall meet or exceed all requirements of Federal Specification SS-S-00210, "Sealing Compound, Preformed Plastic for Pipe Joints," Type I, Rope Form. The sealing compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space between sections. The sealing compound shall be protected by a suitable removable 2 piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. It shall have a minimum width or diameter of 2 inches. The flexible plastic gasket shall also meet the requirements of the following table:

<u>Composition</u>	<u>Test Method</u>	<u>Minimum</u>	<u>Maximum</u>
Bitumen (Petroleum Plastic Content)	ASTM D4	50	70
Ash Inert Mineral Matter	AASHO T111	30	50
Volatile Matter	ASTM D6	--	2.0
<u>Property</u>	<u>Test Method</u>	<u>Minimum</u>	<u>Maximum</u>
Specific Gravity at 77° F	ASTM D71	1.20	1.30
Ductility at 77° F(cm)	ASTM D113	5.0	----
Softening Point	ASTM D36	320° F	----
Penetration 77° F(150gms) 5 sec.	ASTM D217	50	120

B. All contact surfaces of the manhole barrels shall be primed before application of the gasket and placing the barrel section.

C. Gaskets will be used between concrete grade ring and casting.

2.07 MANHOLE STEPS

Manhole steps shall be a 3/8-inch steel reinforced rod encapsulated in polypropylene plastic, and spaced a maximum of 16 inches, O.C. Steps should not be within range of top of manhole cone, so as not to protrude past vertical inside surface of manhole. Refer to standard detail SD-MH-7.

2.08 MANHOLE STUB OUTS

Any stub outs of manholes for future use must be approved by WWTA and be at least 10 feet in length.

2.09 PVC PIPE PENETRATION RUBBER BOOTS AND GASKETS

Approved Manufacturers:

1. Dukor Co., Kor-N-Seal
2. A-lok Corp., A-lok
3. Press Seal Gasket Corp., PS-10
4. Interface Corp., Lock joint flexible
5. or equal

2.10 COAL TAR EPOXY

Coal tar epoxy coating shall be two coats of "Hi-Build Tneme-Tar", Series 46, Koppers "Bitumastic 300-M", or approved equal.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF PRECAST CONCRETE MANHOLES

A. All manhole bases, including curved manhole bases, and inverts shall be constructed of Class A concrete in accordance with details on the Drawings and other applicable sections of this specification. The manhole base and invert shall be carefully formed to the required size and grade by gradual and even changes in sections, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations. Changes in direction of flow

through the sewer shall be made to a true curve as shown on the standard drawings.

- B. Manhole sections shall be set so that the manhole steps align vertically.
- C. A maximum of 1 concrete ring no more than 6 inches thick may be used to complete the precast manhole.
- D. All manholes bases, barrels, and cones shall have straight and even joined surfaces, without imperfections. Manholes shall be completely waterproof.
- E. A Kor-N-Seal Rubber Boot, or approved equal, with stainless steel bands shall be installed in the manholes.
- F. The openings through which pipe enter the structures shall be completely and firmly filled with non-shrink mortar or otherwise constructed to ensure watertightness.
- G. Manholes to be located no more than 400 feet apart.
- H. Manholes located in offsite easements shall have green fiberglass markers.

3.02 CONSTRUCTION OF PRECAST MANHOLE "TUBS"

- A. All fabrication work on the manhole tub shall be done by the manhole or pipe manufacturer at the plant. No field fabrication will be permitted without specific authorization of the Engineer.
- B. Base and first barrel section shall be monolithic cast. Inlet and outlet openings shall be precast or core drilled at the plant by the manufacturer.
- C. Kor-N-Seal Rubber Boots for PVC pipe, or approved equal as specified above, with stainless steel or approved plastic bands shall be installed in the manhole tub by the manhole manufacturer.
- D. The openings through which pipe enter the structures shall be completely and firmly filled with non-shrink mortar.

3.03 MANHOLE FINISHING

- A. Fill outside of lifting holes with non-shrink mortar to form a neat, smooth finish. Manholes shall be completely waterproof.

- B. Coat exterior of manhole seams with coal tar epoxy or equal and seal with one strip of masking wrap over trimmed gasket as specified. When directed by the Engineer, the entire exterior of manhole shall be coated with coal tar epoxy.
- C. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown, and grade of the existing adjacent pavement and a concrete apron shall be poured around the casting.
- D. After backfilling has been completed, the excavated area, if located in a street, alley, or sidewalk, shall be provided with a temporary surface. If the manhole is located out of roadway the casting must be bolted to the cone.

3.04 INVERTS AND FLOW CHANNELS

- A. Inverts and flow channels shall be built out of Class A concrete and shall be formed during or immediately after the placing of the concrete and brush finished as soon as the concrete has sufficiently set.
- B. Inverts shall be smooth and accurately shaped and have the same cross section as the invert of the sewers which they connect. Changes in direction of flow through the sewer shall be made to a true curve as shown on the Standard Drawings.

3.05 INSPECTION AND TESTING

- A. Manholes shall be water-proofed and vacuum tested in conformance with the following procedures:
 1. Manholes are required to be vacuum tested after the completion of the project prior to acceptance. No standing water shall be allowed in the manhole during testing.
 2. All pipes entering the manhole shall be plugged with the use of inflatable test plugs that are appropriately sized for the size of pipe being plugged. The plugs shall be securely braced from being drawn into the manhole.
 3. Installation and operation of the vacuum equipment and indicating devices shall be in accordance with equipment specifications and instructions provided by the manufacturer.

4. The vacuum test head shall be placed at the inside of the top of the cone section and the compression band shall be inflated in accordance with the manufacturer's recommendations to effect a seal between the vacuum base and the structure.
5. A vacuum of 10 inches of mercury shall be drawn and then the valves closed. The test shall pass for 4-foot Diameter Manholes if the vacuum remains at 10 inches of mercury or drops to 9 inches of mercury when the time meets or exceeds the following:

MANHOLE DEPTH	DIAMETER	DROP 1-inch HG
4 ft. to 10 ft.	4 feet	75 seconds
10 ft. to 15 ft.	4 feet	90 seconds
15 ft. to 25 ft.	4 feet	105 seconds

6. For manholes 5 feet in diameter, add an additional 15 seconds and for manholes 6 feet in diameter, add an additional 30 seconds to the time requirements for 4 foot diameter manholes.
7. If the manhole fails the initial test, the Contractor shall locate any leaks and shall make proper repairs. Retesting shall proceed until a satisfactory test is obtained.
8. If the manhole joint mastic or gasket is displaced during the vacuum test, the manhole shall be disassembled and the seal replaced.

- B. Existing manholes shall be vacuum tested prior to making any connection and again upon completion of connection to assess any damage due to construction.
- C. The cost and expense of all testing for watertightness and of providing a watertight structure shall be borne by the Contractor.

END OF SECTION 02605

SECTION 02731
POLYVINYL CHLORIDE (PVC) GRAVITY SEWER AND SERVICE PIPE

PART 1 - GENERAL

1.01 SCOPE

The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) pipe, including accessories, as shown on the Drawings and/or specified herein.

1.02 QUALITY ASSURANCE

- A. The Contractor, at the Engineer's request, shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is fully competent and capable of manufacturing PVC sewer pipe, fittings, and accessories of uniform texture and strength that will fully comply with these Specifications and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage. The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimensions, and strength.
- B. Pipe shall be tested when requested by the Engineer and all pipe so designated shall be tested in accordance with ASTM D 2412 "Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel Plate Loading."
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 1. Manufacturer's name or trademark
 2. Manufactured date
 3. Nominal pipe size
 4. PVC compound used
 5. ASTM material code designation
 6. ASTM specification designation

The text should be set so that it is visible to the RPR at the time of observation (i.e. the text should be facing up when the pipe is set in the trench.)

1.03 SHOP DRAWINGS AND ENGINEERING DATA

Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, "Submittals" of these Specifications.

1.04 STORAGE AND PROTECTION

- A. PVC pipe and fittings shall be stored under black plastic cover.
- B. All pipe and accessories shall be stored aboveground and fully supported so as not to bend or deflect excessively under its own weight.

1.05 GUARANTEE

- A. The Contractor shall provide a guarantee against defective equipment and workmanship in accordance with the requirements of the Section 01740, "Guarantees and Warranties" of these Specifications.

PART 2 - PRODUCTS

2.01 PVC PIPE AND FITTINGS

- A. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
- B. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of the plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.
- C. No single piece of pipe shall be laid on any project covered by this Specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inch per foot of length. If the deviation exceeds this requirement, then the particular piece of pipe shall be rejected from the use until it can comply with this provision.
- D. Wyes, tees, bends, adapters, and any other fittings required shall be provided. Engineering data for such fittings showing cross-sectional views with dimensions shall be provided and such data and fittings shall be approved by the Engineer prior to their use. The materials used in the manufacture of fittings shall conform

to the requirements for the pipe with which they shall be used and any variation of such requirements shall be subject to the approval of the Engineer. Fittings shall have wall thickness equal to or greater than that of the pipe to which they are joined.

2.02 PIPE

- A. PVC piping and accessories shall be made from Virgin Type I, Grade 1 PVC compounds with physical and chemical properties conforming to those defined and described in ASTM D 1784 for "Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds".
- B. The PVC pipe and accessories shall be manufactured in accordance with the requirements of ASTM D 3034, Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- C. Minimum pipe size for gravity mains shall be 8-inch diameter and shall be SDR 26 or less.
- D. Pipe for service lines and house connections shall be a minimum of 4-inch diameter for gravity connections:
 - 4-inch and 6-inch diameter shall be Schedule 40.
 - 8-inch to 24-inch diameter shall be SDR 26 or less.
- E. Under certain conditions, if large diameter pipe, 21" to 48", is required, it shall be closed profile pipe with an integral bell and elastomeric seal joints which meet the requirements of ASTM F-794. Pipe and fittings shall be made from polyvinyl chloride compounds, which comply, with the requirements for a minimum cell classification of 12364A as defined by ASTM D-1784. Use of large diameter closed profile pipe must be approved by the WWTA Chief Engineer or Executive Director.
- F. When the depth of the pipe is greater than 14 feet then the pipe is to be made of ductile iron in accordance with the requirements of section 15062, "Ductile Iron Piping, Ductile Iron and Cast Iron Fittings" of these specifications.
- G. All materials must be inspected by an inspector designated by WWTA before used for construction.

2.03 JOINTS

- A. PVC pipe joints shall be the bell and spigot types subject to the approval of the Engineer.
- B. When required, joints shall be sealed with a rubber O-ring gasket, and shall be of a composition and texture which is resistant to common water, and which will endure permanently under the conditions likely to be imposed by this usage. The gasket installation shall be done in accordance with the pipe manufacturer's instructions using all the necessary materials, lubricants and equipment recommended by the manufacturer.
- C. PVC pipe joints for service laterals shall be solvent weld/glue. Solvent cements shall meet the requirements of ASTM D-2564.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

- A. In accordance with ASTM D-2321.
- B. Before sewer pipe is placed in position in the trench, the bottom and sides of the trench shall be carefully prepared and bracing and sheeting installed where required. Each pipe shall be accurately placed to the exact line and grade called for on the Drawings.
- C. The Contractor shall use the laser beam method of setting a line and grade for the sewer by using the laser beam coaxially through the center of the sewer being laid. The laser beam projector is to be rigidly mounted to its support platforms, with a two-point suspension, or equivalent, assuring that all ground and equipment vibrations are kept to an absolute minimum. All equipment including equipment necessary to control atmospheric conditions in the pipe to keep line and grade to acceptable standards of accuracy shall be furnished by the Contractor. The laser beam system must be operated by competent experienced personnel who have been properly trained to operate the equipment used.
- D. The Contractor shall stake check pegs at all manholes throughout the job. Check pegs midway between manholes and any other check point deemed necessary to assure accuracy of the equipment shall be provided by the Contractor.
- E. Each piece of pipe and special fitting shall be carefully inspected before it is placed and no defective pipe shall be laid in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells uphill. At the

discretion of WWTA, if the first line section is not at minimum grade slope then pipe laying will begin at the first new manhole. When this applies the first line section connecting to the existing sewer shall be the last section of sewer installed. No pipe shall be covered until observed by an RPR. Trench bottoms found to be unsuitable for foundations after pipe laying operations have started shall be corrected and brought to exact line and grade with approved compacted materials.

- F. Bell holes shall be of sufficient size to allow ample room for making the pipe joints properly. Bell holes shall not be cut out more than ten joints ahead of pipe laying. The bottom of the trench between bell holes shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire length as shown on the Drawings. Each joint shall be laid so that it will form a close concentric joint with adjoining pipe in order to avoid sudden offsets or inequalities in the flow line.
- G. Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the joints are completely set or before the trench has been backfilled. At no time shall the Contractor open up more trench than his available pumping facilities are able to dewater. Where sewer pipelines are located in or across stream beds or drainage ditches, the Contractor shall divert the stream flow and dewater each section as the work progresses.
- H. No joints shall be made where pipe or joint materials have been soiled by earth in handling until such soiled surfaces are thoroughly cleaned by wire brushing and wiping until all traces of the earth are removed.
- I. As the work progresses, the interior of all pipe shall be kept thoroughly clean. After each line of pipe has been laid, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the interior.
- J. Backfilling of trenches shall be started immediately after the pipe in place has been inspected and approved by the Engineer or his inspector and backfill shall be deposited and compacted as provided under section 02220 "Earthwork" of these Specifications.
- K. Minimum slope of gravity sewers:

Pipe Diameter (inches)	Minimum Slope (ft per 100ft)
8"	0.40
10"	0.30
12"	0.25

- L. Any stub outs of manholes for future use must be approved by WWTA and be at least 10 feet in length.
- M. Plugged stubs shall be closed with PVC caps held securely in place.
- N. Connections to existing manholes or inlets where no plugged stubs exist shall be made by coring the wall of the existing structure, inserting a length of sewer pipe and approved boot into the hole, and trowelling the inside and outside surfaces of the joint to a neat finish. The bottom of the manhole shall be shaped to fit the invert of the sewer pipe as specified under section 02605 "Manholes" of these Specifications.
- O. Contractor to keep plug at downstream manhole until all testing is complete and sewer is accepted. Contractor required to remove plug. If plug is removed prior to final inspection, contractor will be held responsible for downstream system and shall be required to clean and repair.

3.02 INSTALLATION OF SERVICE PIPE AND TEES

- A. Installation of service pipe shall conform to the appropriate requirements as shown on the drawings, including standard details SD-GEN-15, SD-GEN-16, and SD-GEN-17.
- B. Connections of service lines to the main sewer shall be made with bends of the proper degree to make the service run perpendicular to the main sewer. No greater than a 45-degree bend shall be installed at each change of direction of the sewer service lateral. Pipe shall be laid to a uniform line and grade. Minimum grade shall be 1 percent.
- C. A double clean out shall be provided at the discharge point on the outside sewer service line of the house, and a double clean out shall be provided on the sewer service line at the property line between the public sewer and the structure being connected. Other clean outs shall be provided in accordance with the governing plumbing code.
- D. The end of all service lines shall be plugged with a PVC plug or cap and a wooden 2" x 4" shall extend above existing and/or final grade.
- E. When a service line is installed under the roadway, it shall be backfilled with stone. The top three (3) feet shall be backfilled with crusher run (33P) stone and the last three (3) feet of the line, from the pavement edge, shall be bedded and totally backfilled with crusher run (33P) stone. (See Standard Detail SD-GEN-9).

- F. Riser connections shall be installed at the locations shown on the Drawings or directed by the Engineer. A magnetic marking tape shall be placed 12 inches over the top of each riser during backfilling to mark the location of the riser. The marking tape shall be heavy gauge metallic film (.004 inch thick). Tape shall be standard green color imprinted with the words "Warning - Buried Sewer Line Below."
- G. When a new service line is installed to connect an existing building sewer; when the building sewer is cast iron, concrete, or clay, a Fernco fitting may be approved. Otherwise, NO FERNCO FITTINGS (or other flexible fittings) shall be used for new or the repair of private service laterals.
- H. Service lines shall not be placed under driveways, patios, or other permanent structures.
- I. Service lines shall be bedded and supported completely with washed stone 6" under and 1.5 times pipe diameter over the pipe.
- J. If the sewer service line crosses a water or storm line, there shall be a minimum of 18-inches between the top of the bottom pipe and the bottom of the top pipe.
- K. When it is impractical to obtain proper horizontal or vertical separation or depth, the WWTA shall be contacted, prior to construction of the sewer service line. In the event of reduced separation, additional testing of the sewer service line may be required to insure water-tightness or additional measures may be required. Refer to standard detail SD-GEN-11.

3.03 CONNECTIONS

- A. If the work consists of the construction of a sewer that is to replace an existing sewer, all of the existing service lines shall be kept in operation and connected to the new line.
- B. Unauthorized connections as determined by WWTA shall have their service lateral disconnected and/or have their water shut off.
- C. When existing service line connections include materials or installation methods other than that which is currently approved by the WWTA, the service line shall be removed and replaced properly with currently approved materials and methods.
- D. Connections of service lines shall be made in a neat and professional manner, and approved by WWTA. Cleanout plugs shall be installed, wherever feasible, by using a standard wye or tee.

