City of Clarksville
Standard Water and Wastewater Specifications

WPN 22.0641

APPROVED FOR CONSTRUCTION

THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

Adrian Baker

11/01/2022

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

DW20221169

APPROVED WATER SPECIFICATIONS

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The City of Clarksville, Tennessee

Honorable Joe Pitts, Mayor

Clarksville Gas & Water Department

Mark Riggins, General Manager

Garth B. Branch, PE, Chief Utility Engineer

GARTH B. BRANCH REGISTERED ENGINEER AGRICULTURE COMMERCE No. 110831 STATE OF TENNESSEE

10.07-2022

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City of Clarksville Gas & Water Department

Standard Water and Wastewater Specifications

Table of Contents

02010

GENERAL MISCELLANEOUS SPECIFICATIONS

PART 1 - GENERAL

1.01 Defined Terms

A. Wherever used in these Standard Water and Wastewater Specifications, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below:

1. *City Trees* – Any tree 6" diameter or greater that is located on Owner's property or right-of-ways.
2. *Contractor* – Individual or entity, including its subcontractor(s), supplier(s), or any other individual or entity for whom individual or firm is responsible, that is replacing City-owned, upgrading City-owned or installing new water and/or sewer utilities that will become part of Owner utility system after acceptance.
3. *Developer* – Individual, organization or firm, including its Contractor(s), subcontractor(s), supplier(s), or any other individual or entity for whom individual, organization or firm is responsible, that is developing property and replacing City-owned, upgrading City-owned or installing new water and/or sewer utilities that will become part of Owner utility system after acceptance.
4. *Drawings* – The plans that graphically show the scope, extent, and character of the work to be performed by Contractor.
5. *Engineer* – City of Clarksville Gas & Water Department Chief Utility Engineer or his/her designated representative.
6. *Laws and Regulations; Laws or Regulations* – Any and all applicable laws, statutes, rules, regulations, ordinances, codes, binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
7. *Owner* – City of Clarksville, Tennessee.
8. *Samples* – Physical examples of materials, equipment, or workmanship that are representative of some portion of the work and that establish the standards by which such portion of the work will be judged.

1.02 Miscellaneous

A. All work shall be performed in accordance with applicable Laws and Regulations.

B. Design of utility-related projects shall comply with the provisions of the Subdivision Regulations prepared by the Clarksville-Montgomery County Regional Planning Commission.

C. All survey elevations shall be referenced to mean sea level (MSL). Elevation references

to temporary benchmarks not referenced to mean sea level shall be rejected.

D. If no Stormwater Pollution Prevention Plan (SWPPP) is required, Contractor shall implement and maintain appropriate Erosion Prevention and Sediment Control (EPSC) measures, as published in the Tennessee Department of Transportation (TDOT) Standards and Specifications and the Tennessee Department of Environment and Conservation (TDEC) Erosion and Sediment Control Handbook.

E. Pre-construction photographs and/or video shall be taken on work performed for the Owner, with particular attention to improved areas, to aid in restoring landscaping and other features to their initial condition.

F. Where utilities are installed in new fill, a compaction letter sealed by a Geotechnical Engineer registered in the State of Tennessee shall be submitted to the Owner prior to accepting said utilities. An acceptable compaction letter shall state that field density testing indicates the fill has been compacted to at least 95% of the maximum dry density according to the Standard Proctor. Special protection such as use of ductile iron pipe with joint restraint may be required. In special instances and cases where compaction letters may not have been requested for fill slopes the Engineer retains the right to request additional testing and/or remedies for insuring the integrity of the installed utilities and surrounding property.

G. Where water and/or sewer services cross street curbs, the curbs shall be stamped with the letter “W” or “S” as appropriate. The end of each service stub shall be marked with a 6-foot long 4”x4” wooden post or metal fence post embedded 2 feet into the ground. The post shall be marked with blue paint for water services and green paint for sewer services.

H. Tracer wire shall be installed as specified in the applicable water and/or wastewater specification section.

I. Prior to bacteriological testing and acceptance of newly installed water mains, Contractor shall complete, sign and submit Owner-provided “Disinfection, Flushing, and Pressure Testing Worksheet” to the Engineer’s inspector.

J. All electrical wiring shall be copper conductor. Aluminum is not an acceptable substitute. All control and instrument panels shall be supported by galvanized steel posts and unistrut set in concrete. Wooden posts are not acceptable.

K. Engineer may require Contractors to perform utility work outside of normal business hours.

L. The Contractor shall be responsible for handling sewage flows during construction work by furnishing adequate bypass pumping for the duration of the work. No release of sewage shall be permitted. Unless specified elsewhere, all costs associated with handling sewage flows shall be borne by the Contractor.

M. Industrial Fire Water Tank End Pump: A fire water storage tank and pump are required to be constructed at new industrial developments. The fire water storage tank and pump should be sized to meet the required fire flow and duration for the facility based

on a tank recharge rate of 500 gpm from the public water system.

N. All warranties, including extended and special warranties, must be governed by and construed under the laws of the State of Tennessee.

O. All equipment items furnished shall comply with all governing federal and state laws regarding safety, including all current requirements of the Occupational Safety and Health Act (OSHA). The Contractor shall be solely responsible for job safety in accordance with all laws, regulations, methods, etc. of OSHA and the State.

1.03 Developer Work

A. A permit must be completed prior to beginning any water and/or sewer construction work. Permits may be obtained at no cost at the City of Clarksville Gas & Water Department Chief Utility Engineer's Office.

B. Owner will guarantee no more than 500 gpm of water flow at the point of connection. Water demand in excess of available capacity will require the Developer to construct on- and/or off-site improvements to the distribution system, which must be approved by Engineer, to meet the required demand. In accordance with TDEC's Design Criteria, all water mains including those not designed to provide fire protection shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in distribution system under all conditions of flow.

C. All lift station property, including the dedicated access road, shall have a recorded deed submitted with final plat to the Engineer's office prior to acceptance by the Owner.

D. Where a Developer's preferred choice of sewering a property or subdivision is by pumping sewage from the development to a discharge point in the Owner's existing sewer system, a gravity sewer solution(s) shall also be submitted for consideration by the Engineer. Each sewer alternative shall include a construction cost estimate to aid in the comparison of the alternatives.

E. Upon completion of the installation of the sewer and/or water infrastructure and prior to acceptance by the Owner, the Developer shall submit one hardcopy and one electronic copy either via email or on CD in AutoCad .dwg as well as PDF formats of the as-built drawings.

1. All drawings shall be referenced to Tennessee State Plane Coordinates (NAD83/TN83F).

2. As-built drawings shall also include detailed valve locations showing a minimum of three measurements to permanent features. Also, water lines shall be adjusted to the as-built locations by snapping the lines correctly to the adjusted valve location for each valve or valve cluster.

3. The as-built submission should also be accompanied by a text file, which will include points in State plane format and point type (Ex. 788870.372, 1568830.499,

Fire Hydrant). At a minimum, the text file should include all valves, hydrants, manholes, wet wells, benchmarks, water and/or sewer service markers. Additionally, manhole and wet well data should include as-built rim elevations and invert elevations. Benchmark data should include elevation and description.

4. The Owner will not execute the final plat of the development until as-built drawings are received.
5. A Certificate of Occupancy will not be issued by the City of Clarksville Building & Codes Department until such time that the as-built drawings are received.

F. Warranty, Guarantee and Correction Period

1. Developer's General Warranty and Guarantee

   i. Developer shall warrant and guarantee to Owner that all utilities and related appurtenances have been installed in accordance with Owner's current Standard Water and Wastewater Specifications and will not be defective.

   ii. Developer's warranty and guarantee excludes defects or damage caused by abuse, or improper modification, maintenance, or operation, by persons other than Developer, or normal wear and tear under normal usage.

   iii. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions below.

   iv. Developer agrees that it will obtain from the manufacturers of equipment and materials furnished, guarantees against defective materials and workmanship, and if those guarantees furnished by the manufacturer do not extend for the term of one year following testing and acceptance by Owner, Developer shall make the necessary arrangements and assume all cost for extending this guarantee for the required period.

2. Developer's Correction Period

   i. If within one year following testing and acceptance by Owner, Owner gives Developer written notice that work has been found to be defective or Developer's repair of any damages to the site or adjacent areas has been found to be defective, then Developer shall promptly, without cost to Owner, make such correction, repair, or removal and replacement as may be required under the above specified guarantee, and, when the correction, repair or removal and replacement involve one or more items of installed equipment, shall provide the services of qualified factory-trained servicemen in the employ of the equipment manufacturers to perform or supervise the correction, repair, or removal and replacement.

   ii. For repairs to water mains and most water services, Owner will repair the equipment and invoice the Developer.

   iii. Where defective work (and damage to other work resulting therefrom) has been corrected or removed and replaced by the Developer, the correction

period hereunder with respect to such work will be extended for an additional period of one year after such correction, repair, or removal and replacement has been satisfactorily completed.

iv. If Owner deems it necessary, Developer may be instructed in Owner's written notice, that such correction, repair, or removal and replacement shall be undertaken by Developer within twenty-four (24) hours after receipt of Owner's written notice.

v. If Developer does not promptly comply with the terms of Owner's written notice or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective work corrected, repaired, or removed and replaced, and Developer shall be responsible for and pay all costs, losses, and damages arising out of or relating to such correction, repair, or removal and replacement.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

Return to Table of Contents

02221
TRENCHING, BEDDING AND BACKFILLING

PART 1 - GENERAL

1.01 Work Included

A. Excavation of all materials encountered in trench excavation, including earth, rock or other materials, whether wet or dry.

B. Provide necessary sheeting, shoring and bracing.

C. Dewater excavation as required.

D. Undercut unsuitable materials and replace as required.

E. Prepare a stable, satisfactory trench bottom.

F. Place and compact granular beds, check dams, and backfill as appropriate.

G. Dispose of any unsuitable or excess materials.

1.02 Precautions

A. In accordance with the Tennessee State Law (Tennessee Underground Utility Damage Prevention Act), the Contractor shall properly notify underground utility owners prior to beginning excavation activities. Tennessee State Law requires notification to the statewide one-call center, Tennessee One-Call, at least three working days prior to excavation, but not more than ten working days in advance of beginning the work. Locate requests, including emergency locate requests, to Tennessee One-Call shall be processed in accordance with Tennessee State Law. Contact Tennessee One-Call at 811 or 1-800-351-1111 to process a locate ticket. Owner will not locate its natural gas, water and sewer utilities without a locate ticket from Tennessee One-Call.

B. Protect all structures, utilities, sidewalks, pavements, fences, vegetation and other features to remain.

C. Protect all benchmarks, property pins, survey points and similar items. If disturbed or damaged by construction operations, the Contractor shall pay the cost of restoration by a Licensed Surveyor.

D. Comply with all applicable Federal, State, County, TVA, TDOT, and Railroad regulations.

E. Establish all erosion prevention and sediment control devices.

F. Precautions shall be taken to eliminate tracking of soil, mud, rock and gavel onto streets and roadways.

1.03 Dust Control

A. When ordered by Engineer, furnish and distribute over traveled road surfaces which have not been fully restored an application of regular flake calcium chloride having a

minimum calcium chloride content of 77 percent, or a brine solution consisting of 1.5 pound of calcium chloride and 1 pound of sodium chloride per 100 gallons of water applied by a pressure distributor. Rate of application shall be 3 pounds/square yard for the flake calcium chloride, and 0.48 gallon/square yard for brine solution.