3.04 INSPECTION AND TESTING

- A. After completion of any section of sewer, the grades, joints, and alignment shall be true to line and grade. Joint surfaces shall be smooth. There shall be no visual leakage and the sewer shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar, or other materials on the inside.
- B. One hundred percent of all PVC pipe 8 inches in diameter and greater shall be deflection tested in the presence of the Engineer's Inspector. The maximum allowable deflection for PVC is 5 percent. After the PVC pipe has been installed and backfilled, the Contractor shall check the deflection by pulling a rigid ball or an engineer approved 9-arm mandrel having a diameter equal to 95 percent of the actual inside diameter of the pipe through the pipe. Deflection tests shall not be conducted before the elapse of 24 hours after backfilling. Any pipe not passing the mandrel shall be replaced and rechecked.
- C. All sewer pipe shall be tested using low pressure air testing in accordance with the procedures and standards listed below. Contractor shall furnish all supplies, material, labor, services, etc., needed to make the test at no extra cost to the Owner, including a gauge that reads in 5 pound increments.
 - 1. Clean pipe to be tested by propelling a snug-fitting jet wash ball (approved by inspector) through pipe with water.
 - 2. Plug all pipe outlets with suitable test plugs. Brace each plug securely to prevent blowouts. As a safety precaution, pressurizing equipment shall include a regulator set at slightly above test pressure to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manhole during testing.
 - 3. Service laterals shall be tested at 5 psi for 5 minutes.
- D. If no ground water is present in the sewer trench, the beginning test pressure shall be 5.0 psig. If the elapsed time for a 0.5 psig pressure drop equals or exceeds those listed in Table 1, the section being tested shall have passed.

TABLE 1

Pipe Dia. (in)	Min. Time (min/sec)	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
8	5:00	5:00	5:00	5:00	5:00	5:00	5:00	5:00	5:42
10	5:00	5:00	5:00	5:00	5:00	5:56	6:55	7:54	8:54
12	5:40	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	8:30	9:37	12:49	16:01	18:14	22:26	25:38	28:51
21	9:55	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	11:24	17:57	22:48	28:30	34:11	38:53	45:35	51:17
27	12:45	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54

- E. No drop in PSI during the test will be allowed. Any leakage, including active seepage, shall be corrected by removal and replacement of pipe or joint where such leakage exists until the pipelines meet the requirements of the allowable leakage specifications.
- F. All sewer pipe shall be videoed using Close Circuit Television (CCTV). CCTV will require the following: CCTV equipment must possess a color camera capable of producing color digital video with on screen accurate footage and video titler. Color digital video is to be non-pixelated, sharp image, representing the true shape and color of the pipe with defects being easily recognizable. Digital records shall be submitted to WWTA in an accessible manner. Footage will be displayed on the digital recorded video image. Video titler system will have capability of inputting on screen defect codes, and all applicable site information.

3.05 CLEANUP

- A. After completing each section of the sewer line, the Contractor shall remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line and leave the entire construction area in a clean and neat condition. Unless otherwise called for on the Drawings, the Contractor shall restore all disturbed areas to as good as or better than its original condition. Restoration shall include but not be limited to grassing, replacing shrubbery, trees, fences and other improvements which have been disturbed.
- B. Cleanup and restoration of each yard shall be completed no later than 7 calendar days after each section of sewer line is installed.

C. Upon final inspection, if any foreign matter is present in the system, flush and clean the sections of line as required.

END OF SECTION 02731

SECTION 02732
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) pressure pipe, including valves, unions, fittings, couplings, adapters, and accessories, as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is called to the fact that all PVC piping and accessories are not necessarily shown completely on the Drawings which are more or less schematic. However, the Contractor shall furnish and install all piping indicated or required for proper operation of the equipment or services requiring such piping.

1.02 QUALITY ASSURANCE

- A. The Contractor, at the Engineer's request, shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is fully competent and capable of manufacturing PVC pipe and fittings of uniform texture and strength that will fully comply with these specifications and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage. The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimensions, and strength.
- B. All pipe shall be tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 1. Nominal size
 2. Type and grade of material and ASTM standard
 3. SDR, Class, or Schedule Rating
 4. Manufacturer
 5. National Sanitation Foundation's seal of approval
 6. Manufacture Date

1.03 SUBMITTALS

- A. Certification: Submit manufacturer's certification that products meet requirements of referenced specification.
- B. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, "Submittals" of these Specifications.

1.04 STORAGE AND PROTECTION

- A. PVC pipes and fittings shall be stored under cover.
- B. All pipe and accessories shall be stored aboveground and fully supported so as not to bend or deflect excessively under its own weight. Height of stacked pipe shall not exceed 4 feet. Bundled pipe shall not be stacked more than two bundles high.
- C. Kinked, flattened, buckled, broken, or otherwise defective pipe and fittings shall not be used and shall be removed from the site.
- D. Pipe shall be handled using nylon slings. Wire rope slings or chains shall not be used.

1.05 GUARANTEE

Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, "Guarantees and Warrantees" of these Specifications.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
- B. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.

- C. No single piece of pipe shall be laid on any project covered by this specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inch per foot of length. If the deviation from straightness exceeds this requirement, then the particular piece of pipe shall be rejected for use until it can comply with this provision.
- D. All materials must be inspected by an inspector designated by WWTA before being used for construction.

2.02 PIPE

- A. PVC pipe shown on the Drawings to be installed outside of structures or buried underground and used to convey water or wastewater shall have push-on joints unless otherwise noted on the Drawings. All pipe material shall be Class 12454-B in accordance with ASTM D 1784. Pipe material shall be C900 PVC and have a pressure rating of at least 200 psi in accordance with ASTM D 2241. Alternate pipe material may be approved by WWTA. Ductile Iron Pipe shall be required for stream crossings and any above grade applications.
- B. PVC pipe shown on the Drawings to be installed inside of structures or used to transport liquid or gaseous chlorine shall have threaded joints. **Solvent Welding of Field Joints will not be Permitted** unless shown on detail. PVC for threaded joints shall be Schedule 80, National Sanitation Foundation approved and shall conform to the latest requirements of Commercial Standard CS 207 and ASTM D 1785 for Schedule 80 water pressure ratings. Pipe material shall be Class 12454-B, in accordance with the requirements of ASTM D 1784. Fittings shall comply with the requirements of ASTM D 1464 for moulded, Schedule 80 screwed fittings.
- C. Detection wire shall be a 12 gauge coated wire installed 6" above the pipe.

2.03 APPURTENANCES

- A. Joints shall be made with flexible elastomeric seals (gaskets) in accordance with ASTM D 3212 and capable of passing all tests specified in ASTM D 3212.
- B. Fittings and plugs shall meet the testing requirements for the PVC pipe. Engineering data for the fittings shall be submitted and approved by the Engineer prior to their use.

C. Fittings for PVC pipe inside of structures or used to convey liquid or gaseous chlorine shall comply with requirement of SCTM D 2464 for Moulded, Schedule 80, screwed fittings.

2.04 JOINTS

A. Push-On Joints

1. The joints shall be designed so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment. The push-on joint shall be single rubber gasket joint designed to be assembled by the positioning of a continuous, molded, rubber ring gasket in an annular recess in the pipe or fitting entering pipe into the socket thereby compressing the gasket radically to the pipe to form a positive seal. The gasket and the annular recess shall be so designed and shaped that the gasket is locked in place against displacement as the joint is assembled. Details of the joint design and assembly shall be in accordance with the joint manufacturer's standard practice. The joints shall be designed so as to provide for the thermal expansion or contraction experienced with a total temperature change of at least 75 degrees F in each joint per length of pipe. The joint shall comply with ASTM D 3139.
2. Lubricant furnished for lubricating joints shall be nontoxic, shall not support the growth of bacteria, shall have no deteriorating effects on the gasket or pipe material, and shall not impart color, taste, or odor to water. The lubricant containers shall be labeled with the manufacturer's name.
3. Gaskets shall comply with ASTM F 477 for high head application and meet all applicable requirements of ANSI A21.11. Gasket dimensions shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape as to provide adequate compressive force against the spigot and socket after assembly to effect a positive seal under all combinations of joint and gasket tolerances. The trade name or trademark, size, mold number, gasket manufacturer's mark and year of manufacture shall be molded in the rubber on the back of the gaskets.
4. The gasket manufacturer shall set up such quality control procedures as to insure the gasket is meeting the requirements of this standard. They shall furnish a monthly report of representative quality control test results to the pipe manufacturer.

5. A sample push-on fitting shall be submitted to the Engineer for examination and approval prior to delivery of any pipe.

B. Threaded Joints

1. Joints shall be made with American Standard IPS threads. All joints shall be made up with Teflon thread tape or thread dope or with pipe manufacturer's recommended joint compound for use with chlorine solution.
2. All fittings shall be Schedule 80 with screwed joints. Gaskets for flange fittings and unions shall be as recommended by pipe manufacturer for use with chlorine solution.

C. Solvent Cement Joints

1. Joints shall be made with American Standard IPS threads. All joints shall be made with solvent cleaner and solvent cement recommended by pipe manufacturer for use with chlorine solution.
2. All fittings shall be solvent cement joints and a pressure rating of at least 200 psi in accordance with ASTM D-2241.

PART 3 - EXECUTION

3.01 LAYING PIPE

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe from being damaged.
- B. All pipe and fittings shall be carefully examined by the Contractor for defects just before laying and no pipe or fitting shall be laid which is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense.
- C. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with bulkhead during construction.
- D. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Installation of pipe in underground pressure piping systems shall

conform to the requirements of AWWA C900. Excavation of trenches and backfilling around pipes shall conform to the requirements of section 02220, "Earthwork" of these Specifications.

- E. All elbows, tees, branches, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping containing unharnessed push-on or mechanical joints or expansion joints shall be restrained by thrust blocks. Thrust blocks shall consist of Class B concrete conforming to the requirements of section 03300, "Cast-In-Place Concrete" of these Specifications and shall be of the size and shape as shown on the Drawings. The Contractor may use forms or earth walls to mold the thrust blocks. When earth walls are used, they shall be cut true to shape in undisturbed earth, and all excess earth removed. The work shall be cut true to shape in undisturbed earth, and all excess earth removed. The work shall be conducted so that no loose earth will become mixed with the concrete. At the end of 24 hours, damp earth may be placed over the concrete to retain moisture.
- F. Detection wire shall be a 12 gauge copper wire installed with all PVC pressure mains and service lines.
- G. A magnetic marking tape, green in color and imprinted with the words, "Warning – Buried Sewer Line Below," shall be installed 12-inches above all pressure pipe.
- H. PVC pipe laid underground shall have a minimum of 48 inches of cover in traffic areas and 30 inches of cover in non-traffic areas.

3.02 FIELD TESTING

- A. Acceptance tests for pressure pipelines shall be based on hydrostatic pressure and leakage tests.
- B. Conduct pressure test and leakage test concurrently, and in the presence of the Engineer or his representative.
- C. Do not test until at least 48 hours have elapsed after the last concrete thrust restraint has been cast. Thirty-six hours minimum shall elapse if high-early strength cement is used.
- D. Conform to AWWA C600 procedures.
 - 1. As modified herein.
 - 2. Shall apply to all pipe materials specified.

- E. Prior to test Contractor and Engineer shall inspect valves within the test section to make sure they are fully open.
 - 1. Test between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.
 - 2. Contractor shall furnish and install test plugs, including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs.
- F. Pressure and Allowable Leakage Test for Force Mains – The test shall be conducted with a pressure of 150 psig at the low point, with no section of the line measuring less than 50 psig. The line shall be tested in sections if the change in elevation is more than 231 vertical feet. The contractor shall isolate the line at a point where the test elevation change is no more than 231 vertical feet.
 - 1. Slowly fill pipe with water:
 - a. Limits fill rate of line to available venting capacity, not to exceed a velocity when flowing full of 1 fps.
 - b. Contractor shall make necessary arrangements to provide water for testing at no cost to Owner.
 - 2. Remove all air.
 - a. Install corporation cocks at high points to evacuate air if permanent air vents are not located there.
 - 3. Leave pipe filled with water at working pressure for a minimum of 24 hours prior to hydrostatic pressure test.
 - 4. Conduct at test pressure of 150 psig at the lowest elevation of the section of line being tested.
 - 5. Maintain the test pressure within 5 psig of the test pressure for at least 24 hours.
- G. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solution and any other materials required to conduct the tests.

H. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed or otherwise protected.

I. Acceptance

1. Acceptance shall be based on the basis of test pressure and maximum allowable leakage.
2. Locate and repair defective materials and joints if the test discloses leakage greater than that specified.
3. All visible leaks are to be repaired regardless of the amount of leakage.
4. Repeat test as necessary until satisfactory performance of test.
5. Owner or Engineer shall witness all pressure and leakage tests.

END OF SECTION 02732

SECTION 02733
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE
for LOW PRESSURE APPLICATIONS

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) pressure pipe, including valves, unions, fittings, couplings, adapters, and accessories, as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is called to the fact that all PVC piping and accessories are not necessarily shown completely on the Drawings which are more or less schematic. However, the Contractor shall furnish and install all piping indicated or required for proper operation of the equipment or services requiring such piping.

1.02 QUALITY ASSURANCE

- A. The Contractor, at the Engineer's request, shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is fully competent and capable of manufacturing PVC pipe and fittings of uniform texture and strength that will fully comply with these specifications and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage. The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimensions, and strength.
- B. All pipe shall be tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 1. Nominal size
 2. Type and grade of material and ASTM standard
 3. SDR, Class, or Schedule Rating
 4. Manufacturer
 5. National Sanitation Foundation's seal of approval
 6. Manufacture Date

1.03 SUBMITTALS

- A. Certification: Submit manufacturer's certification that products meet requirements of referenced specification.
- B. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, "Submittals" of these Specifications.

1.04 STORAGE AND PROTECTION

- A. PVC pipes and fittings shall be stored under cover.
- B. All pipe and accessories shall be stored aboveground and fully supported so as not to bend or deflect excessively under its own weight. Height of stacked pipe shall not exceed 4 feet. Bundled pipe shall not be stacked more than two bundles high.
- C. Kinked, flattened, buckled, broken, or otherwise defective pipe and fittings shall not be used and shall be removed from the site.
- D. Pipe shall be handled using nylon slings. Wire rope slings or chains shall not be used.

1.05 GUARANTEE

Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, "Guarantees and Warrantees" of these Specifications.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
- B. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.

- C. No single piece of pipe shall be laid on any project covered by this specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inch per foot of length. If the deviation from straightness exceeds this requirement, then the particular piece of pipe shall be rejected for use until it can comply with this provision.
- D. All materials must be inspected by an inspector designated by WWTA before being used for construction.

2.02 PIPE

- A. Pipe shall meet ASTM D 2241, "Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR)", Class 200, SDR 21. Length shall be 20 feet.
- B. Gasket shall be ASTM F 477, "Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe." Gaskets for pipe 6 inches and larger shall be supplied with retainer rings.
- C. Push-on joint shall be ASTM D 3139, "Standard Specification for Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals."
- D. PVC material 12454-B (PVC 1120) shall be ASTM D 1784, "Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPC) Compounds."
- E. Fittings for pressure sewers 1-1/2 inches through 4 inches in diameter shall be Class 200 PVC with solvent weld joints.
- F. Low pressure main lines shall be a minimum of 2 inches in diameter.

2.03 PLASTIC VALVES

- A. All thermoplastic Ball Valves shall be True Union type constructed from PVC Type 1 Cell Classification 12454-B. All o-rings shall be EPDM. All valves shall have stem and double stop polypropylene handle. All valve union nuts shall have buttress threads. All valve components shall be replaceable. All valves shall be listed for potable water use by the National Sanitation Foundation (NSP). All 1/2 inch through 2 inch valves shall be pressure rated at 235 psi and all 2-1/2 through 4 inch valves shall be pressure rated at 150 psi for water at 73°F, as manufactured by Spears Manufacturing Company, or equal. All valves shall be connected to the pipe with solvent weld joints.

B. All thermoplastic Check Valves shall be True Union Ball type constructed from PVC Type 1 Cell Classification 12454-B. All o-rings shall be EPDM. All valve union nuts shall have buttress threads. All valve components shall be replaceable. All valves shall be listed for potable water use by the National Sanitation Foundation (NSP). All $\frac{1}{2}$ inch through 2 inch valves shall be pressure rated at 235 psi and all 2- $\frac{1}{2}$ through 4 inch valves shall be pressure rated at 150 psi for water at 73°F, as manufactured by Spears Manufacturing Company, or equal. All valves shall be connected to the pipe with solvent weld joints.