1.04 Maintenance of Traffic and Closing of Streets

A. Work shall be performed in a manner which will cause a minimal interruption to traffic. Not more than two consecutive blocks, including the cross street intersected, shall be closed to through travel. Where traffic must cross open trenches, provide bridges at street intersections and driveways. Post signs indicating that a street is closed as well as necessary detour signs for the proper maintenance of traffic. Before closing any streets notify responsible municipal, state, county, emergency, transit and school system authorities.

B. Place and maintain barricades, fences, construction signs, lights and flagmen as required during the progress of the construction work and until it is safe for traffic to use the roads and streets. The rules and regulations of OSHA and TDOT as well as standards of Manual on Uniform Traffic Control Devices (MUTCD) and other appropriate authorities respecting traffic safety provisions shall be observed.

PART 2 - PRODUCTS

2.01 Bedding and Backfill Materials

A. Class I Material: Angular, 1/4 to 1 inch graded stone.

B. Class II Material: Coarse sands and gravels with a maximum particle dimension of 1-1/2 inch including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.

C. Class III Material: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures.

D. Class IV Material: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.

E. In rock cuts, paved areas, roadways or other areas where free drainage bedding or backfill material is required, use Class I angular material.

F. Flowable Fill: See requirements described in Section 02575, Part 2.

PART 3 - EXECUTION

3.01 Preparation

A. Where controlled blasting is required for rock removal, the Contractor shall perform a pre-blast survey and have a blasting program prepared as specified in Paragraph 3.04 of this Section.

B. Protect all features to remain.

C. Put in place all traffic and other safety provisions as required.

3.02 Excavation

A. All excavation is unclassified and includes excavation to subgrade elevations regardless of the character of materials and obstructions encountered. It is to be understood that any reference to rock, earth or any other material on the Drawings is not to be taken as an indication of classified excavation or the quantity of either rock, earth or any other material involved.

B. Perform excavation in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.

C. The Contractor shall be responsible for stripping, storing and protecting topsoil that is to be removed prior to excavation. This topsoil is to be reused during the cleanup and restoration. The Contractor is responsible for obtaining and providing other topsoil as may be necessary to restore the excavated area to its original topsoil quantity and quality.

D. Pavement cuts shall be made along neat, straight lines with either a pavement breaker or pavement saw prior to the excavation. Cut pavement to be a minimum of 6 inches outside of trench cut. All street cuts must be coordinated with the State, County and Owner Street Departments, as applicable.

E. Trenches shall be excavated to the depths indicated on the Drawings. Trench depth shall be sufficient to provide a minimum cover of 36 inches over the top of the pipe in non-traffic areas and 48 inches in areas subject to vehicular traffic. Depth of cover is measured from finished grade to top of the pipe. Where approved by the Engineer, additional pipe protection such as use of ductile iron pipe or concrete encasement may be used where minimum cover is not possible. Increased depth may be required as noted on the Drawings to avoid obstructions, avoid requiring an air release valve and other reasons.

F. Excavated material shall be placed a minimum of 2 feet back from the edge of the trench.

G. When unstable soil or other unsuitable material is encountered at the trench bottom, undercut these materials to a depth required to assure support of the pipeline or as directed by the Engineer and backfill to the proper grade with compacted crushed stone. The top 6 inches shall be Class I angular material.

H. Remove rock encountered in trench excavation to a minimum depth of 6 inches below the bottom of the pipe barrel, backfill with Class I angular material, and compact to uniformly support the pipe. In no case shall solid rock exist within 6 inches of the finished pipeline.

I. Maximum width at the crown of the pipe shall be 2 feet plus the nominal diameter of the pipe, unless specifically approved otherwise by the Engineer due to unusual

bracing and shoring requirements. Trenches constructed by mechanical trenching are allowed only with prior approval of Engineer. Over-excavation will be required at locations for fittings and valves and construction of concrete thrust blocks.

J. Trenches 4 feet or more in depth should be provided with a means of egress. Spacing between ladders or other means of egress must be such that a worker will not have to travel more than 25 feet laterally to the nearest means of egress.

K. Open excavations shall be barricaded when the Contractor is not at the site. At a minimum, this shall consist of orange polyethylene barricade safety fence. See Paragraph 1.05 of this Section for additional requirements for excavations in traffic areas.

3.03 Sheeting, Shoring and Bracing

A. Furnish, put in place, and maintain such sheeting, shoring and bracing, as may be required to support the sides of the excavation and to prevent movement as required by OSHA. Damages resulting from improper shoring or failure to shore shall be the sole responsibility of the Contractor.

B. Comply with all OSHA standards in determining where and in what manner sheeting, shoring and bracing are to be accomplished. The sheeting, shoring and bracing system shall be designed by a professional engineer licensed in the State of Tennessee and shall be subject to approval by the Engineer. However, such approval does not relieve the Contractor of the sole responsibility for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of the sheeting, shoring and bracing.

C. The Contractor may use a trench box, which is a prefabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system.

D. Do not leave sheeting, shoring or bracing materials in place unless called for in the Drawings, ordered by the Engineer, or deemed necessary or advisable for the safety or protection of new or existing work or features. Remove these materials in such a manner that the new structure or any existing structure or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.

3.04 Rock Removal

A. Controlled blasting may be used as an alternative to non-explosive methods of rock removal at the approval of the Engineer. Controlled blasting shall be performed by a qualified explosive specialist, employed by the Contractor. The blasting contractor shall have a Registration Certificate and each employee engaged in the blasting activity shall carry a valid identification card issued by the Division of Fire Prevention.

B. All blasting shall be performed in accordance with the Tennessee Blasting Standards Act of 1975. All blasting operations shall be conducted in accordance with prevailing

municipal, state or other agency regulations, codes, ordinances, or laws.

C. The Contractor assumes all liability for all personal injury, any damage to real or personal property, or interference with the use or enjoyment of any property by reason of blasting or the resulting vibration or concussion. The Contractor assumes full responsibility for operating all equipment and performing all blasting in accordance with Laws and Regulations limiting the amount of vibration or concussion.

D. The Contractor shall prepare or retain a consultant to prepare the blasting program and to supervise and assist in monitoring the blasting. The blasting program shall include, but not be limited to, data on the locations, hole size, depth, over-depth, pattern and inclination of the blast holes, the type, strength, amount, distribution and powder factor for the explosives used, per hole and per blast, the sequence and pattern of delays, maximum amount of explosives in any one period, depth of rock, and depth of overburden, if any, and the description and purpose of special methods to be used. This data shall be submitted to the Engineer upon request.

E. The Contractor shall conduct a pre-blast survey of the surrounding structures within 300 feet of any blasting operation and document their condition prior to any blasting. Documentation shall include written descriptions, videos and/or photographs of the structures, and measures of obvious signs of structural distress such as cracks. Gauge marks shall be located over existing cracks at selected locations to be measured before and after blasting to determine if widening or displacement has taken place.

F. All blasts shall be designed to prevent fly rock. The Contractor shall use adequate, good quality stemming material and cover the blasts with blasting mats or an adequate soil cover.

G. If structures or pipelines are damaged, promptly replace or repair them at no expense to Owner.

H. Seismographic monitoring shall be done by the Contractor and a record made of the peak particle velocities caused by the blasting. This data shall be included in the blasting report.

I. Air blast shall be monitored with an approved instrument having the required frequency response and capable of providing a permanent record of the air blast effects. These records, identified by time and recording location shall be included in the blasting report.

J. The Contractor shall maintain a daily log available for inspection by the Engineer. A completed blasting report shall be submitted to the Engineer at the conclusion of all blasting.

3.05 Disposal of Materials

A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the Drawings or directed by the Engineer shall be used for those purposes.

B. Any materials not so used shall be considered waste materials and disposed of by the Contractor. Waste materials may be deposited in spoil areas at locations approved of by the Engineer, or shall be properly disposed of off-site if there is no approved spoil area.

3.06 Unauthorized Excavation

A. Unauthorized excavation is defined as all excavation outside or below the proposed lines and grades shown on the Drawings or that which is directed by the Engineer.

B. Backfill areas of unauthorized excavation with the type of material necessary to ensure the stability of the structure or construction involved.

3.07 Dewatering

A. The Contractor shall furnish, install and operate all necessary equipment to keep excavated areas free of water while work is in progress. Dewatering equipment shall be of adequate size and quantity to assure maintaining proper conditions for installing pipe, concrete, bedding, backfill or other material or structure in the excavation.

B. Well-pointing shall be performed, if required.

C. Contractor shall take particular precautions to prevent the displacement of structures or pipelines as a result of accumulated water. Any pipe displaced due to accumulated water shall be replaced by the Contractor at no cost to the Owner.

D. Dewatering operations shall be performed in a manner so as not to cause injury to public or private property or nuisance to the public nor contribute to pollution to surface water.

3.08 Obstructions

A. Obstructions shown on the Drawings are for information only and do not guarantee their exact locations nor that other obstructions are not present. The crossing of existing mains and services, which are approximately perpendicular to the proposed ditch line, is considered normal construction practice. The Contractor shall have the responsibility of making these crossings and repairing any damages to such crossings at no cost to the Owner.

B. Whenever unknown obstructions are encountered during the progress of the work that directly interfere with the vertical or horizontal alignment of the pipeline, the Engineer shall have the authority to order a deviation from the grade or alignment or for the removal, relocation or reconstruction of the obstructing utility or structure. Likewise, the Contractor may request to relocate the proposed line or request reimbursement for relocating the existing line or performing unusual shoring beyond what is normally required for trench stabilization.

C. When utilities or obstructions are not shown on the Drawings but are present off the roadway at the location of the proposed pipeline route, the Contractor may request to relocate the pipeline in the roadway if necessary to avoid disturbing the utility or obstructions.

D. Contractor shall exercise due care in excavating adjacent to existing obstructions and not disturb same unless absolutely necessary.

E. In the event existing utilities are disturbed, Contractor shall repair or replace disturbed utilities as quickly as possible to the condition existing prior to their disturbance at no cost to the Owner. If required by the Owner, Contractor shall pay for the repair or replacement work performed by the forces of the utility company or other appropriate party.

F. If replacement or repair of disturbed obstructions during Developer work is not performed after a reasonable period of time, the Owner may have the right to withhold acceptance of utility infrastructure until necessary work is done.

3.09 Bedding of Gravity Sewer Mains

A. Contractor shall always maintain proper grade and alignment during the bedding and tamping process. Any pipe damaged or displaced during this process shall be replaced by the Contractor at his expense.

B. Minimum of 6 inches of compacted Class I angular material for bedding of all gravity sanitary sewer pipe shall be provided regardless of pipe material. Bell holes shall be dug so that the barrel of the pipe will rest for its entire length upon the prepared bedding to assure uniform support of the pipe.

C. Each PVC sewer pipe section shall be completely encapsulated with a minimum of 6 inches of Class I angular material on the top, both sides and the bottom of the pipe.

D. Where gravity sewer pipe, regardless of pipe material, is laid within a rock cut, each pipe section shall be completely encapsulated with a minimum of 6 inches of Class I angular material on the top, both sides and the bottom of the pipe.