2.04 CUSTOMER SERVICE LINE CONNECTION BOXES

A. Install each service line from the low pressure sewer main to the individual customer at the edge of the right-of-way, property line, or easement as indicated on the Drawings. Service line connections shall include a true union ball check valve and isolation ball valve installed in a meter box. Meter box shall be rectangular, high density polypropylene with a green bolt down lid, NDS Standard Series 17" x 30", or approved equal. Refer to standard detail SD-LP-1.

2.05 AIR RELEASE/VACUUM VALVES

A. All air release/vacuum valves shall be ARI manufactured valves, or approved equal.

B. Valves shall be designed with a working pressure of 0 to 150 psi.

C. Sewage valves shall have a 2" NPT threaded end and be equipped with a 2" brass shut off valve. All components shall be rated at 150 psi.

D. Install all low pressure cleanouts, air release valves, and service connection boxes in rectangular, high density polypropylene meter box with a green bolt down lid, NDS Standard Series 17" x 30", or approved equal.

E. All meter boxes shall be identified by a 5-foot tall green metal fence pole buried vertically next to the box.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe from being damaged.

- B. Detection wire shall be a # 12 gauge copper wire installed with all low pressure pipe and service lines.
- C. A magnetic marking tape, green in color, imprinted with the words, "Warning – Buried Sewer Line Below," shall be installed 12-inches above all low pressure lines.
- D. All pipe and fittings shall be carefully examined by the Contractor for defects just before laying and no pipe or fitting shall be laid which is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense.
- E. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with bulkhead during construction.
- F. When a joint consists of a PVC flange and a metal flange, the metal flange shall be flat faced and furnished with a full face resilient gasket.
- G. PVC valves shall be installed with the flow arrow in the proper direction. Union nuts on PVC valves shall be tightened only hand tight in accordance with manufacturer's instructions. Spare O-rings seals and seats shall be furnished with each PVC valve.
- H. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Install the pipeline so that a positive or negative grade is maintained between major high points and low points. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Installation of pipe in underground pressure piping systems shall conform to the requirements of AWWA C900. Excavation of trenches and backfilling around pipes shall conform to the requirements of section 02220, "Earthwork" of these Specifications.
- I. All elbows, tees, branches, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping containing unharnessed push-on or mechanical joints or expansion joints shall be restrained by thrust blocks. Thrust blocks shall consist of Class B concrete conforming to the requirements of section 03300, "Cast-In-Place Concrete" of these Specifications and shall be of the size and shape as shown on the Drawings. The Contractor may use forms or earth walls to mold the thrust blocks. When earth walls are used, they shall be cut true to shape in undisturbed earth, and all excess earth removed. The work shall be cut true to shape in

undisturbed earth, and all excess earth removed. The work shall be conducted so that no loose earth will become mixed with the concrete. At the end of 24 hours, damp earth may be placed over the concrete to retain moisture.

- J. PVC pipe laid underground shall have a minimum of 48 inches of cover in traffic areas and 30 inches of cover in non-traffic areas.
- K. Low pressure main lines to be located under roadway or sidewalk areas must first be approved by WWTA.

3.02 PIPE FIELD TESTING

- A. Acceptance tests for pressure pipelines shall be based on hydrostatic pressure and leakage tests.
- B. Conduct pressure test and leakage test concurrently, and in the presence of the Engineer or his representative.
- C. Do not test until at least 7 days have elapsed after the last concrete thrust restraint has been cast.
 - 1. Thirty-six hours minimum shall elapse if high-early strength cement is used.
- D. Conform to AWWA C600 procedures.
 - 1. As modified herein.
 - 2. Shall apply to all pipe materials specified.
- E. Prior to test Contractor and Engineer shall inspect valves within the test section to make sure they are fully open.
 - 1. Test between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.
 - 2. Contractor shall furnish and install test plugs, including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs.
- F. Pressure Test for Low Pressure Service Lines (1½-inch)
 - 1. Slowly fill pipe with water:
 - a. Limits fill rate of line to available venting capacity, not to exceed a velocity when flowing full of 1 fps.

- b. Contractor shall make necessary arrangements to provide water for testing at no cost to Owner.
2. Remove all air.
 - a. Install corporation cocks at high points to evacuate air if permanent air vents are not located there.
3. Conduct at test pressure of 70 psig at the lowest elevation of the section of line being tested.
4. Maintain the test pressure for at least 2 hours.

G. Pressure and Allowable Leakage Test for Force Mains

1. Slowly fill pipe with water:
 - a. Limits fill rate of line to available venting capacity, not to exceed a velocity when flowing full of 1 fps.
 - b. Contractor shall make necessary arrangements to provide water for testing at no cost to Owner.
2. Remove all air.
 - a. Install corporation cocks at high points to evacuate air if permanent air vents are not located there.
3. Conduct at test pressure of 90 psig at the lowest elevation of the section of line being tested.
4. Maintain the test pressure within 5 psig of the test pressure for at least 24 hours.

H. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solution and any other materials required to conduct the tests.

I. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed or otherwise protected.

J. Acceptance

1. Acceptance shall be based on the basis of test pressure and maximum allowable leakage.
2. Locate and repair defective materials and joints if the test discloses leakage greater than that specified.
3. All visible leaks are to be repaired regardless of the amount of leakage.
4. Repeat test as necessary until satisfactory performance of test.
5. Owner or Engineer shall witness all pressure and leakage tests.

3.03 VALVE INSTALLATION

- A. Install all valves in strict conformance with the Drawings and approved shop drawings and manufacturer's instructions.
- B. Install valves in such a way that operators and packing are easily acceptable. Valves with field placement seats shall be installed with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.

3.04 VALVE FIELD TESTING

- A. Following installation, test all valves under the anticipated operating conditions. The ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque shall be demonstrated to the satisfaction of the Engineer. At the Contractor's expense, adjust and/or replace any valve as necessary to ensure satisfactory operation.

3.05 CLEANUP

- A. After completing each section of the sewer line, remove all debris and construction materials and equipment from the site of the work, grade and smooth over the surface of both sides of the line, and leave the entire right-of-way or easement area in a clean and neat condition. Unless otherwise called for on the Drawings, restore all disturbed areas to as close to its original condition as possible. Restoration shall include, but not be limited to, grassing and replacing shrubbery, trees, fences, and other items, which have been disturbed.
- B. Cleanup and restoration shall be completed within 30 calendar days after each section of sewer line is installed. Should the Contractor fail to do the cleanup within 30 calendar days, payment made for pipe sewers and service lines for that

section of the sewer not cleaned up shall be removed from the periodic pay estimate until the cleanup work is completed.

- C. A metal fence post shall be installed at each service connection box, air release valve, and clean out to extend 2' above final grade which may not be removed until after final inspection of the building.

END OF SECTION 02733

SECTION 02830
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install galvanized, chain link fence with PVC privacy slats, including all excavation, concrete, and accessories, as shown on the Drawings or specified herein.
- B. Excavation and backfilling and concrete shall conform with the requirements of sections 02220, "Earthwork" and 03300, "Cast-In-Place Concrete", respectively.

1.02 SUBMITTALS

- A. Shop Drawings: Indicate assemblies in elevation with connections and details.
- B. Manufacturer's literature: Materials description.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All ferrous materials entering into the construction of required fencing shall be heavily galvanized by the hot dip process in accordance with ASTM A120 or A123 as applicable.
- B. Overall height shall be a minimum of 84 inches high:
 1. Minimum of 72 inches of chain link fabric
 2. 3 rows of barbed wire on extension arms

2.02 FENCE MATERIALS

- A. Fabric
 1. 9 gage
 2. 2-inch mesh
 3. Galvanized ASTM A392, Class II with twisted and barbed selvage top and bottom.
 4. 6' - 0" height
- B. Posts: Steel pipe, ASTM A120
 1. Line post: 2-3/8 inch O.D., Schedule 40 (3.65 lb./ft.)
 2. Corner, end, angle, and pull posts: 2-7/8 inch O.D., Schedule 40, (5.8 lbs./ft.)

3. Gate posts, 20 feet wide: 4 inch O.D., Schedule 40, (7.58 lbs./ft.)
- C. Top rail: 1 5/8 inch O.D., Schedule 40 (2.27 lb./ft.), with expansion couplings spaced at not less than 20 feet intervals.
- D. Braces: material same as Top rail; provided wherever fabric is not continuous.
- E. Bottom tension wire: 6 gage.
- F. Barbed wire: four-point pattern, two strand, No. 12-1/2 gauge, with 14 gauge barbs on 3 inch centers.
- G. Extension arms:
 1. Pressed steel arms on intermediate posts
 2. Heavy malleable iron arms on end and corner posts
 3. Carry 3 barbed wires at 45 degree angle towards the outside enclosure
- H. Fittings: heavy malleable iron or pressed steel

2.03 GATE

- A. Type: 16 foot minimum, double swing. Refer to standard detail SD-PS-7.
- B. Frames
 1. 2 inch O.D. pipe Schedule 40, (2.72 lb./ft.) or 2 inch square tubing, 2.8 lb. linear foot.
 2. Material: Zinc-coated steel.
 3. Construction: Welded corners or assembled with corner fittings and 3/8 inch steel truss rods.
 4. Provide horizontal 1 1/4 inch brace rail and 3/8 inch truss rod for gates 5 feet wide or greater.
 5. Provide vertical 1 1/4 inch brace rail for gates 6 feet wide or wider, spacing not to exceed 5 foot centers.
- C. Fabric: Same as fence fabric.
- D. Hinges
 1. Standard type.
 2. Size to accommodate gate frame and post.
- E. Latches: Industrial gate latch with drop rod or center stop.
- F. Keepers
 1. Mechanical keeper for each gate leaf.
 2. Secure free end of gate when in full open position.

G. Locks

1. Contractor to keep station locked until final acceptance by the County.
2. Hamilton County will provide their own locks upon final acceptance.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that final grading in fence location is complete without irregularities which would interfere with fence installation.
- B. Locate fence line posts 12" inside asphalt.
- C. Measure and lay out complete fence line.
- D. Locate line posts at equal distance spacing, not exceeding 10 foot centers.
- E. Use corner posts at positions where fence changes direction more than 10 degrees.

3.02 INSTALLATION

A. Posts

1. Minimum post hole diameter three times outside post diameter or 10 inches, whichever is larger.
2. Minimum post hole depth below grade.
 - a. Line posts: 3 feet.
 - b. Corner posts, end posts, and gate posts: 3 1/2 feet.
3. Set posts 3 inches above hole bottom.
4. Set post plumb to 1/4 inch in 10 feet.
5. Fill hole with concrete to 2 inches above grade.
6. Crown surface of concrete to slope away from posts.
7. Brace each gate and terminal post with a horizontal pipe brace and an adjustable truss extending to an adjacent line post.
8. Brace corner posts in both directions.

B. Fence Fabric

1. Install top rails and tension wires before the fabric.
2. Install tension wires approximately 6 inches above grade and attach to each post and securely anchor to terminal or gate posts.
3. Position bottom of fabric approximately 2 inches above ground at each post.
4. Join ends of fabric by weaving with single strand of fabric wire to form continuous mesh pattern.
5. Attach fabric to outside of line posts using wire ties or clips, spacing not to exceed 15 inches on centers.

6. Attach top edge of fabric to top rail using wire ties or clips, spacing not to exceed 24 inches on centers.
7. Attach bottom edge of fabric to bottom tension wire using wire ties or clips, spacing not to exceed 24 inches on centers.
8. Thread stretcher bar through fabric and anchor to the post at 15 inch centers by positive mechanical means.
9. Fasten barbed wire to each extension arm by internal clips or external fabric ties; top wire to be 12" vertically from the top of the fabric.

C. Gates

1. Install gates plumb and level to 1/4 inch in 10 feet.
2. Install ground-set items in concrete.
3. Adjust hardware to provide smooth operation.
4. Brace and reinforce as necessary to prevent sagging.

3.03 ADJUST AND CLEAN

- A. Adjust brace rails and tension rods for rigid installation.
- B. Tighten hardware, fasteners and accessories.

END OF SECTION 02830

SECTION 02921 TOPSOIL

PART 1 – GENERAL

1.01 SCOPE

The work covered by this Section consists of furnishing all labor, equipment, and material required to provide and place topsoil on the site, including compacting, fine grading, raking, and other placement operations on graded earthen areas to receive topsoil as described herein and/or as shown on the Drawings. In general, topsoil operations shall be conducted on all newly graded earthen turf areas not covered by structures, pavement, or sidewalks; all cleared or grubbed areas which are to remain as finished grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be topsoiled according to these Specifications.

1.02 QUALITY ASSURANCE

- A. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Services or other certified testing laboratory.
- B. All existing lawns encountered shall be replaced with topsoil and seeding of the same type and quality as that existing prior to construction and shall be restored to original condition or better.

PART 2 – PRODUCTS

1.02 TOPSOIL

- A. Topsoil shall be natural topsoil without admixture of subsoil material. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than $\frac{1}{2}$ inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips, or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and perennial weed seeds, and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.

B. The topsoil's pH shall range from 5.5 to 7.0. Topsoil shall contain not less than 5 percent nor more than 20 percent, by weight, of organic matter as determined by loss on ignition of oven-dried samples to 65° C.

C. Topsoil shall possess the following characteristics, shall be subject to testing as described above, and shall be subject to the approval of the Engineer:

20-60% sand (.075-2mm)
0-50% silt (.002-.075mm)
0-30% clay (.001-.002mm)
96% passing no. 10 sieve

PART 3 – EXECUTION

3.01 STRIPPING TOPSOIL

A. Strip any available topsoil to its full depth at all areas to be regraded, resurfaced, or paved within contract limit work area.

B. Stockpile topsoil in a location acceptable to the Owner, for use in finish grading.

1. Stockpiled topsoil shall be free from trash, brush, stones over 3" diameter, and other extraneous matter.
2. Grade and slope stockpiles for proper drainage and to prevent erosion.

3. **No topsoil shall be removed from the site.** It is the property of the Owner.

C. Protect all areas which are not to be resurfaced or regraded, and adjacent areas outside of the contract limits from damage due to site preparation.

D. Unless otherwise specified, topsoil and other unsuitable materials at the site and at a minimum distance of 5 feet beyond the surfaced area, shall be removed in such a manner to minimize disturbance of the remaining subgrade soils, and to facilitate placement of embankment materials and/or base course materials.

3.02 PLACING TOPSOIL

A. Contractor shall spread topsoil to a thickness of at least 4 inches over all surrounding site contours except areas requiring finishing with material other than topsoil in accordance with the Drawings. Use loose, dry topsoil. Do not use frozen or muddy topsoil. Place during dry weather.

B. On-site sources of topsoil shall be approved by the Engineer prior to disturbance.

- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.
- D. Remove stones, roots, weeds, and debris while spreading topsoil materials. Rake surface clean of stones 1" or larger in any dimension and all debris. Provide surfaces suitable for seedbed preparation under Section 02933 "Seeding" of these specifications.

3.03 MAINTENANCE

- A. Protect finish graded areas from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settled, eroded, and damaged areas.
- B. Where completed areas are disturbed by construction operations or adverse weather, scarify, reshape, and compact to required density.

END OF SECTION 02921

SECTION 02933 SEEDING

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this Section consists of furnishing all labor, equipment, and material required to prepare seedbed, to place topsoil, seed, commercial fertilizer, agricultural limestone, and mulch material, including seedbed preparation, harrowing, compacting, and other placement operations on graded earthen areas as described herein and/or shown on the Drawings. In general, seeding operations shall be conducted on all newly graded earthen turf areas not covered by structures, pavement, or sidewalks; all cleared or grubbed areas which are to remain as finished grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- B. The work shall include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion.

1.02 QUALITY ASSURANCE

- A. Prior to seeding operations, the Contractor shall furnish to the Engineer labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirement of this section.
- B. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Services or other certified testing laboratory.
- C. All existing lawns encountered shall be replaced with topsoil and seeding of the same type and quality as that existing prior to construction and shall be restored to original condition or better.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. The Contractor shall place and prepare topsoil according to Section, 02921 "TOPSOIL" of these specifications, or as shown on the Drawings.

2.02 SEED

- A. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- B. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- C. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Engineer samples of seed may be taken for check against the growers analysis.
- D. Species, rate of seeding, fertilization, and other requirements are shown in the Seeding Requirements Table.

2.03 FERTILIZER AND LIMING MATERIALS

- A. Fertilizer and liming materials shall comply with applicable State, Local, and Federal laws concerned with their production and use.
- B. Commercial fertilizer shall be a ready mixed material and shall be equivalent to the grade or grades specified in the Seeding Requirements Table. Container bags shall have the name and address of the manufacturer, the brand name, net weight, and chemical composition.
- C. Agricultural limestone shall be a pulverized limestone having a calcium carbonate content of not less than 85 percent by weight. Agricultural limestone shall be crushed so that at least 85 percent of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

2.04 MULCH MATERIAL

- A. All mulch materials shall be air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
- B. Mulch shall be composed of wood cellulose fiber, straw, or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch blowing equipment.
- C. Wood-cellulose fiber mulch shall be as manufactured by Weyerhaeuser Company, Conway Corporation, or equal.

D. Straw mulch shall be partially decomposed stalks of wheat, rye, oats, or other approved grain crops.

E. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum, or other approved standing field crops.

2.05 MULCH BINDER

A. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be non-toxic to plant life and shall be acceptable to the Engineer.

B. Emulsified asphalt binder shall be Grade SS-1, ASTM D 977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

2.06 INNOCULANTS FOR LEGUMES

All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.07 WATER

Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

PART 3 EXECUTION

3.01 SECURING AND PLACING TOPSOIL

A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Engineer.

B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage, and other characteristics as to offer assurance that, when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.

C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen, or its residue, and any other refuse which will hinder or prevent growth.

D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such materials shall be removed from the topsoil, or if required by the Engineer, the pit shall be abandoned.

- E. Before placing or depositing topsoil upon any areas, all improvements within the area shall be completed, unless otherwise approved by the Engineer.

3.02 SEEDBED PREPARATION

- A. Before fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line free from unsightly variation, bumps, ridges and depressions, and all detrimental material, roots, and stones larger than 1/2 inch in any dimension shall be removed from the soil.
- B. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 2 inches with a weighted disc, tiller, pulvimer, or other equipment, until the surface is smooth and in a condition acceptable to the Engineer.
- C. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be placed in a condition suitable for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition.

3.03 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown in the Seeding Requirements Table. Copies of all weight tickets shall be furnished to the Engineer.
- B. Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1/2 inch.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.
- D. Agricultural limestone shall be thoroughly mixed into the soil according to the rates in the Seeding Requirements Table. The specified rate of application of limestone may be reduced by the Engineer if the pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.

E. It is the responsibility of the Contractor to make one application of maintenance fertilizer according to the recommendations listed in the Seeding Requirements Table.

3.04 SEEDING

- A. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates shown in the Seeding Requirements table unless otherwise approved by the Engineer. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation. Copies of all weight tickets shall be furnished to the Engineer.
- B. Seeds shall be uniformly sown by any approved mechanical method to suit the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder, or approved mechanical power drawn seed drills. Hydro-seeding and hydro-mulching may be used on steep embankments, provided full coverage is obtained. Hard packing and ruts shall be prevented or repaired when hydro-seeding and hydro-mulching. Care shall be taken to adjust the seeder for seedings at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.
- C. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- D. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen-fixing inoculant in accordance with the manufacturer's mixing instruction.

3.05 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion, and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:
 1. Wood Cellulose Fiber 1,400 lbs/acre
 2. Straw 4,000 lbs/acre
 3. Stalks 4,000 lbs/acre

These rates may be adjusted at the discretion of the Engineer at no additional cost to the Owner depending on the texture and condition of the mulch material and the characteristics of the seeded area.

- C. Mulch on slopes greater than 3 to 1 ratio shall be held in place by the use of an approved mulch binder. Binder shall be thoroughly mixed and applied in accordance with manufacture's specifications.
- D. The Contractor shall cover structure, poles, fence, and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- E. Mulch and binder shall be applied in accordance with manufacture's specifications.

3.06 WATERING

- A. Contractor shall be responsible for maintaining the proper moisture content of the soil to insure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain an adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank trucks, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.07 MAINTENANCE

- A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris, and excess material and the premises shall be left in a neat and orderly condition.
- B. The Contractor shall maintain all seeded areas without additional payment until a uniform stand is accomplished and until final acceptance of the seeding work by the Owner. Seeding work shall be repeated on defective areas until a uniform stand is accomplished at the Contractor's expense. Damage resulting from erosion, gulleys, washouts, or other causes shall be repaired by filling with topsoil, compacting, and repeating the seeding work at Contractor's expense.
- C. If sowing season is missed, the Contractor shall stabilize, maintain, and prevent erosion and stormwater pollution in the areas to be seeded until the appropriate sowing season, at which time appropriate seedbed preparation shall be performed and seeding operations shall resume immediately.

SEEDING REQUIREMENTS TABLE

AREA	SOWING SEASON	RATES PER 1,000 SQUARE FEET				Maintenance**
		SPECIES	Seed	Fertilizer	Pelleted	
General Seeding Areas:	Flat to rolling terrain with slopes less than 3:1	Kentucky 31 Fescue	4 lbs.	30 lbs.	20 lbs.	15 lbs.
		Ladino White Clover*	1/4 lb.			
		Annual Ryegrass	2 lbs.			
	8/1 to 11/1	Kentucky 31 Fescue	4 lbs.	30 lbs.	20 lbs.	15 lbs.
		Ladino White Clover*	1/4 lb.			
		Annual Ryegrass	2 lbs.			
Embankments with slopes greater than 3:1	1/1 to 6/1	Crownvetch*	1 lb.	30 lbs.	20 lbs.	10 lbs.
		Kentucky 31 Fescue	2 lbs.			
		Weeping Lovegrass	1/4 lb.			
	8/1 to 11/1	Crownvetch*	1 lb.	30 lbs.	20 lbs.	10 lbs.
		Kentucky 31 Fescue	2 lbs.			
		Annual Ryegrass	2 lbs.			
Turf Seeding Areas:	1/1 to 6/1	Team-Mates*** (or approved equal)	7 lbs	4 lbs.	20 lbs.	

* Requires inoculation.

** Maintenance fertilizer shall be applied in early spring following initial establishment of cover.

*** Team-Mates is a blend of Stetson, Bravo, Lancer, and All-Sport fescues with an additional 20% perennial rye.

END OF SECTION 02933

SECTION 02951

RAILROAD AND HIGHWAY CROSSINGS

PART 1 - GENERAL

1.01 SCOPE

The work covered by this section includes furnishing all labor, materials, service, and equipment required to properly complete sewer and/or water pipeline construction under railroads and federal or state highways, as described herein and/or shown on the Drawings.

1.02 SHOP DRAWINGS AND ENGINEERING DATA

Complete engineering data and product information shall be submitted to the Engineer in accordance with the requirements of section 01300, "Submittals" of these Specifications.

1.03 STORAGE AND DELIVERY

All materials shall be stored and protected with strict conformance to the manufacturer's recommendations and as approved by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel casing pipe for sizes 6 inches and smaller shall conform to ASTM A 120 (standard weight), of the latest standard specifications.
- B. Steel casing pipe, sizes 8 inches through 54 inches, shall be straight seam welded steel pipe conforming to ASTM A 139 Grade B of the latest standard specifications.
- C. All steel casing pipe shall be bituminous coated inside and out, when required by the approval agency.
- D. Structural steel liner plates shall be used for excavated tunnels where the casing pipe is 54 inches or greater in diameter. Liner plates shall be of the thickness shown on the Contract Drawings. The liner plates shall be of the two-flange, lap - joint type. The corrugations shall be 3-1/2 inches center to center. Bolts and nuts used shall be a minimum of 5/8-inch in diameter and shall conform to the latest revision of ASTM A 307 for plate thickness less than 0.209 inch, and ASTM A 307 for plate thickness equal to or greater than 0.209 inch, and ASTM A449 for

plate thickness equal to or greater than 0.209 inch. Each plate shall have one 2-inch diameter half coupling and plug for grouping.

- E. The sand fill between the casing pipe and carrier pipe, where permitted, shall conform to section 03300, "Cast-In-Place Concrete" Part 2.02 B (Fine Aggregate) of these Specifications.

PART 3 - EXECUTION

3.01 GENERAL

- A. Any solidification of embankments, boring headings, or tunnel headings or sides shall be the Contractor's responsibility and shall be done at his own expense.
- B. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.
- C. The casing pipe shall be jacked into the boring as soon as possible after the boring is made. Lengths of casing pipe as long as practical shall be used. Joints between sections shall be completely welded as recommended for joining the particular type of pipe.
- D. Once the jacking procedure has begun, it should be continued without stopping until completed subject to weather and conditions beyond the control of the Contractor.
- E. Any replacement of carrier pipe in an existing casing shall be considered a new installation, subject to the applicable requirements of these Specifications.
- F. Open cut installations, where permitted, shall be in accordance with the details and procedures shown on the Drawings.
- G. Steel liner plates shall be installed in excavated tunnels when called for on the Drawings. The liner plates shall be installed progressively as excavation proceeds. Excavation shall not continue more than 24 inches past the end of the liner plate already in place. At this time an additional section of liner shall be installed before excavation shall continue. Grout shall be placed under pressure in the annular void as the excavation proceeds. Grout should be continuously placed as close to the heading as possible, using grout stops if necessary. Grout shall be injected in the lower holes first, moving upward as the back space is filled. Threaded plugs shall be installed after filling each grout hole.
- H. Care shall be taken to ensure that casing pipe installed by boring and jacking or open cut method will be at the proper alignment and grade.

- I. The Contractor shall maintain and operate pumps, well points, and drainage system equipment to keep work dewatered at all times.
- J. Adequate sheeting, shoring, and bracing for embankments, operating pits, and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously. Upon completion of the required work, the sheeting, shoring, and bracing shall be left in place, cut off, or removed, as designated by the Engineer.
- K. Trench excavation; mining for tunnels; all classes and types of excavation; the removal of rock, muck, debris; the excavation of all working pits; and backfill requirements of section 02220, "Earthwork" are included under this section.
- L. Carrier pipe for all lines 6 inches and larger shall have push-on joints and fittings.
- M. After the casing pipe or tunnel liner is installed, the carrier pipe shall be installed exercising care at all times to protect the interior of the casing pipe and to maintain tight, full-seated joints in the carrier pipe. The carrier pipe shall be installed at the proper line and grade without any sags or high spots.
- N. The carrier pipe shall be held concentric with the casing pipe by the use of approved stainless steel casing spacers spaced radially around the pipe and secured together so that they remain firmly in place. The spacing of spacers longitudinally in the casing pipe shall not be greater than 10 feet.
- O. Except where prohibited, sand shall be forced under pressure into the annular space between the carrier pipe and the casing pipe. This shall begin at the center of the crossing and completely fill the space to each end. Care shall be exercised at all times to maintain the carrier pipe at its proper line and grade.

3.02 RAILROAD CROSSINGS

- A. The Contractor shall secure permission from the railroads to schedule work so as not to interfere with the operation of the railroads. All work will be done under the supervision of the Engineer and the railroads involved. The Contractor will furnish the railroad with such additional insurance as may be required, cost of the same to be borne by the Contractor.
- B. The casing pipe shall extend no less than 25 feet from the centerline of outside track to the end of the pipe. The casing pipe shall extend beyond the railway right-of-way limits, if necessary, to obtain this distance.
- C. All work on railway right-of-way including necessary supporting of tracks, safety of operations, and other standard and incidental operation procedures shall be under the supervision of the appropriate authorized representative of the railway

system affected and any decisions of this representative pertaining to construction and/or operations shall be final and constructions must be governed by such decisions.

D. If, in the opinion of the railway company, it becomes necessary to provide flagging protection, watchmen, removal or replacement of tracks, or the performance of any other work in order to keep the tracks safe for traffic, the Contractor shall reimburse the railroad in cash for such services, in accordance with accounting procedures agreed on by the Contractor and affected railway company before construction is started.

3.03 HIGHWAY CROSSINGS

- A. The Contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the state highway right-of-way.
- B. Work along or across the state highway department right-of-way shall be under the supervision of the Engineer and state highway department engineer.
- C. All water and sewer pipelines installed under paved roads and paved crossroads within the rights-of-way of the state highway department shall be encased. This includes, but is not limited to, all water and sewer service lines.
- D. For open trench cut installations, the Contractor shall make satisfactory arrangements to detour traffic around the area of highway where work is in progress, with minimum inconvenience placed on the traveling public. The Contractor shall provide suitable flagmen, watchmen, safety devices, and other services and facilities as may be required by the state highway department. The cost of the same shall be borne by the Contractor.
- E. All water and sewer lines shall have a minimum cover of 30 inches unless otherwise shown on the Drawings, but in no case shall the minimum cover be less than that required by the regulations of the highway agency involved.
- F. Unless otherwise shown, encasement shall extend 5 feet beyond the highway embankment or back of side ditch. On curbed portions of conventional highways the casing pipe shall extend to the back of curb or sidewalk.
- G. For open trench cut installations, the Contractor shall be responsible for scheduling and coordinating all construction work. All work at one particular crossing shall be completed with the trench backfilled, compacted, and a temporary crushed stone surface provided for traffic before any work is started on another such crossing.

- H. All installations shall be done to leave free flows in drainage ditches, pipes, culverts, or other surface drainage facilities of the highway, street, or its connections.
- I. Where sodding is disturbed by excavation or backfilling operation, such areas shall be replaced by mulch sodding on slopes 5 percent or less. All slopes over 5 percent shall be replaced with block sodding. No separate payment shall be made for sodding which shall be included in the bid prices for installation of pipe.
- J. All trench excavation within the right-of-way, but not under pavement, shall be backfilled by tamping in 6-inch layers.
- K. All surplus material shall be removed from the right-of-way and the excavation finished flush with surrounding ground.
- L. Grout backfill shall be used for unused holes or abandoned pipes.
- M. Boring, jacking, or driving of carrier or casing pipes under existing highways shall be accomplished without jetting, sluicing, or wetboring.
- N. No excavated material or equipment shall be placed on the pavement or shoulders of the highway without the express approval of the state highway department engineer.
- O. In no instance will the Contractor be permitted to leave equipment (trucks, backhoes, etc.) on the pavement or shoulder overnight. Construction materials to be installed which are placed on the right-of-way in advance of construction shall be placed in such a manner as not to interfere with the safe operation of the highway.

END OF SECTION 02951

SECTION 03200
CAST-IN-PLACE CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 CODES AND STANDARDS

These specifications make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT). Even though the weather limitations, constructions methods, and materials specifications contained in the TDOT specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.

PART 2 - PRODUCTS

All cast-in-place concrete reinforcement shall conform to TDOT specifications, Section 907, "Concrete Reinforcement", referring to "Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction", 1981 or latest edition.

END OF SECTION 03200

SECTION 03300 CONCRETE

PART 1 - GENERAL

1.01 CODES AND STANDARDS

ACI 301, "Specifications for Structural Concrete Buildings"; ACI 318, "Building Code Requirements for Reinforced Concrete"; comply with applicable provisions except as otherwise indicated.

1.02 CONCRETE TESTING SERVICE

Employ acceptable testing laboratory to perform materials evaluation, testing and design of concrete mixes.

Owner will employ separate testing laboratory to evaluate concrete delivered and placed at the site.

Certificates attesting to concrete strength, which are signed by the concrete producer and Contractor, may be submitted to the Engineer in lieu of material testing laboratory reports.

1.03 QUALITY CONTROL

Owner's testing laboratory will perform sampling and testing during concrete placement as directed by Engineer. This testing does not relieve Contractor of responsibility of providing concrete and testing in compliance with specifications. At no expense to Owner, Contractor may perform additional testing, as he deems necessary, to ensure quality of concrete. Owner's testing program may include the following:

Sampling: In compliance with ASTM C-172.

Air Content: In compliance with ASTM C-173, one for each set of compressive strength specimens.

Test results will be reported in writing to Engineer, Contractor, and concrete producer within 2 days after the tests are made.

1.04 MANUFACTURER'S DATA

Submit manufacturer's product data with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.

1.05 LABORATORY REPORTS

Submit 2 copies of reports of laboratory evaluations and/or test results for concrete materials and mix designs.

1.06 MIX DESIGN PROPORTIONS

Proportion concrete ingredients by laboratory trial batch method complying with ACI 301 to produce the following minimum compressive strengths at 28 day age when sampled, cured and tested:

<u>Class of Concrete</u>	<u>Average of any 3 cylinder breaks</u>	<u>Minimum of single cylinder break</u>
A	4000 PSI	3500 PSI
B	3000 PSI	2500 PSI

Submit written report for each proposed concrete mix design to Engineer at least 15 days prior to start of concrete work. Do not begin concrete production until all concrete mix designs have been reviewed by and are acceptable to Engineer.

Mix designs may be adjusted when material characteristics, job conditions, weather, test results or other circumstances warrant. Any adjustment shall produce the lowest water-cement ratio which is consistent with good workability and produces a plastic cohesive mixture. Do not use revised mix designs until all revisions have been reviewed by and are acceptable to Engineer.

Use air-entraining admixtures in all concrete. Provide not less than 4% nor more than 8% entrained air for all concrete exposed to freezing and thawing conditions; and, from 2% to 4% for all other concrete.

Unless otherwise indicated or directed by Engineer, the slump range for all concrete shall be:

Footings, blocking,
sidewalks, driveways, etc..... 2" to 4"

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: In accordance with ASTM C-150, Type I or III, as required to suit job conditions.

B. Aggregates: In accordance with ASTM C-33, except local aggregates of proven durability may be used when acceptable to Engineer.

C. Water: Use only clean, potable water.

D. Air-Entraining Admixtures: In accordance with ASTM C-260.

2.02 CONCRETE RELATED MATERIALS

A. Moisture Barrier: Clear, 8 mils thick polyethylene; polyethylene coated barrier paper; or, 1/8" thick asphalt core membrane sheet.