3.10 Bedding of Water Mains and Sewer Force Mains

A. Water mains and sewer force mains may be laid on a stable earth bed in a trench cut in natural ground. Contractor shall excavate the trench in such a manner as to form a suitable bed on which to place the pipe. Where unstable soil or other unsuitable material is encountered at the trench bottom, undercut and replace these materials as discussed in Paragraph 3.02 of this Section.

B. Where water lines and sewer force mains are laid within a rock cut, completely encapsulate each pipe section with a minimum of 6 inches of Class I angular material on the top, both sides and the bottom of the pipe.

C. Bell holes shall be dug so that the barrel of the pipe will rest for its entire length upon the natural earth trench bed or prepared bedding to assure uniform support of the pipe.

3.11 Initial Backfilling

A. No backfilling is allowed before the Engineer has inspected or approved the grade and alignment of the pipe, the bedding of the pipe, and the joints between the pipes. If

backfill material is placed over the pipe before an inspection is made, the Engineer may require the Contractor to reopen the trench in order for an inspection to be made at no cost to the Owner.

B. Contractor shall perform initial backfilling by hand or by carefully dumping small quantities of fill from a loader bucket, until fill has progressed to 6 inches above the top of the pipe.

3.12 Final Backfilling

A. Final backfilling shall be performed as soon as practicable after inspection and initial backfilling is complete. Adequate precautions shall be taken to ensure proper placement and compaction of backfill without disturbing or damaging pipe. Fill shall be properly compacted and suitable precautions shall be taken to ensure permanent stability for pipe. Utilities shall be provided with adequate cover or additional protection as described in Paragraph 3.02 of this Section.

B. Backfilling in unimproved areas:

1. All soft, yielding or organic material that is unsuitable for trench backfill shall be disposed of and replaced with suitable material. The maximum dimension of individual stones and broken rock within the backfill should not exceed 6 inches.

2. Backfill shall be deposited, spread and compacted in even layers no greater than 12 inches deep to the surface with suitable equipment in such a manner so as not to disturb the pipe. If earth material for backfill is, in the opinion of the Engineer, too dry to allow thorough compaction, the Contractor shall add enough water so that the backfill can be properly compacted.

3. Sufficient surplus excavated materials shall be neatly rounded over the trench to compensate for settlement of the backfill.

4. The top 12 inches of backfill material shall consist of fine loose earth free from large clods, vegetable matter, debris, stone and/or other objectionable materials.

5. Contractor shall properly dispose of all excess excavated material.

6. Prior to acceptance, Contractor shall finish grade, restore topsoil and reestablish landscaping as specified in Sections 02410 and 02485.

C. Backfilling beneath flexible and rigid pavements:

1. Contractor shall use Class I angular material of either crushed limestone or crushed gravel of high weight and density.

2. Contractor shall carefully deposit in uniform layers, not to exceed 6 inches thick.

3. Each layer shall be compacted thoroughly by rolling, ramming and tamping with tools suitable for that purpose in such a manner so as not to disturb the pipe.

4. Flowable fill may be used at the Contractor’s request with approval of the Engineer, when specified on a particular project, or when required by the Clarksville Street Department or TDOT.

D. Backfilling of shoulders along streets and highways:

1. Backfilling methods and materials for shoulders along streets and highways shall be in accordance with the requirements of governing State, County or Owner departments maintaining the particular roadway or highway.
2. Contractor shall replace all shoulders that may be damaged or destroyed as a result of pipe trenching with similar materials.
3. Where shoulders along state highways have seal coat surfaces, Contractor shall replace seal coat surfaces with double bituminous seal in accordance with TDOT requirements.
4. TDOT or local authority may require trenches to be backfilled entirely with granular material in the shoulder of roads.
5. Backfill in state highways may also be performed utilizing flowable fill. Refer to Section 02575 for installation requirements.

E. Crushed stone for pavement and shoulder replacement:

1. Where possible, Contractor shall salvage and reuse all base material that is removed during construction work.
2. Contractor shall wet and thoroughly compact crushed stone and blade to tie into the existing surface prior to acceptance.

3.13 Check Dams

A. Check dams shall be installed in the bedding and backfill of new or replaced gravity sewer lines to limit the drainage area subject to the French drain effect of gravel bedding.

B. Check dams shall consist of compacted clay bedding and backfill at least 3 feet thick to the top of the trench and cut into the walls of the trench 2 feet. Alternatively, concrete may be used, keyed into the trench walls.

C. Check dam material within 1 foot of the sewer main shall be carefully hand placed and compacted. No gravel backfill or bedding shall be used in the check dam area.

D. Check dams shall be installed upstream of each manhole.

E. All stream crossings shall include concrete check dams on both sides of the crossing.

F. Dams shall be placed no more than 500 feet apart.

END OF SECTION

Return to Table of Contents

02410
CLEANUP AND RESTORATION

PART 1 - GENERAL

1.01 Work Included

A. Work included in this section consists of finish grading, site cleanup, patching of pavement, repairing and/or reinstalling all public and private improvements disturbed by the construction work.

B. Cleanup shall follow in close succession to other construction activities and shall be a daily function. Allowances will be made for time of settling of backfilled trenches before final grading and landscaping is attempted; however, drainage ditches are not to be left obstructed. The concept of leaving cleanup until the other construction work is completed is not acceptable.

PART 2 - PRODUCTS

2.01 All materials and products used for repair and/or replacement of disturbed areas shall meet or exceed the type and quality of the original.

PART 3 - EXECUTION

3.01 The Contractor shall use the photographs and/or video taken prior to construction work to aid in cleanup and restoring landscaping and other features, public or private, to their original condition or better.