2.03 FORMING MATERIALS

A. Provide form materials with sufficient strength and stability to withstand the pressure of placed concrete without excessive bow or deflection.

B. Exposed Concrete Surfaces: Materials suitable to project conditions.

2.04 REINFORCING MATERIALS

A. Deformed Reinforcing Bars: In accordance with ASTM A-615, Grade 60 unless otherwise indicated.

B. Welded Wire Fabric: In accordance with ASTM A-185, FY = 65 KSI.

PART 3 - EXECUTION

3.01 FORMING, MIXING & PLACING CONCRETE

A. Job-Site Mixing: Use drum type batch mixer; mixing time at least 1.5 minutes for 1 cu. yd. or smaller volume; and, increase mixing time by at least 15 seconds for each additional cu. yd. or fraction thereof.

B. Ready-Mix Concrete: In accordance with ASTM C-94.

C. Formwork: Construct so that concrete members and structures are the correct size, shape, alignment, elevation and position.

Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.

Clean and adjust forms prior to concrete placement. Apply release agents or wet forms as required. Re-tighten forms during concrete placement if required to eliminate mortar leaks.

D. Reinforcing: Accurately position, support and secure reinforcing against displacement. Support reinforcing with non-corrosive or plastic coated metal chairs, runners, bolsters, spacers and hangers located at sufficient frequency to limit reinforcing deflection between supports to a maximum of 3/8".

Unless otherwise indicated, the amount of concrete cover protecting the reinforcing shall be :

Concrete cast against and
permanently exposed to earth 3.00"

Install welded wire fabric in as long lengths as practicable, lapping at least 8" with transverse wires overlapping by at least 2".

E. Joints: Provide construction, isolation, and control joints as indicated or required. Construction joints shall occur at locations which will not impair strength or detract from the aesthetics of the installation. Place isolation and control joints at locations which will stabilize random cracking.

F. Concrete Placement: Comply with ACI 318, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.

Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping, in continuous vertical motions, so that concrete is worked around reinforcing and other embedded items and into forms.

Do not transport any concrete within forms by using vibration equipment. Transport of concrete within forms shall be performed only by hand spading as necessary.

Protect concrete from physical damage or reduced strength due to hot or cold weather extremes during mixing, placement and curing.

3.02 CONCRETE FINISHES

A. Exposed-to-view Surfaces: Provide a smooth finish for exposed concrete surfaces and surfaces that are to be covered with a coating or covering material that is to be applied directly to the concrete. Remove fins and projections, patch defective areas with cement grout and rub smooth.

B. Curing: Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for at least the first 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing

compound. Provide protections as required to prevent damage to exposed concrete surfaces.

END OF SECTION 03300

SECTION 11312

SANITARY SEWAGE PUMP STATIONS

PART 1 - GENERAL

1.01 SCOPE

These specifications are to serve as guidelines in the design of pump stations for the WWTA sanitary sewer system. All pump station designs, including details, pump ratings and specifications, wiring diagrams, controls, and all appurtenances shall be submitted to the office of the WWTA Executive Director for review and approval.

1.02 SUBMITTALS

Submit operation and maintenance data separate from shop drawings unless so specified or required by the Engineer to determine if equipment will comply with the Contract Documents and requirements.

Submit the following information for each item proposed to be furnished:

1. Certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
2. Assembly drawings and/or diagrams, detail reference drawings lists, and lists of erection details.
3. Shop detail drawings showing individual subassemblies and fabricated pieces, with material specifications and other applicable data.
4. Installation instructions, operating and maintenance manuals and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
5. Schematic diagrams of power, control and piping system.
6. Service data sheets showing design performance, utility requirements, etc. as applicable to the specific duty for which the equipment is furnished.
7. Head capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data.
8. Curves and/or data for over-all range of operations from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.

9. Materials of construction of all components.
10. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
11. Stuffing box sizes; packing sizes, specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.

PART 2 – PRODUCTS

2.01 SINGLE SUPPLIER

- A. A single supplier shall furnish all components of the pump station control system. The supplier's experience must include equipment of comparable type and size in successful operation for not less than three years. Components shall be from a U.S. manufacturer with parts and service available within 200-mile radius of Chattanooga.

2.02 SITE REQUIREMENTS

2.1.1 PUMP STATION

- A. Lot size of at least 50 feet x 50 feet must be provided to contain the pump station and must be deeded to Hamilton County Water & Wastewater Treatment Authority. A minimum lot size of 40 feet x 40 feet may be permitted for small pump stations, if approved by the WWTA Executive Director or Chief Engineer.
- B. An access road right-of-way of at least 25 feet in width leading from a public road to the pump station must be deeded to Hamilton County. An access road of at least 16 feet in width must be constructed within the right-of-way consisting of a minimum of 6-inch layer of crushed stone on a properly compacted subgrade and must contain the necessary provisions for routing of storm drainage completely off the road surface.
- C. A minimum of 6-inch thick layer of crushed stone and 2-inch asphalt surface shall be provided over the entire 50 feet x 50 feet pump station lot.
- D. The finished grade of the pump station lot shall facilitate complete runoff of all storm water and shall in no way permit any standing water. The finished grade of the pump station lot shall be a minimum of one foot (1') above any 100-year flood elevations applicable to the site.

- E. The pump station site shall have properly designed and constructed side slopes, if applicable, to include soil erosion control fabric, seeding, and stone armor protection if required.
- F. The entire pump station lot shall be fully enclosed with a minimum 7-foot high chain link fence with vinyl privacy slats grey in color, located 1 foot inside edge of asphalt, which includes a one-foot section of three strands of barbed wire across the top. A 16-foot wide vehicle gate shall be provided on the side facing and in line with the access road. Fence fabric shall have no more than a 2-inch space between it and the finished grade of the pump station lot. A 3-foot wide walk-in gate shall be provided on the front side between the vehicle gate and corner post.
- G. Pump Station Wash Down Pad. An outdoor water hose spigot shall be provided within the pump station lot and shall be connected to a public water source. A reduced pressure backflow preventer shall be provided on the water service line within the pump station lot, and shall be located or properly housed such that freezing will be prevented, a 120v GFCI receptacle shall be provided with heat tape for the backflow preventer. The backflow preventer may be located on spigot if approved by local water utility company.

2.1.2 PUMP STATION WET WELL AND VALVE BOX

- A. The top of the pump station wet well (cover or hatch) shall be mounted 2-inches above the finished grade of the pump station lot.
- B. The cover or hatch of the pump station wet well and of the valve box shall both be capable of accommodating a padlock.
- C. All pump station wet wells and valve box shall be made completely waterproof, including any inlets or outlets and shall be coated with Hydo-Ester Coating, FX-70-9, as manufactured by Fox Industries. Concrete wet wells shall be constructed in accordance with WWTA's Manhole Specifications (Section 02605).
- D. Guiderails longer than 20' shall be provided with intermediate brackets.
- E. Wet wells shall be a minimum of 8' in diameter.
- F. Shut off valves and bypass port tees shall be required on the force main between the valve box and fence boundary, allowing for easy access and at least 4 feet between valve box and valves.
- G. Aluminum safety grate(s) able to withstand 300 lbs/sq ft shall be installed in wet wells. Refer to standard detail SD-PS-15.

H. Compaction

1. Unless otherwise specified herein, earth backfill shall be compacted to not less than 90 percent of the maximum density at optimum water content as determined by AASHTO T-99, Method A. Crushed stone and sand shall be compacted or consolidated to not less than 83 percent of the solid volume density as determined from the bulk specific gravity by AASHTO T-84 and T-85 and the dry weight of the aggregate.
2. Material that is too dry for adequate compaction shall receive a prior admix of sufficient water to secure optimum moisture content. Material having excessive water content shall not be placed at any time.
3. Unless otherwise specified herein backfill material required to be compacted shall be placed in horizontal layers not to exceed 6 inches in thickness (before compaction) and compacted in place by ramming, tamping, or rolling. Compaction shall be accomplished by power driven tools and machinery wherever possible. Compaction and consolidation of sand and crushed rock backfill shall be accomplished using vibrating equipment.

I. The wetwell shall be tested for water-tightness. Contractor shall fill wetwell with potable water and allow it to sit for 24 hours. If more than ten gallons of water is lost during the 24 hours, contractor shall empty the wetwell, make any necessary corrections, and retest.

PART 3 – EXECUTION

3.01 ELECTRICAL

All electrical installation and connections shall be performed by a licensed electrician. All work shall be performed and installed in accordance with all applicable NEC, State, and local electrical codes requirements.

3.02 POWER DISTRIBUTION

3.2.1 MAIN POWER FEED

- A. A 3 phase fused disconnect switch in a NEMA 4x (rain-tight), 304 stainless steel enclosure shall be provided between the electric meter base and the control panel, and shall be located inside the pump station fence and adjacent to the control panel mounted on the service pole.
- B. 40 watt LED security light with photocell and vandal shield shall be provided within the pump station lot and shall have a manual switch for

operating the light on and off. The light shall be located on the service pole.

- C. The incoming power shall be 480 volts, 3 phase, 60-hertz service. Any variation must be approved by the WWTA. Terminal blocks with box type lugs shall be supplied to terminate all wiring for floats and heat and seal sensors for the pump, if required.

3.2.2 AUXILLIARY

- A. 60 amp to 200 amp Lift Station: 200-amp Crouse-Hines \ receptacle (AR2042) shall be mounted on control panel and shall be compatible with existing WWTA generator(s).
- B. 400 amp Lift Station: 400-amp Crouse-Hines reverse contact receptacle (AR4044) shall be mounted on control panel and shall be compatible with existing WWTA generator(s).
- C. A manual breaker type transfer switch with mechanical interlock shall be provided inside the control panel for switching to auxiliary power. Power must equal incoming utility power.
- D. Pumps shall operate in automatic or manual modes under emergency generator powered conditions.
- E. A 3 phase lightning suppressor shall be mounted outside the disconnect on the service pole.

3.03 PUMP CONTROL PANEL

3.3.1 GENERAL

- A. Pump control panels provided for pump stations shall meet the following specifications. The motor control panel shall be fully assembled and shop tested, and ETL approved prior to installation at the pump station site.
- B. The main circuit breaker trip rating shall be determined by the control panel vendor and approved by the Engineer.
- C. A circuit breaker shall be used to protect from line faults and to disconnect the pump from the incoming power. Circuit breakers shall be thermal magnetic and sized to meet NEC requirements for motor controls. One circuit breaker shall be supplied for each motor, with a

separate circuit breaker being supplied for the transient voltage suppression.

- D. 120V Power to be supplied to the backflow preventer for heat tape, enclosure ventilation and heating components, instrumentation devices, and convenience power outlets (one outside and one inside the control panel).
- E. Control voltage shall be 120 volts AC and may be accomplished by the means of a transformer. A control breaker and fuse shall protect and isolate the control voltage from the line.
- F. Wire Duct and wire ties shall be used to maintain panel wiring in neat bundles and to prevent interference with operating devices. All wiring shall be numbered to facilitate maintenance and repair of the control panel. A schematic and a chart indicating a legend for wire numbers as used on the schematic shall be permanently attached to the inside surface of the front door.
- G. All ground connections shall be made with ring terminals to assure proper ground.

3.3.2 CONTROLS

- A. The controls for the pump shall be contained in a stainless steel, rain tight, NEMA type 4X rated enclosure.
- B. A canopy made of galvanized steel shall be provided over the entire control panel area, providing protection from the weather for personnel working in and around control panel(s).
- C. Panel shall contain a stainless steel dead front providing a protective barrier to operating personnel. This dead front will house all lights, pushbuttons, meters, displays and other operational interfaces.
- D. A locking hasp shall be provided on the outside panel door.
- E. A stainless steel skirt shall be installed on the front and back of the panel to hide and seal conduit entrances.
- F. The panel shall be equipped with an internal 400W condensation heater with adjustable thermoswitch. The heater shall be a Hoffman D-AH4001 or approved equal and the thermoswitch shall be a Hoffman Model A-TEMNC or approved equal.

- G. Equip the panel enclosure with a weatherproof intake louver and a thermostatically-controlled exhaust fan to provide positive panel ventilation and heat rejection. The louver shall be a Hoffman T-EP10SS or approved equal. The exhaust fan shall be a Hoffman Model T-FP 101SS or approved equal. The thermoswitch shall be a Hoffman model A-TEMNC or approved equal.
- H. A Hoffman Model A-LF16M12R fluorescent fixture and switch, or approved equal shall be mounted inside the control panel to illuminate the controls.
- I. A 120-volt outdoor duplex receptacle, with a ground fault interrupter shall be mounted on the control panel and shall be connected to a 20-amp circuit breaker.
- J. A steel back panel shall be provided. The back panel shall be mounted on stand-offs or studs using nuts and lock washers to maintain enclosure integrity and shall be used as the means for mounting the components in the enclosure.
- K. A 3 phase voltage surge suppressor shall be supplied to protect the motors from transient high voltage surges. This surge suppressor shall be wired to the main breaker on the secondary side. Device shall be an Eaton Model PTX160-NN400.
- L. Pumps shall be controlled by NE152 duplex pump controller.
- M. Phase Monitoring per pump. A phase monitor, undervoltage/overvoltage relay shall be provided to monitor correct phase sequence/voltage balance, and hard-wired to the controls to prevent motor operation in the event of a phase loss or improper voltage range condition. This failure should initiate the telemetry system. Phase monitor to be manufactured by Diversified Electronics SLA-440-ALE.
- N. The Dead Front shall contain a Phase Selectable Voltage Meter allowing the capability to view the voltage for all three phases of incoming power.
- O. The Dead Front shall contain a Phase Selectable Amperage Meter allowing the capability to view the amperages for all three phases of incoming power.
- P. The Dead Front shall contain Amperage Meters for each pump.
- Q. Conduits leading from wet-well and valve box shall be galvanized rigid pipe with PVC coating. All conduits, fittings, or connections shall enter

the enclosure through the bottom only. The seal offs and conduit entrance to Motor Control Panel shall be sealed with non-hardening putty. Locate the incoming power terminal block at the bottom of the enclosure to facilitate bottom conduit entry and ensure sound electrical integrity of the incoming power connections.

- R. For each pump a run light (GE 30mm or approved equal) and Hand-Off-Auto three-position switch (GE 30mm CR104 series or approved equal) shall be provided. Run lights and 3-position switches shall be mounted on the deadfront of the panel. The run light and 3-position switches shall be properly labeled as to function. The Hand-Off-Auto switches shall be selector switch type. Run lights shall be green. Pilot lights shall be supplied with LED type lamps.
- S. For each pump a reset button (GE 30mm 104 series or approved equal) and alarm light (GE 30mm or approved equal) shall be provided. The reset button will be an input to the alarm monitoring systems for resetting the alarm(s). Alarm lights shall be red. The pump leads shall be terminated at the overload relay.
- T. Motors less than 40hp shall use a NEMA rated full voltage motor starter and be sized using NEMA ratings. The magnetic starter shall include an overload relay which is ambient temperature compensated. The overload relay shall be capable of being reset manually with an overload reset mechanism. This mechanism will allow resetting the overloads from the deadfront.
- U. Motors rated 40hp or more shall use a solid-state reduced voltage starter with an integral bypass contactor manufactured by Danfoss or WEG.
- V. Control systems requiring variable frequency drives shall be approved by WWTA on case by case basis.
- W. All indicator lamps shall be push-to-test type.

3.04 CONTROL MODES

The pump control panel shall have two control modes: 1) Automatic and 2) Float. Each mode is briefly described below:

Automatic Mode – This mode is activated by the 2-position switch on the deadfront of the control panel. When the switch is in Automatic the system will alternate the lead and lag pumps to satisfy the duplex pump controller preset level setpoints. The analog level transducer will deliver a signal to the duplex pump controller to operate pumps.

Float Mode – This mode is activated by the 2-position switch on the deadfront of the panel. When the switch is in Float, the circuit is completely hard wired. Pump #1 will be the lead pump and pump #2 will be the lag pump. Float mode will be the backup mode for when the duplex pump controller is out of service.

Each pump shall have a hand-off-auto switch. Pumps left in auto shall operate in either float or automatic mode.

3.05 EXTERNAL DEVICES

There shall be a total of five (5) redundant float switches on the system: 1) low level alarm float, 2) pump(s) off, 3) lead pump on, 4) lag pump on, and 5) high-level alarm float. These shall be used for backup operation of pumps in case of pump controller failure and for redundant high and low level alarm. These shall be internally weighted mechanical float switches. Each float switch assembly shall include an internal weight to sufficiently hold the float in position. Each level switch shall have a switch rating of at least 10 amps, and be supplied with sufficient 2-conductor type SJO cable to reach the control enclosure with no splices. Cable splices or junction boxes inside the wet well are not acceptable. Conduit for SJO cables shall be at least 2" in diameter.

The wet well level shall be monitored by a loop powered 4-20ma analog level transmitter to the controller with stainless steel mounting bracket. The level transmitter shall be VEGAPULS C11 or C21, model varies depending on wetwell depth.

A seal failure alarm system shall be provided for each pump and shall consist of the necessary dual channel seal fail alarm relays and wiring to detect moisture in the pump seal housing and activate an indicating light.

A thermal overload/heat sensor control circuit shall be provided for each pump to insure pump shutdown if a motor overtemp condition occurs. (Applies to submersible pumps only.)

Elapsed time meters shall be provided for each pump motor to independently record pump running times, and one (1) additional time-meter shall be provided to record parallel pump running time. Time resolution shall be in 1/10th hours.

3.06 FAILURE/ DIALER

The pump control panel shall include an eight-channel minimum automatic alarm dialer and all necessary contact relays to monitor the pump station fault conditions listed below, and automatically report these fault conditions by the phone lines to the programmed phone numbers. Dialer shall be capable of monitoring the following fault conditions:

1. Phase Failure
2. Low Wet Well Level
3. High Wet Well Level
4. #1 Pump Failure
5. #2 Pump Failure
6. #1 and #2 Pump Seal Failure
7. #1 Overtemp
8. #2 Overtemp

The alarm dialer shall be a Sensaphone Express II. A surge protector shall be provided for the dialer power supply and phone line. All fault conditions, except the pump failure shutdown circuit, shall reset automatically when the fault condition returns to normal. Dialer shall be protected from extreme temperatures, and shall be mounted inside electrical panel with keypad, digital readout and input lights visible through secondary door.

The alarm dialer shall be configurable from the HMI. The ability to select which alarm goes to each dialer input will be provided from the touch screen.

3.07 MISSION COMMUNICATIONS RTU

1. Furnish a Mission Communications MyDro Model M850 Wireless Real-Time Alarm, Monitoring, and Remote Control RTU unit in a Flatpak NEMA 1 enclosure. Install the unit in the control cabinet. The RTU unit shall be supplied with a VEGAPULS C11 radar sensor for wet well depths less than 27.3 feet or a VEGAPULS C21 for depths greater than 27.3 feet. RTU unit shall be mounted with stainless steel brackets. 24V auxiliary output shall be provided to power the radar sensor.
2. The Mission Communications system shall include a minimum of eight on-board digital inputs (dry) and two on-board analog inputs with four alarm set points each. Furnish all necessary contact relays to monitor the pump station fault conditions listed below and automatically report these fault conditions by cell phone signal to the programmed phone numbers. The unit shall be capable of monitoring the following fault conditions:

1. #1 Pump Run
2. #2 Pump Run
3. Low Wet Well Level
4. High Wet Well Level
5. #1 Pump Failure
6. #2 Pump Failure
7. #1 Overtemp
8. #2 Overtemp

3.08 INSPECTION

- A. Inspect equipment for factory defects or transportation/handling damage prior to installation. Replace or repair damaged equipment.

3.09 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations and installation drawings.

3.10 START UP AND OPERATION

- A. The Contractor shall provide pump station check-out and start-up by the manufacturer's service representative(s) and start-up shall be performed in the presence of an authorized WWTA representative.
- B. Operation and Maintenance manuals for all equipment (three copies) shall be submitted to the Engineer. The manuals shall be bound in a three ring binder.
- C. The manufacturer is to furnish the services of a factory-trained field engineer specializing in this work to inspect and adjust the equipment after installation, to test the equipment, supervise start-up, and instruct the Owner's personnel in its proper use. Provide a minimum of one day of operator training for both operation and routine maintenance requirements for the pumps and motors.

D Field Tests

1. Manufacturer's field engineer to test each unit under actual operating conditions to show that each pump unit operates satisfactorily without cavitation, overheating, or overloading, and free from excessive vibration and noise throughout the complete head and capacity range at rated speed.
2. Allow Engineer to observe field tests.
3. Successful operation shall be demonstrated to the satisfaction of the Engineer. Make, at Contractor's expense, all necessary changes, modifications, and/or adjustments required to assure satisfactory and efficient operation.
4. Control system's authorized representative to provide a written report to the Engineer noting that pumps and motors have been installed in accordance with manufacturer's recommendations, are in conformance with project performance requirements, and are ready for operation.

END OF SECTION 11312

SECTION 11314

SIMPLEX GRINDER PUMP SEWAGE STATIONS

PART 1 – GENERAL

1.01 SCOPE

- A.** The work covered by this section shall include furnishing all labor, equipment and materials required for the construction and installation of simplex grinder pump sewage stations.

1.02 DESCRIPTION

- A.** Simplex grinder pump sewage stations shall be supplied as a packaged system and shall consist of sewage grinder pump, level control switches, discharge plumbing with hydraulically sealed discharge flange, pump mounting plates with bottom rail supports, upper rail supports, lifting chain and cord sealing plate which is installed in a factory fabricated fiberglass basin with cover. Sufficient length of electrical cord shall be supplied for mounting remote from the basin as required.

1.03 OPERATING CONDITIONS

- A.** Simplex Unit. Provide 24-gpm capacity pump against a total head of 80 feet. Pump motor shall be 2 hp, single phase, 230 volts, 3500 rpm.
- B.** Pumps shall be designed to pump against a minimum shutoff head of 94 feet.

1.04 SUPPLIER

- A.** Simplex grinder pump sewage stations (including pump, control panel, interior valves and piping, and fiberglass basin) shall be purchased from an approved supplier.

1.05 GUARANTEE

- A.** The Contractor shall provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, “Guarantees and Warranties”, of these Specifications.

PART 2 – PRODUCTS

2.01 SEWAGE PUMPS

- A.** Construction. Each simplex pump shall be 2 hp sealed submersible type, Model HPG200M2-2 (with 5.00-inch impeller) as manufactured by Aurora/Hydromatic

Pumps, Inc. The pump volute, motor, and seal housing shall be high quality gray cast iron, ASTM A-48, Class 30. All external mating parts shall be machined and Buna N Rubber O-ring sealed on a beveled edge. Gaskets shall not be acceptable. All fasteners exposed to the pumped liquids shall be 300 series stainless steel.

B. Electrical Power Cord

1. Electrical power cord shall be water resistant 600V, 60° C, UL and/or CSA approved and applied dependent on amp draw for size.
2. The power cable entry into the cord cap assembly shall first be made with a compression fitting. Each individual lead shall be stripped down to bare wire, at staggered intervals, and each strand shall be individually separated. This area of the cord cap shall then be fitted with an epoxy compound potting which will prevent water contamination to gain entry even in the event of wicking or capillary attraction.
3. The power cord leads shall then be connected to the motor leads with extra heavy connectors having brass inserts with a screwed wire to wire connection.
4. The cord cap assembly where bolted to the connection box assembly shall be sealed with a Buna N Rubber O-ring on a beveled edge to assure proper sealing.

C. Motor

1. The stator, rotor, and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F insulation (155° C or 311° F), and a dielectric oil filled motor, NEMA L design (single phase).
2. The pump and motor shall be specifically designed so that they may be operated partially dry or completely submerged in the liquid being pumped.
3. Stators shall be securely held in place with a removable end ring and threaded fasteners so that they may be easily removed in the field, and must be capable of being repaired or rewound by a local motor service station. No special tools shall be required for pump and motor disassembly.
4. Pump shall be equipped with heat sensor. The heat sensor shall be a low resistance, bi-metal disc that is temperature sensitive. It shall be mounted directly in the stator and sized to open at 120° C or 130° C and automatically reset at 30-35° C differential. The sensor shall be connected

in series with the motor starter coil so that the starter is tripped if a heat sensor opens. The motor starter shall be equipped with overload heaters so all normal overloads are protected by external heater block.

D. Bearings and Shaft

1. An upper radial bearing and lower thrust bearing shall be required. These shall be permanently lubricated by the dielectric oil which fills the motor housing.
2. The shaft shall be machined from solid 416 stainless steel and be a design which is of large diameter with minimum overhead to reduce shaft deflection and prolong bearing life.

E. Seals and Sensors. The rotor and stator in the motor housing shall be separated and protected from the pumped liquid by an oil filled seal housing incorporating two type 21 carbon ceramic mechanical seals mounted in tandem. The seal housing shall be equipped with 2 moisture sensing probes installed between the seals, and the sensing of moisture in the seal chamber shall be automatic, continuous, and not require the pump to be stopped or removed from the wet well. The sensor probes shall be electrically isolated, with a resistor between each probe to eliminate grounding to the casing.

F. Impellers. Impellers shall be bronze multi-vane, semi-open, non-overloading design. They shall be factory trimmed to meet specific performance conditions. Impellers shall be hydraulically and statically balanced at the factory, and machined for threading on to the pump shaft.

G. Grinder Cutters

1. The combination centrifugal pump impeller and grinder unit shall be attached to the common motor and pump shaft made of 416 stainless steel. The grinder unit shall be on the suction side of the pump impeller and discharge directly into the impeller inlet leaving no exposed shaft to permit packing of ground solids. The grinder shall consist of two stages. The cutting action of the second stage shall be perpendicular to the plane of the first cut for better control of the particle size. The grinder shall be capable of grinding all materials found in normal domestic sewage, including plastics, rubber, sanitary napkins, disposable diapers, and wooden articles into a finely ground slurry with particle dimensions no greater than $\frac{1}{4}$ inch. Both stationary and rotating cutters shall be made of 440C stainless steel hardened to Rockwell 60C and ground to close tolerance.

2. The upper (axial) cutter and stationary cutter ring shall be reversible to provide new cutting edges to double life. The stationary cutter ring shall be slip fit into the suction opening of the volute and held in place by three (3) 300 series stainless steel screws and a retaining ring. The lower (radial) cutter shall macerate the solids against the I.D. of the cutter ring and extrude them through the slots of the cutter ring. The upper (axial) cutter shall cut off the extrusions, as they emerge from the slots of the cutter ring to eliminate any roping effect which may occur in single stage cutting action. The upper (axial) cutter shall fit over the hub of the impeller and the lower (radial) cutter shall be slip fit and secured by means of peg and hole and rotate simultaneously with the rotation of the shaft and impeller. The grinding mechanism shall be locked to the shaft by a 300 series stainless steel countersunk washer in conjunction with a 300 series stainless steel flat head cap screw threaded into the end of the shaft.

H. Painting. The pump shall be painted after assembly, with an alkyd air dried lead free enamel with a minimum mil thickness of 3 to 4 mils.

I. Testing. Commercial testing shall be required and include the following:

1. The pump shall be visually inspected to confirm that it is built in accordance with the specifications as to HP, voltage, phase, and hertz.
2. The motor and seal housing chambers shall be hi-potted to test for moisture content and/or insulation defects.
3. Pump shall be allowed to run dry to check for proper rotation.
4. Discharge piping shall be attached, the pump submerged in water, and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator will be replaced.

2.02 ALARM AND CONTROL PANEL

A. Each simplex grinder pump station control panel shall be UL listed and shall include a NEMA 4X enclosure. It shall include circuit breaker(s) and all necessary components to accomplish proper pump and control operation including the following control and alarm capabilities:

1. The liquid level in the fiberglass basin shall be controlled by a diaphragm pressure switch or wide angle mechanical float switch.

2. When liquid level in fiberglass basin rises above the alarm level, visual and audio alarms will be activated by a float switch.
3. Audio alarm may be silenced by means of a push-to-silence button.
4. Visual alarm remains illuminated until sewage in the basin returns to normal operating level.

B. The visual alarm shall be a red fluted lens mounted on the top of the enclosure in such a manner as to maintain rain proof integrity.

C. The audio alarm shall be capable of being de-activated by depressing a push-type switch mounted on the interior or exterior of the enclosure.

2.03 CHECK VALVES AND PIPING

A. The discharge piping shall include a ball check valve with hydraulically sealed discharge flange and isolation valve. Discharge from station shall be fitted with NPT couplings. All piping external to the station shall be furnished and installed by the contractor.

2.04 FIBERGLASS BASIN

A. Unless otherwise indicated, the plastic terminology used in this specification shall be in accordance with the definitions given in ASTM D3299-81. This specification is for the hand lay-up, chopped spray technique and filament wound methods for manufacturing of vertical underground fiberglass basins. Other methods of manufacturing shall not be acceptable.

B. The resin used shall be of a commercial grade and shall be evaluated as a laminate by test or determined by previous service to be acceptable for the environment. The resins used may contain the minimum amount of fillers or additives required to improve handling properties. Up to 5% by weight of thixotropic agent which will not interfere with visual inspection may be added to the resin for viscosity control. Resins may contain pigments and dyes by agreement between fabricator and engineer, recognizing that such additions may interfere with visual inspection of laminate quality.

C. The reinforcing material shall be a commercial grade of glass fiber having a coupling agent which will provide a suitable bond between the glass reinforcement and the resin.

D. The laminate shall consist of an inner surface, and interior layer, and a filament-wound structural exterior layer of laminate body.

- E. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot, providing the pits are less than 1/8" in diameter with not over 1/32" deep and are covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness shall be permissible as long as the surface is smooth and free of pits. Between 0.100 and 0.020 inches of resin-rich surface shall be provided.
- F. A minimum of 0.100 inch of laminate next to the inner surface shall be reinforced with 30% by weight of chopped-strand fiber having fiber lengths from 0.5 to 2.0 inches.
- G. Subsequent reinforcement shall be continuous-strand roving fiberglass. The thickness of the filament-wound portion of the tank shell shall vary with the tank height to provide the aggregate strength necessary to meet the tensile and flexural requirements. If additional longitudinal strength is required, the use of other reinforcement, such as woven fabric, chopped-strand mat, or chopped strands shall be interspersed in the winding to provide additional strength. Glass content of this filament-wound structural layer shall be 50 to 80% by weight. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. Hand work finish shall be present to prevent fiber exposure.
- H. The tank wall must be designed to withstand wall collapse based on assumption of hydrostatic type loading by backfill with a density of 120 lb./cu.ft. The tank wall laminate must be constructed to withstand or exceed two times the assumed loading for any depth of basin.
- I. For the tank bottom, subsequent reinforcement shall be of 1.5 oz./sq.ft. chopped strand fiber or woven roving to a thickness to withstand applicable hydrostatic uplift pressure, with a safety factor of 2. In saturated conditions, the center deflection of any empty tank bottom shall be less than 3/8" (elastic deflection) and will not interfere with bottom pump mounting requirements nor rail system.
- J. The width of the first layer of joint overlay shall be 3" minimum. Successive layers shall uniformly increase in width to form a smooth contour laminate that is centered on the joint $\pm \frac{1}{2}$ ". A highly filled resin paste may be placed in the crevices between joined pieces leaving a smooth surface for lay-up. The cured resin surface of the parts to be joined shall be roughened to expose glass fiber. The roughened area shall extend beyond the lay-up areas so that no reinforcement is applied to an unprepared surface. Surfaces shall be clean and dry before lay-up. The entire roughened area shall be coated with resin after joint overlay is made.
- K. The finished laminate shall be free as commercially practicable from visual defects such as foreign inclusion, dry spots, air bubbles, pinhole, pimples, and delamination.

- L. The surfaces shall be relatively smooth, hand finish is acceptable, with no exposed fibers or shard projections.
- M. Tanks shall be mounted on cradles if shipping is horizontal, or on a suitable skid or pallet if shipping in the vertical position. The tank shall be secured to the cradles or skid so that there can be no movement of the tank in relation to the skid or cradle under normal handling.
- N. The tank bottom shall extend past the tank walls so that the O.D. is approximately 4" larger in diameter than the O.D. of the sidewalls. This larger diameter shall serve as an anti-floatation flange. The contractor shall place the tank on stone bedding and pour concrete covering the anti-floatation flange.
- O. Tank shall include NPT discharge fitting. Two 6-inch caulking type bolt-on thermoplastic influent hubs shall be provided for mounting in the field. The hubs shall be beveled approximately three degrees to accommodate gravity pipe coming in from various angles. The influent hubs shall have textured surface in order to provide better caulking adhesion.
- P. The top flange and cover O.D. shall assure a tight fit and afford ease of access. Noncorroding stainless steel heli-coils shall be inserted in all bolt holes of the top flange and shall be positively locked with threads and resin to prevent stripping. A 10-hole pattern shall accommodate the mounting of a one-piece cover.

2.05 COVER

- A. Cover shall be of fiberglass construction with an O.D. equal to the O.D. of the top flange on the basin. Cover shall be secured by stainless steel bolts.

2.06 ELECTRICAL SPLICE J-BOX

- A. The electrical splice j-box shall provide easy access for inspection and servicing and be of corrosion resistant materials. The electrical splice box shall be UL approved for wet locations, equipped with electrical cord grips with four (4) ½-inch cord grips and two (2) ¾-inch cord grips, and include UL listed butt splice connectors.

PART 3 – EXECUTION

3.02 PUMP AND CONTROL PANEL INSTALLATION

- A. All pumping systems shall be installed in accordance with the manufacturer's recommendations.