3.02 Finish Grading and Topsoil Restoration

A. After allowing backfill adequate time to settle, Contractor shall finish to grade all areas to produce a uniform, satisfactory finish with rounded surfaces at the top and bottom of abrupt changes in grade.

B. Areas where noticeable settlement has occurred shall be refilled.

C. Finish grading shall be performed such that the area will drain satisfactorily and will not hold or collect standing water.

D. Topsoil shall be restored as specified in Section 02485, Paragraph 3.02.

E. Prior to final inspection the surface shall be free of large clods, debris, stone and/or other objectionable material.

F. Contractor shall restore lawn and grass landscaping in accordance with Section 02485. Final stabilization by lawn and grass landscaping shall occur within 14 days of completion of finish grading to begin establishment of ground cover to prevent erosion.

3.03 Pavement Maintenance and Replacement

A. All excavation in traffic areas, whether bituminous, concrete, or gravel, shall be backfilled with compacted crushed stone. The stone shall be brought to the grade of the surrounding pavement to provide a temporary surface for traffic. The Contractor is responsible for grading and maintaining the gravel surface until the final pavement is in place.

B. Throughout the duration of the project, pavements shall be kept free of mud, gravel and other construction debris to avoid unnecessary tracking of mud and spreading of dust. If conditions warrant, the Contractor shall be responsible for arranging for street washing to remove unnecessary amounts of mud from the pavement and also to control dust at no cost to the Owner.

C. Damaged pavement, whether concrete or asphalt, shall be properly replaced with the corresponding same equal material. In some cases the Clarksville Street Department will assume the responsibility for the final paving after the Contractor has properly cut, trimmed and backfilled the utility trench. The Contractor shall assume the total responsibility for repaving unless stated specifically elsewhere in the Specifications. Pavement repair shall be performed in accordance with Section 02575.

3.04 Curbs, Sidewalks, Steps, Etc.

A. All curbs, sidewalks, steps, etc., which are damaged or disturbed, shall be replaced by squarely cutting or removing at the nearest sound joint or section and re-pouring the new structure to match or exceed the quality and appearance of the original.

B. All repairs must be performed in accordance with Laws and Regulations, must meet local regulations and be compliant with the Americans with Disabilities Act (ADA). Any new curbs, sidewalks, steps, etc. shall be designed and installed to meet requirements of the ADA.

3.05 Fences

A. All fences and posts, which are damaged or removed, shall be re-erected. Posts shall be firmly set and tamped. Wire fences shall be tightly stretched. New materials shall be used when specified or if otherwise obvious that the existing material cannot be reinstalled to its condition prior to being disturbed.

3.06 Shrubs, Flowers and Ornamentals

A. Where noted on the Drawings or as directed by the Engineer, all attempts shall be made to protect, preserve and reset shrubs, flowers and ornamentals disturbed by the construction work.

3.07 Mailboxes and Public or Private Improvements

A. Mailboxes that are disturbed by the construction work shall be reinstalled or relocated immediately in a serviceable condition and location. After backfilling and re-grading, the mailbox shall be permanently and properly erected.

B. All other public or private improvements disturbed by the construction work shall be repaired or replaced to original condition unless specifically exempted elsewhere.

END OF SECTION

Return to Table of Contents

02485

LAWN AND GRASS LANDSCAPING

PART 1 - GENERAL

1.01 Work Included

A. All activities necessary to restore areas disturbed by construction work, or other designated areas, to their original landscaped condition and quality.

B. Preparation of landscape area including loosening, pulverizing and fertilizing.

C. Placement of seed, sprigging, sod and topsoil including mulch, where required.

D. Watering of landscaping.

PART 2 - PRODUCTS

2.01 Seed Materials

A. Inspect and test seed for germination and purity prior to mixing.

B. Uniformly mix by Group:

Seed Name	Quantity % by Weight
Group "A"	
Lespedeza (common or Korean)	20%
Sericea Lespedeza	15%
Kentucky 31 Fescue	40%
English Rye	25%
Group "B"	
Kentucky 31 Fescue	55%
Redtop	15%
English Rye	30%
Group "C"	
Sericea Lespedeza	50%
Kentucky 31 Fescue	30%
English Rye	20%

C. Use Group "A" seed from February 1 to August 1.

D. Use Group “B” seed from August 1 to December 1, with the exception that either Group “A” or “B” may be used during the month of August.

E. Use Group “C” seed from December 1 to February 1, but only when specified on the Drawings or otherwise approved.

F. All seed shall meet the requirements of the Tennessee Department of Agriculture.

G. Upon request, furnish the Engineer a certified laboratory report showing the analysis of the seed to be furnished. The report shall bear the signature of a senior seed technologist.

H. Inoculant for Legumes

1. Nitrogen fixing bacteria cultures adapted to the particular seed to be treated.

2. Furnish in containers of a size sufficient to treat the specified quantity of seed to be planted.

2.02 Mulch Materials

A. Hay composed of approved stalks from grasses, sedges or legumes, or straw composed of stalks from rye, oats, wheat, or other approved grains.

B. Air dried and reasonably free from noxious weeds, weed seeds, and other detrimental plant growth.

C. Suitable for spreading with mulch blower machinery.

D. Wood fiber mulch, when used, shall meet the requirements of the Tennessee Erosion and Sediment Control Handbook.

E. Mulch Binders:

1. Cut back asphalt, Grade RC-70 or RC-250 conforming to AASHTO M81, M82, M141, for the type and grade specified.

2. Emulsified asphalt, Type SS-1 conforming to AASHTO M140. In addition to Type SS-1, a special mixing material AE-3 or a special priming material AE-P may be specified.

2.03 Jute Mesh

A. Open plain weave of single jute yarn or photodegradable straw-filled mesh blankets and non-toxic to vegetation.

B. Tag jute rolls for identification with 58 warp ends per yard, 41 weft ends per yard and weighing approximately 0.9 pounds per square yard with an acceptable tolerance of 5 percent.

2.04 Staples shall be new and unused, machine-made of No. 11 gauge steel wire formed into a "U” shape.

2.05 Sod Materials

A. Live, dense, well-rooted growth of permanent grasses, free from Johnson grass,

nutgrass, and other undesirable grasses or weeds and well-suited for the proposed application to particular soils.

B. Cleanly cut in strips having a reasonably uniform thickness of not less than 2-1/2 inches, a uniform width of approximately 8 inches, and a minimum length of 12 inches.

2.06 Commercial Fertilizers

A. Unless otherwise specified, inorganic 10-10-10 nitrogen, phosphoric acid, and potash for seeding and 15-15-15 or 10-10-10 for sodding.

B. Furnish in standard containers with the brand name, weight and guaranteed analysis of the contents clearly marked.

C. Comply with Federal, State, and local laws.

D. Ammonium Nitrate shall be a standard commercial product, having a minimum of 33.5 percent nitrogen.

E. Agricultural limestone shall contain a minimum of 85% of calcium carbonate and magnesium carbonate combined, and be of particular size that 85% will pass a No. 10 mesh sieve.

2.07 Contractor shall ensure that water is free of harmful organisms or other objectionable materials.

2.08 Topsoil

A. Natural, friable, fertile, fine sandy loam possessing characteristics of representative top soils in the vicinity, which produce heavy growths of vegetation.

B. Free from subsoil, noxious weeds, stones larger than 1 inch in diameter, lime, cement, ashes, slag, or other deleterious matter.

C. Well drained in its original position and free from toxic quantities of acid or alkaline elements.

PART 3 - EXECUTION

3.01 General

A. All unpaved or non-graveled areas disturbed by the construction work or any other areas as specified shall have a stand of grass developed by one of the following methods:

1. Seeding will generally be acceptable.

2. If repeated seeding fails due to continued erosion or other unsatisfactory conditions, sprigging or sodding shall be used.

3. If the imported topsoil or seeds result in Johnson grass or other undesirable weeds, the Contractor shall eliminate this growth with herbicides and reestablish

an acceptable growth.

B. Before beginning seeding, sprigging or sodding operations in any area, complete finish grading and restoration of topsoil and have work approved by the Engineer.

3.02 Topsoil

A. The Contractor shall save and stockpile the topsoil removed from the excavation area or otherwise obtain topsoil to restore the area and reestablish an acceptable stand of grass.

B. Prepare landscape area to receive topsoil in close conformity to the lines and grades shown on the Drawings.

C. Place topsoil at depths and locations shown on the Drawings. Otherwise, topsoil shall be restored to its original quantity and quality, but no less than necessary to establish and promote an acceptable stand of grass.

3.03 Seeding

A. Scarify, disc, harrow, rake or otherwise work each area to be seeded until it has been loosened and pulverized to a depth as directed by the Engineer.

B. Uniformly incorporate fertilizer into the soil to a depth of approximately ½-inch at the rate of:

1. Not less than 40 lbs. per 1,000 square feet for grade 10-10-10 or equivalent.

2. Not less than 100 lbs. per 1,000 square feet for agricultural limestone.

C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment.

D. Sow seed of the specified group as soon as preparation of the seedbed has been completed.

E. Sow uniformly by means of a rotary seeder, hydraulic equipment, or other satisfactory means at the rate of 1½ pounds per 1,000 square feet, unless otherwise specified.

F. Inoculate Group "C" seed and seeds of legumes, when sown alone, before sowing in accordance with the recommendations of the manufacturer of the inoculant.

G. Do not perform seeding during windy weather, or when the ground surface is frozen, wet or otherwise non-tillable. No seeding shall be performed during December through February unless otherwise permitted by Engineer.

H. When specified, provide seeding with mulch:

1. Spread hay or straw mulch evenly over the seeded area at an approximate rate of 75 pounds per 1,000 square feet immediately following the seeding operations. This rate may be varied by the Engineer depending on the texture and condition of the mulch material and the characteristics of the area seeded.

2. Hold hay or straw mulch in place by the use of a mulch binder applied at the

approximate rate of 4 gallons per 1,000 square feet as required.

3. Cover bridges, guardrails, signs and appurtenances, if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.

4. When wood fiber mulch is used, uniformly apply at the rate of 28 to 35 pounds per 1,000 square feet with hydraulic mulching equipment.

3.04 Sprigging

A. Lightly incorporate fertilizer into the soil to a depth of approximately ½-inch at the rate of:

1. 15 lbs. per 1,000 square feet for grade 0-20-20 or equivalent.

2. 40 lbs. per 1,000 square feet for agricultural limestone.

B. Perform sprigging during September-November or April-May and only when the soil is in tillable or workable condition.

C. Do not set crowns during windy weather or when the ground surface is frozen.

D. Set crowns as soon as preparation of the sprig bed has been completed.

E. Set crowns at the rate of three sprigs per square yard by means of a tree-planting bar or equal.

F. When specified, perform mulching before sprigging:

1. Spread mulch material evenly over the area to be planted at the rate of 100 lbs. per 1,000 square feet. This rate may be varied by the Engineer depending upon the texture and condition of the mulch material and the ground surface.

2. Cover with a uniform layer of mulch so that 20 to 25 percent of the ground is visible. The mulch shall be loose enough to allow sunlight to penetrate and air to circulate slowly, but thick enough to partially shade the ground and to reduce erosion.

3. Hold the mulch in place with mulch binders applied at the rate directed by the Engineer, not to exceed 0.1 gallon per square yard, as required to hold the mulch in place.