- B. The pump control panel shall be mounted as shown on the Drawings, a minimum of 3 feet for finished grade, and shall be accessible to maintenance personnel. The control panel shall be wired to a dedicated 30 amp breaker which supplies power within 5 feet of the control panel.
- C. Underground wiring shall be installed a minimum of 8 inches deep in Schedule 40 conduit with warning tape installed 6 inches above the buried power. The warning tape shall be plastic non-biodegradable marked "Power".
- D. Wiring from the pump control panel to the electrical splice j-box on the basin cover shall be a minimum #14 stranded wire and colored insulation matching the manufacturer's diagram. Connections in the j-box shall be installed as per the manufacturer's specification. A good quality heat shrink shall be used on all leads except that the "common" connection may be an approved wire nut. Splices shall be capable of lifting out of the junction box a minimum of one foot.
- E. Excess float and power cables shall be tied with ABS ties or other approved corrosion resistant material to keep the cables from interfering with the float switches.
- F. All electrical work shall conform to the State and local electric codes.
- G. All electrical inspections and tests for the control panel and grinder pump stations are done by Hamilton County Water and Wastewater Treatment Authority.
- H. All electrical inspections and tests shall be completed and passed before acceptance of the system.

3.03 FIBERGLASS BASIN INSTALLATION

- A. All manufacturer's recommendations and installation instructions shall be followed during installation and backfill operations. The basin hole shall not be more than 1-foot longer and 1-foot wider than the tank. There shall be a minimum 6-inch, 57 stone bedding under the tank when in soil terrain. There shall be a minimum 12-inch, 57 stone bedding under the tank when in rock.
- B. After setting the basin in the hole, the basin shall pass a leakage test. The leakage test shall be in accordance with the Tennessee Department of Environment and Conservation criteria.
- C. Prior to backfill, the basin shall pass an inspection conducted by the Engineer.
- D. After passage of the leak test and inspection, the concrete anti-flootation ring shall be poured and the basin covered. The backfill shall contain no rocks or stones larger than 2-inches in diameter.

- E. Basins shall not be installed beneath the paths of vehicles or heavy equipment.
- F. Grading, restoration, and cleanup shall be completed prior to final acceptance by the Engineer.

END OF SECTION 11314

SECTION 15062
DUCTILE IRON PIPING AND DUCTILE IRON AND CAST IRON FITTINGS

PART 1 - GENERAL

1.01 SCOPE

The work covered by this section includes furnishing all labor, equipment, and materials required to furnish, install, and test ductile iron piping, including all fittings, wall pipe and sleeves, couplings, toppings, anchor blocks, and accessories, as specified herein and/or shown on the Drawings.

1.02 QUALITY ASSURANCE

- A. The Contractor shall submit to the Engineer written evidence that the pipe furnished under this specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.
- B. Each ductile iron pipe length and fitting and cast iron fitting shall be clearly marked with the pressure rating, metal thickness class, heat mark, net weight (excluding lining or coating) and name of the manufacturer. In addition, each item of piping shall be marked with an identifying mark corresponding to the appropriate mark on the shop drawings for that particular item of piping.

1.03 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data on all piping and accessories shall be submitted to the Engineer in accordance with the requirements of section 01300, "Submittals" of these Specifications.
- B. Shop drawings shall indicate piping layout in plan and elevations as may be required and shall be completely dimensioned. The Drawings shall include a complete schedule of all pipe, fittings, specials, hangers, and supports. Special castings shall be clearly detailed showing all pertinent dimensions.
- C. The Contractor shall furnish the Engineer with lists, in duplicate, of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size, and description of each item received.

1.04 STORAGE AND PROTECTION

Piping and accessories shall be stored and protected in accordance with the requirements of section 01615, "Storage and Protection" of these Specifications.

1.05 SHOP PAINTING

Unless otherwise specified herein, all ductile iron pipe and fittings and cast iron fittings shall be cleaned and provided with a bituminous coating and cement lining applied at the factory.

1.06 GUARANTEE

Provide a guarantee against defective materials and workmanship in accordance with the requirements of section 01740, "Guarantees and Warranties" of these Specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. No broken, cracked, deformed, misshapened, imperfectly coated, or otherwise damaged or defective pipe or fittings shall be used. All such material shall be removed from the site of the work.

B. Unless otherwise shown on the Drawings or directed by the Engineer, the minimum pipe wall thickness and thickness class of pipe shall be as follows:

<u>Pipe Size</u>	<u>Pressure Class (psi)</u>	<u>Metal Wall Thickness (Inches)</u>
3-Inch Ductile Iron	350	0.25
4-Inch Ductile Iron	350	0.25
6-Inch Ductile Iron	350	0.25
8-Inch Ductile Iron	350	0.25
10-Inch Ductile Iron	350	0.26
12-Inch Ductile Iron	350	0.28
14-Inch Ductile Iron	250	0.28
16-Inch Ductile Iron	250	0.30
18-Inch Ductile Iron	250	0.31
20-Inch Ductile Iron	250	0.33
24-Inch Ductile Iron	250	0.37
30-Inch Ductile Iron	250	0.42
36-Inch Ductile Iron	250	0.47
42-Inch Ductile Iron	250	0.52
48-Inch Ductile Iron	250	0.58
54-Inch Ductile Iron	250	0.65
60-Inch Ductile Iron	250	0.68

2.02 DUCTILE IRON PIPE

- A. Ductile Iron pipe shall be designed in accordance with ANSI A21.50, Thickness Design of Ductile Iron Pipe, using 60,000 psi tensile strength, 42,000 psi yield strength, and 10 percent elongation. Additionally, ring bending stress is limited to 48,000 psi to provide a 2.0 safety factor based upon ultimate bending stress.
- B. Ductile iron pipe shall be manufactured in accordance with ANSI A21.51, Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids, and shall be made of ductile iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi and 10 percent minimum elongation.

2.03 CAST IRON AND DUCTILE IRON FITTINGS

- A. All fittings shall conform in every respect to ANSI A21.10, 2 inches through 48 inches, for Water and Other Liquids.
- B. Unless otherwise shown on the Drawings, directed or specified, all fittings shall be for pressure rating of 250 psi.

C. In general, flanged fittings shall be ANSI pattern using long radius elbows except where space limitations prohibit the use of same. Design of all fittings, whether long or short pattern, shall be as indicated or dimensioned on the Drawings. Special fittings and cast iron and ductile iron wall pipes and sleeves shall conform to the dimensions and details shown on the Drawings.

2.04 JOINTS FOR DUCTILE IRON PIPE AND FITTINGS AND CAST IRON FITTINGS

A. General

1. Joints for ductile iron pipe and fittings and cast iron fittings shall be mechanical joints, flanged joints, push-on joints, or ball joints, as shown on the Drawings or specified herein.
2. Unless otherwise shown on the Drawings, specified or directed, all ductile iron pipe laid underground shall be joined using mechanical joints or push-on type joints.

B. Mechanical Joints

1. Mechanical joints shall consist of a bolt joint of the stuffing box type as detailed in ANSI A21.10 and described in ANSI A21.11.
2. Mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high strength, heat treated cast iron containing 0.50 copper or high strength low-alloy steel having a minimum yield point strength of 40,000 pounds per square inch and an ultimate tensile strength of 70,000 pounds per square inch.
3. Gaskets and bolts and nuts shall conform to ANSI A21.11. Gaskets shall be of neoprene or rubber of such quality that they will not be damaged by the liquid or gases with which they will come into contact.
4. Glands shall be of high strength ductile iron.

C. Flanged Joints

1. Flanged joints shall conform to ANSI B16.1, Class 125, and in accordance with Table 10.23 of ANSI A21.10.
2. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolts and nuts shall conform in dimensions to the American Standard heavy series. Nuts shall be hexagonal, cold pressed. Bolts and nuts shall be cadmium plated, cold pressed, steel machine bolts, conforming to

ASTM A 307, Grade B. Cadmium plating shall be by an approved process and shall be between 0.003- to 0.0005-inch thick. After each joint has been made, all bolts, heads, and nuts shall be coated with two coats of heavy asphaltum or other approved coating.

3. Gaskets of "Cranite," red rubber, asbestos composition, or other approved quality shall be used in all flanged joints. Gaskets shall conform to the requirements of ANSI B16.21.
4. Flanged ductile iron pipe approximately twelve (12) inches or less in length shall have flanges cast solidly to the pipe barrel. Flanges on ductile iron pipe longer than twelve (12) inches may be of the screw type. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. Flange faces on cast iron fittings shall be coated with white lead immediately after they have been faced and drilled. All pipe with screw type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the Engineer.
5. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.

D. Push-On Joints

1. Push-on joints shall conform to ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as "Fastite," "Bell-Tite," or "Tyton" joints.
2. Gaskets shall be in accordance with ANSI A21.11 and shall be of such quality that they will not be damaged by the liquid or gases with which they will come into contact.

E. Ball Joints

Ball joints in river pipe shall be self-restraining, boltless, provide 15° of deflection in any direction, and shall conform to the applicable requirements of AWWA C110.

2.05 PIPE COATING AND LINING

- A. All ductile iron pipe and fittings and cast iron fittings buried underground or submerged shall have a standard bituminous outside coating conforming to ANSI

A21.6 or A21.51. All exposed ductile iron pipe and ductile iron and cast iron fittings shall have an outside coating of universal primer.

- B. All ductile iron pipe used for wastewater shall be cleaned and provided with a bituminous coating and Protecto 401, TNEMEC 431, or Permax CTF lining or approved equal.
- C. No lining shall be provided for ductile iron pipe and ductile iron and cast iron fittings used for air.

- D. Where a special lining is indicated on the Drawings for resistance to corrosive wastewaters, pipe and fittings shall be furnished with a minimum 20 mil thick lining of chemically inert, abrasion resistant polyethylene. The lining shall be a blend of high density and low density polyethylene powders complying with ASTM D 1248 compounded with carbon black to provide resistance to ultraviolet rays during storage above ground. The pipe shall be preheated in a furnace (to ensure uniformity of heat distribution) to an adequate temperature to provide uniform fusing of the polyethylene powders and proper bonding to the pipe. The lining shall be unaffected by hydrogen sulfide, detergents, grease, oil, inorganic acids, alkalis, and most organic materials found in municipal wastewaters and shall be suitable for service at operating temperatures of up to 180°F. The lining shall have a Hazen-Williams "C" coefficient of approximately 150 and a Manning "n" coefficient of approximately 0.010. Polyethylene-lined ductile iron pipe shall be U.S. Pipe "Polylined," American Cast Iron Pipe "Polybond," or equal.

2.06 PIPE COUPLINGS

- A. Pipe couplings shall be installed where shown on the Drawings, required for installation, or directed by the Engineer.
- B. HDPE to DI transition couplings must match the DI MJ bell and provide a restrained connection. Specific configurations shall be submitted to the engineer for review and approval prior to installation.

2.07 WALL PIPE AND WALL SLEEVES

- A. Contractor shall furnish and install ductile or cast iron wall sleeves where ductile iron piping passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors.
- B. Where sleeves are to be installed flush with the wall or slab, the flange or bell shall be tapped for studs. Where the flange or bell will project beyond the wall, the projection shall be sufficient to allow for installation of connecting bolts.

2.08 SPARE PARTS

Upon the request of WWTA the Contractor shall furnish four (4) spare gaskets for each size and type of joint requiring the use of a gasket. The Contractor shall furnish eight (8) bolts and nuts of each size and type used for cast iron and ductile iron pipe joints.

PART 3 - EXECUTION

3.01 LAYING

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed by the Engineer.
- B. All pipe and fittings shall be carefully examined by the Contractor for defects just before laying and no pipe or fitting shall be laid which is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense.
- C. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Installation of ductile iron pipe in underground pressure piping systems shall conform to the requirements of AWWA C600. Excavation of trenches and backfilling around pipes shall conform to the requirements of section 02220, "Earthwork" of these Specifications.
- E. All ductile iron piping laid underground shall have a minimum of 36 inches of cover above the top of the pipe unless otherwise shown on the Drawings.
- F. All elbows, tees, branches, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping containing unharnessed push-on or mechanical joints or expansion joints shall be restrained by thrust blocks. Thrust blocks shall consist of Class B concrete conforming to the requirements of section 03300, "Cast-In-Place Concrete" of these Specifications and shall be of the size and shape as shown on the Drawings. The Contractor may use forms or earth walls to mold the thrust blocks. When earth walls are used, they shall be cut true to shape and all excess earth removed. The work shall be

conducted so that no loose earth will become mixed with the concrete. At the end of 24 hours, damp earth may be placed over the concrete to retain moisture.

- G. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth as shown on the Drawings to prevent breakage resulting from settlement of backfill around the structure.
- H. Wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.
- I. Wall sleeves shall be installed when the wall or slab is constructed. Blocking out or breaking of the wall for later insertion shall not be permitted.
- J. Cutting or weakening of structural members to facilitate pipe installation shall not be permitted. All piping shall be installed in place without springing or forcing.
- K. Sufficient couplings and flanged joints shall be provided to facilitate equipment installation and removal.
- L. Exposed ductile iron piping shall be supported as shown on the Drawings.

3.02 CUTTING

- A. Whenever pipe requires cutting to fit the lines, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made for the portion cut off and not used.
- B. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.
- C. All cutting of ductile iron pipe shall be done with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe.

3.03 JOINING

- A. Mechanical Joints
 - 1. The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and that adequate anchorage shall be provided where abrupt changes in direction and dead ends occur.

2. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
3. Joint bolts shall be tightened by the use of approved wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side and last, the remaining bolts. This cycle shall be repeated until all bolts are within the range of acceptable torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
4. After installation, bolts and nuts in buried or submerged piping shall be given two (2) heavy coats of a bituminous paint.

B. Flanged Joints

1. All flanges shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations, or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. Where screwed flanges are used, the finished pipe edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe.
2. Connections to equipment shall be made in such a way that no strain is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.
3. After installation, bolts and nuts in buried or submerged piping shall be given two (2) heavy coats of a bituminous paint.

C. Push-on Joints

1. The inside of the bell and the outside of the pipe from the plain end to the guide stripe must be wiped clean immediately before assembling the pipe joint. Then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe from the plain end to the yellow guide stripe and to the inside of the gasket. The plain end shall be centered in the bell and the spigot pushed home. Wherever possible the pipe shall be socketed by hand; however, jacking may be required to push the spigot in place on the larger sizes of pipe. The completed joint shall be permanently sealed and watertight.
2. Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

D. Permissible Deflection of Joints

1. Deflection of ductile iron pipe at joints for long radius curves or for avoiding obstacles shall be permitted only upon approval of the Engineer.
2. Where deflection of joints is permitted, such deflection shall be made in accordance with and shall not exceed limits provided in Section 9b.5 and Section 9c.4 as applicable, of the AWWA C600.

E. Joints of Dissimilar Metals

When a flanged joint consists of a ductile iron flange mated to a steel or alloy flange, the steel flanges shall be flat faced and furnished with full-faced gaskets, insulating bushings, and stainless steel bolts.

3.04 SERVICE CONNECTIONS

- A. In general and unless otherwise shown, small service lines and branches shall connect to larger ductile iron mains using ductile iron tapped tees and crosses and to cast iron mains using cast iron tapped tees and crosses.
- B. Tapped tees and crosses shall have minimum 2-inch NPT branch connections and shall be furnished with mechanical joint ends.

3.05 CUT-INS TO EXISTING PIPING

- A. In general and unless otherwise shown, cut-ins to existing ductile iron piping for installation of new mechanical joint fittings and valves shall be made using ductile iron cutting-in sleeves.

B. Cutting-in sleeves shall have a pressure rating not less than that of the existing pipeline and shall be furnished with mechanical joint end on one end and a plain end on the other.

3.06 DRILLING AND TAPPING

A. Wherever required, ductile iron pipe and fittings and cast iron fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.

B. Where the size of the pipe to be connected is such as to require bosses for connection and when the pipe wall thickness is too thin to permit the effective length of pipe threads to be utilized as necessary for the size pipe being connected by threads, the Contractor shall furnish such pipe with cast-on bosses suitable for drilling, tapping, and connecting such pipe. Alternately, where shown or specified a tapped saddle clamp may be used in lieu of a cast-on boss. Saddle clamp shall be of the heavy-duty type with O-ring gasket and two (2) heavy U-bolt clamps.

C. All tapping shall be carefully and neatly done by skilled workmen with suitable tools.

D. Where connections are made between new and old piping, the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.

E. Cut-ins to existing and operating pipelines shall be done at times agreeable to the Owner upon approval of the Engineer.

F. Existing pipelines that may be cut or damaged during the performance of work under this item shall be repaired, reconnected, and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Specification.

G. No separate payment will be made for drilling, tapping, making connections, cut-ins, repairs to damaged existing pipelines, and reconnections in existing pipelines.

3.07 FIELD TESTING

A. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.

- B. All piping shall be subject to a hydrostatic gauge pressure equal to 150 percent of the maximum operating pressure of the pipe section under test or 150 psig, whichever is greater, based on the elevation of the lowest point of the section of pipe under test and corrected to the elevation of the test gauge. The above pressures shall be maintained for a minimum of two (2) consecutive hours. No leakage will be allowed. Leakage may be determined by loss of pressure or other methods approved by the Engineer. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed gate or butterfly valves.
- C. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- D. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled adequately to secure the pipe during the test. All joints, fittings, and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.
- E. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants, blow-offs, or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- F. After satisfactory completion of the pressure test, a leakage test shall be performed on each section of pipe in accordance with Section 4.2 of AWWA C600 at a hydrostatic pressure equal to the maximum operating pressure of the pipe section under test, based on the elevation of the lowest point of the line or lowest point of the section under test and corrected to the elevation of the gauge.
- G. Any leakage developing during the test shall be corrected at the Contractor's expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. Caulking will not be permitted. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility tested without leakage.
- H. After all test on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent the freezing of the same. The Contractor shall also demonstrate to the satisfaction of the Engineer that any and all lines are free from obstructions and foreign material.

- I. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and any other materials required to conduct the tests.

END OF SECTION 15062

SECTION 15064
HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test high density polyethylene (HDPE) pipe as shown on the Drawings and/or specified herein.

1.02 QUALITY ASSURANCE

- A. All HDPE pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with ASTM methods and shall comply with these Specifications.

1.03 PIPE MARKING

- A. All HDPE pipe shall have the following data clearly marked on each piece:
 - 1. Manufacturer's name or trademark.
 - 2. Nominal pipe size and O.D. base.
 - 3. ASTM material code designation.
 - 4. Dimension ratio.
 - 5. Type, class, and grade.
 - 6. ASTM specification designation (D 3350).

1.04 SUBMITTALS

- A. Shop drawings shall be submitted to the Engineer for approval and shall include dimensioning, product data, and technical specification for all piping to be furnished.
- B. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of section 01300, "Submittals" of these Specifications.

1.05 STORAGE AND PROTECTION

- A. Care shall be taken during transportation of the pipe that it is not cut, kinked, or otherwise damaged.
- B. Ropes, fabric, or rubber protected slings shall be used when handling pipe.

- C. Chains, cables, or hooks inserted into the pipe ends shall not be used.
- D. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground.
- E. The handling of the joined pipe line shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.
- F. Slings for handling the pipeline shall not be positioned at butt fused joints.
- G. Sections of the pipe with deep cuts and gouges shall be removed and the ends of the pipeline rejoined.
- H. Pipes shall be stored on wooden sleepers, spaced suitably and of such width as to not allow deformation of the pipe at the point of contact with the sleeper or between the supports.
- I. Stacking of the HDPE pipes shall be limited to a height that will not cause excessive deformation of the bottom layers of the pipe under anticipated temperature conditions.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. The pipe and fittings supplied under this Specification shall be high performance, high molecular weight, high density polyethylene pipe as manufactured in accordance with ASTM D 1248.
- B. The pipe material shall be a Type III, Class D, Category 5, P47, Grade E10 or 11 material as described in ASTM D 1248, PE4710. Minimum cell classification values of the pipe material shall be in conformance with ASTM D 3350.
- C. The fittings supplied under this Specification shall be molded from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe or shall be manufactured using a polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe supplied under this Specification. To ensure compatibility of the polyethylene materials, all fittings supplied under this Specification shall be of the same manufacture as the pipe being supplied.

2.02 PHYSICAL PROPERTIES

- A. Density shall be 0.947 – 0.955 gms/cm³ when tested in accordance with ASTM D 1505.
- B. Melt Flow shall not be greater than 0.15 gms/10 min. when tested in accordance with ASTM D 1238 – Condition E. (Melt Flow shall be no greater than 4.0 gms/10 min. when tested in accordance with ASTM D 1238 – Condition F).
- C. Flexural Modulus shall be 110,000 psi to less than 180,000 psi when tested in accordance with ASTM D 790.
- D. Tensile Strength at Yield shall be 3,000 psi to less than 4,000 psi when tested in accordance with ASTM D 638.
- E. Hydrostatic Design Basis shall be 1,600 psi at 23°C when tested in accordance with ASTM D 2837.

2.03 PIPE DIMENSIONS

- A. General. Pipe supplied under this Specification shall have a nominal ductile iron pipe size (DIPS) O.D. unless otherwise specified. The standard dimension ratio (SDR) of the pipe supplied shall be as specified on the Drawings. Pipe shall be SDR 11 or thicker.

2.04 CERTIFICATION

- A. The Owner or the Engineer may request certified lab data to verify the physical properties of the materials supplied under this Specification or may take random samples and have them tested by an independent laboratory.

2.05 REJECTION

- A. HDPE pipe and fittings may be rejected for failure to meet any of the requirements of this Specification. The decision to accept material deviating from this Specification shall be the responsibility of the specifying Engineer.

PART 3 - EXECUTION

3.01 LAYING

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent damage to the pipe. Any damage shall be remedied as directed by the Engineer.
- B. All pipe and fittings shall be carefully examined by the Contractor for defects just before laying and no pipe or fitting shall be laid which is defective. If any

defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense.

- C. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Excavation of trenches and backfilling around pipes shall conform to the requirements of section 02220, "Earthwork" of these Specifications.
- E. All HDPE piping laid underground shall have a minimum of 36 inches of cover above the top of the pipe unless otherwise shown on the Drawings.
- F. All HDPE piping shall be adequately supported, anchored, and restrained.
- G. Pipes shall be joined to one another, to the polyethylene fitting, and to the flange connections by means of thermal butt-fusion. Thermal butt-fusion is a process whereby the two pipes or fittings to be joined are held aligned in a fixture, their ends are softened by means of heat and then pressed together under controlled pressure.
- H. HDPE pipe lengths, fittings, and flanged connections to be joined by thermal-butt fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
- I. Where specifically shown or called for on the Drawings, taps into HDPE pipe shall be made using tapping saddle constructed for use with HDPE pipe. The saddle shall be constructed of bronze or brass, shall have all stainless steel bolts or screws, and have a resilient rubber gasket to provide a positive, water-tight seal.
- J. Connection of dissimilar pipes shall be made using Fernco Donut gaskets or approved equal.

3.02 FIELD TESTING

- A. After all piping has been placed and backfilled, each run of newly laid pipe or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer.
- B. All piping shall be subject to a hydrostatic gauge pressure equal to 150 percent of the maximum operating pressure of the pipe under test or 100 psig, whichever is

greater, based on the elevation of the lowest point of the section of pipe under test and corrected to the elevation of the test gauge. The above pressures shall be maintained for a minimum of twenty-four (24) consecutive hours. The allowable leakage shall be 0.5 gallons.

- C. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- D. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled adequately to secure the pipe during the test. All joints, fittings, and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.
- E. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants, blow-offs, or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- F. Any excessive leakage developing during the test shall be corrected at the Contractor's expense. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility meeting allowable leakage.
- G. After all test on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent the freezing of the same. The Contractor shall also demonstrate to the satisfaction of the Engineer that any and all lines are free from obstructions and foreign material.
- H. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and any other materials required to conduct the tests.

END OF SECTION 15064

SECTION 15101

VALVES

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish and install all metal valves, including operators, boxes, and accessories, as specified herein, shown on the Drawings, or required for proper completion of the work under these Contract Documents.
- B. The Contractor's attention is called to the fact that all valves, especially in the smaller sizes, are not necessarily shown completely on the Drawings, which are more or less schematic. Furnish and install all valves indicated or required for proper operation of the equipment or services requiring such valves.

1.02 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit complete shop drawings and engineering data to the Engineer in accordance with the requirements of section 01300, "Submittals" of these specifications.

1.03 STORAGE AND PROTECTION

- A. Store and protect valves and accessories in accordance with the requirements of the valve manufacturer or as directed by the Engineer.
- B. Completely drain valves prior to shipment. Protect ends of flanged and mechanical joint valves with full size wooden baffles securely bolted to the valve ends. Size of baffles shall be at least equal to outside diameter of flange. Secure valves 24 inches in size and larger to a wooden skid to facilitate handling and storage.

1.04 SHOP PAINTING

- A. Clean, shop prime, and shop paint valves and accessories in accordance with the requirements of these Specifications.
- B. All interior and exterior nonmachined, nonbearing ferrous surfaces on iron body valves, gates, and accessories shall be blast-cleaned and painted at the factory with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, unless otherwise specified. Exterior nonmachined, nonbearing ferrous surfaces on valve operators and on nonsubmerged or nonburied butterfly and eccentric plug valves shall be blast-cleaned and painted at the

factory with one coat of zinc chromate primer conforming to Federal Specification TT-P-645 and one coat of compatible alkyd enamel. Other paint systems may be proposed by the valve supplier, subject to the Engineer's approval.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit complete operation and maintenance data on the valves in accordance with the requirements of section 01300, "Submittals" of these specifications.

1.06 QUALITY ASSURANCE

- A. The valve manufacturers shall furnish a written certification to the Engineer that all valves and operators furnished comply with all applicable requirements of the governing AWWA standards specified herein.

1.07 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of section 01740, "Guarantees and Warranties" of these specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All castings, regardless of material, shall be free from surface defects, swells, lumps, blisters, sandholes, or other imperfections.
- B. All valves shall have the name of the manufacturer, rated working pressure, and size of the valve cast upon the body or bonnet in raised letters. Alternately, the name of the valve manufacturer, rated working pressure, and size may be stamped on a stainless steel identification plate permanently attached to the valve body or bonnet. Valves specified to conform with AWWA requirements shall have the letters "AWWA" cast upon the valve body or bonnet in raised letters.
- C. Valves and operating mechanisms shall be of the proper size and dimensions to fit the pipe connections thereto and shall be installed in the position and within the space shown on the Drawings.
- D. The direction of rotation of the operator to open the valve shall be to the left (counterclockwise), unless otherwise specified. Each valve body or operator

shall have cast thereon the word OPEN and an arrow indicating the direction to open.

- E. A union or coupling shall be provided within 2 feet on each side of a threaded end valve unless the valve can be otherwise easily removed from the piping. This shall not apply to soldered end valves in copper plumbing.
- F. All exposed bolts and nuts on buried or submerged valves and operators shall be brass or stainless steel for corrosion resistance. Exposed bolts and nuts on exposed valves and operators shall be of corrosion-resistant materials or shall be zinc or cadmium plated.
- G. Valves and operators shall be of the proper size to fit the pipe connections and shall fit in the position and space as shown on the Drawings.
- H. Valve operators shall be of sufficient size and capacity to seat, unseat, and operate the valve under the maximum specified differential pressure. Where no maximum differential pressure is specified, the operator shall be designed for a differential pressure equal to the maximum working pressure of the valve. Additional allowances shall be made for the lubricating and/or scale-forming tendencies of the fluid.

2.02 GATE VALVES

- A. Gate valves in sizes 2 through 24 inches for use in water and wastewater shall be of the ductile iron body, resilient seated type, manufactured in conformance with AWWA C509. Gate shall be of ductile iron with bonded resilient seat and integral flush drain. Minimum working pressure shall be 200 psi when unbalanced pressure is applied to either side of the gate. Gate valves shall have a minimum of two O-ring stem seals; one above and one below the integral stem collar. The area between the O-rings shall be filled with permanent lubricant. Valve shall have no metal fasteners or screws exposed in the wetted portion of the valve. All ferrous surfaces shall be shot-blasted to a white metal finish. All interior and exterior valve surfaces, including the interior of the gate and all bolt holes shall be coated with an epoxy coating in accordance with AWWA C550. The minimum thickness of the coating shall be 8 mils. Valve ends shall be of the type required for the installation as specified herein or shown on the Drawings.
- B. Furnish gate valves with nut, wrench, chain, or handwheel operators as shown on the Drawings. Unless otherwise shown or specified, valves shall have operators as specified in this section. Extension stems, floor stands, and valve boxes and covers shall be furnished where shown or required.

2.03 AIR-VACUUM VALVES

- A. Air-vacuum valves shall have stainless (SAE316) body and cover. All other attaching parts or internal parts shall be non-corrosive.
- B. Valve shall be designed for a working pressure of 3 to 150 psi unless otherwise shown or specified and shall be equipped with an orifice appropriate to the venting needs of the pipeline.
- C. Sewage valves shall be equipped with a conical body, a 2-inch NPT inlet connection, and a 1/2-inch NPT outlet connection and shall be provided with 2-inch inlet shut-off valve, 1-inch blow-off valve, and 1/2-inch back-flush valve with quick-disconnect coupling and flushing hose with quick-disconnect connections.
- D. Valves shall be ARI Model D-025 Air/Vacuum Valve, stainless steel body for high pressure force mains and nylon body for low pressure force mains.

2.04 MANUAL VALVE OPERATORS

- A. All gate valves shall be furnished with manual operators as follows, unless otherwise shown or specified:
 - 1. Buried Extension stem where required, a valve box with standard operating nut, and a T-handle operating wrench.
 - 2. Submerged or Located in Vault Handwheel operator or valve box with T-handle operating wrench (as shown on the Drawings).
- B. Operating nuts for buried or submerged valves shall be standard 2-inch-square nuts and shall conform to AWWA C500, Section 19. Extension stems, valve boxes, and stem guides shall be furnished where shown, specified, or required for proper operation.

2.05 CHECK VALVES

- A. Check valves shall be of the swing type suitable for use in either horizontal or vertical piping, unless otherwise shown or specified. Disc shall swing entirely clear of the path of flow when in the open position. All internal parts shall be readily accessible and easily replaced in the field.

- B. Check valves in sizes 3 inches and larger shall be iron body, bronze mounted valves conforming to AWWA C508, epoxy-coated inside and outside. Valves shall have 125-pound cast iron body, bolted and gasketed cover, stainless steel or bronze hinge pin, rubber faced, renewable, bronze or cast iron resilient disc, renewable bronze seat ring, outside lever and adjustable weight, and 125-pound flanged ends per ANSI B16.1. Cast iron for body and cap shall conform to ASTM A126, Grade B. Bronze for disc and seats shall conform to ASTM B584. Iron body check valves shall be Mueller Fig. A2600-6-01, Clow F-5345, or equal.
- C. Check valves for low pressure sewers 1.5-inch to 3-inch shall be true union PVC, Model 1720 as manufactured by Spears, or approved equal.
- D. Valves shall be installed with pressure under the disc.

2.06 VALVE BOXES

- A. All buried iron-body gate valves shall be provided with three-piece, cast iron, extension, sleeve-type valve boxes suitable for the depth of cover shown on the Drawings.
- B. Valve boxes shall not be less than 5 inches in diameter, shall have a minimum thickness of 3/16 inch at any point, and shall be provided with suitable cast iron bases and covers. Covers shall have cast thereon an appropriate name designating the service for which the valve is intended ("W" for water, "S" for drain or waste lines). Covers in roadways shall be of the deep locking type.
- C. All parts of valve boxes, bases, and covers shall be heavily coated with a suitable bituminous finish.
- D. Valves and boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves with the top of the box flush with the finished grade.

2.07 T-HANDLE OPERATING WRENCH

- A. Furnish two T-handle, steel valve operating wrenches with sockets compatible with standard 2-inch-square valve operating nuts.
- B. The operating wrenches shall be at least 36 inches in length.

2.08 SPARE PARTS

- A. Furnish the following spare parts where applicable upon request for the valves specified herein:

1. Stem packing	One set each type and size of valve
2. Renewable stainless steel or bronze seat ring	One each type and size of valve
3. O-ring stem or shaft seals	One set each type and size of valve
4. Resilient seat or disc	One each type and size of valve
5. Shaft bearings or bushings	One set each type and size of valve
6. Hinge pin, disc, spring, and disc bolts	One set each type and size of check valve
7. Gaskets	One set each type and size of valve
8. Special tool or seat wrench	One each required for valve servicing and maintenance

B. Suitably protect spare parts against corrosion and impact to withstand long-term storage. All parts shall be clearly labeled and identified by manufacturer's name and number and the valve to which they belong.

PART 3 - EXECUTION

3.01 FACTORY TESTS

- A. Test all valves at the point of manufacture for proper and unobstructed operation and for leakage and adequacy of design.
- B. Test iron body gate valves in accordance with AWWA C500, Section 5.
- C. Test iron body check valves in accordance with AWWA C508, Section 5.
- D. All other valves shall be given an operation test, a leakage test at rated pressure differential, and a hydrostatic test at two times rated pressure. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft or stem seal, nor shall any part be permanently deformed. During the leakage test, leakage shall not exceed that permitted by ANSI B16.104, Class IV for metal seated valves and Class VI for resiliently seated valves.

3.02 INSTALLATION

- A. Install all valves in strict conformance with the Drawings and approved shop drawings and manufacturer's instructions.
- B. Install all underground valves using a concrete valve box with cast iron frame and cover or in a cast iron valve box as specified herein.
- C. Install valves in such a way that operators and packing are easily accessible. Valves with field replaceable seats shall be installed with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.

3.03 FIELD TESTING

- A. Following installation, test all valves under the anticipated operating conditions. The ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque shall be demonstrated to the satisfaction of the Engineer. At Contractor's expense, adjust and/or replace any valve as necessary to ensure satisfactory operation.

END OF SECTION 15101