3.05 Sodding

A. Place sod at all locations shown on the Drawings or where directed.

B. Loosen the surface of the ground to be sodded to a depth of not less than 1 inch with a rake or other device.

C. If necessary, sprinkle with water until saturated for a minimum depth of 1 inch and keep moist until the sod is placed.

D. Immediately before placing the sod, fertilize the prepared surface uniformly at the rate of:

1. 12 lbs. per 1,000 square feet for grade 10-10-10 or equivalent.

2. 100 lbs. per 1,000 square feet for agricultural limestone.

E. Place sod as soon as practical after removal from the point of origin, and keep in a moist condition during the interim.

F. Carefully place, by hand, on the prepared ground surface with the edges in closed contact and, as far as possible, in a position to break joints.

G. Each strip of sod laid shall be fitted and pounded into place using 10-inch wood tramps, or other satisfactory implements.

H. Immediately after placing, thoroughly wet and roll with an approved roller or hand-tamp as approved by the Engineer.

I. On slopes of 2:1 or steeper, pinning or pegging may be required to hold the sod in place.

END OF SECTION

Return to Table of Contents

02575

PAVEMENT REPAIR

PART 1 - GENERAL

1.01 Work Included

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, and walks shall 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 pavement surface to neat lines outside of the trench wall, and repave the entire area as specified below and as shown on the Drawings.

B. These specifications 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.

C. All pavement repair work shall be in compliance with the requirements of the State, County or Clarksville Street Department.

PART 2 - PRODUCTS

2.01 Pavement materials shall conform to TDOT Standard Specifications for Road and Bridge Construction.

PART 3 - EXECUTION

3.01 All paving shall be completed using appropriate equipment and machinery. All work must be coordinated with and approved by the City or County Street Department, TDOT or other governing authority. The Contractor shall perform all work in accordance with the governing authority and shall make all repairs as directed by that authority at no expense to the Owner.

3.02 Subgrade

A. Before any base material is installed, compact the sub-grade of the area to be paved to 95% of optimum density as determined by ASTM D698 (Standard Proctor).

B. The backfill material shall contain no topsoil or organic matter. For all areas where sub-grade has been prepared, test for uniformity of support by driving a loaded dump truck at a speed of two to three miles per hour over the entire surface. Make further

improvements on all areas that show a deflection of 1 inch or more. When completed, the finished sub-grade shall be hard, smooth, stable, and constructed in reasonably close conformance with the lines and grades that existed prior to beginning construction work.

C. When a base course is compacted, cut back the surface course of the existing pavement a minimum of 1 foot beyond the limit of the joint between the old and new base course or as shown on the 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.

3.03 Base: Install a mineral aggregate base of the type specified above in accordance with Section 303 of the TDOT specifications. The maximum compacted thickness of any one layer shall be 6 inches and total thickness of the base shall as shown on the Drawings.

3.04 Seal Coat Surface: Uniformly apply a bituminous prime coat of emulsified asphalt, Grade AE-P, or cutback asphalt, 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.

3.05 Double Bituminous Surface

A. Apply the first course at a rate of 0.38 to 0.42 gallon per square yard with emulsified asphalt, Grade RS-2, or cutback asphalt, Grade RC-800 or RC-3000, and then immediately cover the 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 the 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 four days, or as directed by the Engineer. 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 with rotary brooms. Sweep the surface at the time determined by the Engineer.

3.06 Asphaltic Concrete Binder

A. Apply a bituminous prime coat of emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, at a rate of 0.38 to 0.42 gallon per square yard. Take care to prevent the bituminous material 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 as shown on the Drawings.

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.

3.07 Asphaltic Concrete Surface

A. 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 Part 2 - Products at a rate of 0.05 to 0.10 gallon per square yard.

B. Take care to prevent the bituminous material splashing on exposed faces of curbs, gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime or tack coat has been properly cured, apply the asphaltic concrete to the thickness shown on the Drawings. Apply the surface course as described above for the binder course.

3.08 Flowable Fill

A. Flowable fill shall be used where designated on the Drawings and on any crossing of a State Highway or as required by City Street Department or the County Highway Department.

B. Flowable fill shall be covered or otherwise protected while in the flowable state. No embankment or fill shall be placed on the flowable fill prior to final set or hardening as determined by the Engineer.

C. All sections of pipe shall be securely braced or anchored both horizontally and vertically, if necessary, to prevent movement of the pipe during placement of the flowable fill. Pipe sections shall be joined so as to prevent the influx of flowable fill around the joints. The Contractor shall replace any pipe or sections of pipe which do not conform to the above requirements at no cost to the Owner.

D. Flowable fill shall be proportioned as follows:

1. Portland Cement Type 1, 100 lbs./c.y.
2. Fly Ash, 250 lbs. (minimum)/c.y.
3. Fine Aggregate, 2,800 lbs./c.y.
4. Water, 60 gal/c.y.
5. Proportions may be adjusted by the Engineer to achieve a consistency for satisfactory flow.

3.09 Smoothness: The finished surfaces shall conform to the lines and grades that existed prior to construction work. No deviations, variations, or irregularities exceeding 1/4 inch in any direction when tested with a 12-foot straightedge shall 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 approval of these reports before starting paving operations.

B. Tests shall be made of 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. Remove and reinstall all such sections. Patch all test holes in connection with thickness test.

C. When making surface tests, furnish one man to mark all surface defects for corrections.

3.11 Pavement Striping: All disturbed pavement markings including stop bars shall be replaced to match existing striping.

END OF SECTION

Return to Table of Contents

02713

WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 Work includes installation, testing, and disinfection of water lines and appurtenances.

PART 2 - PRODUCTS

2.01 Materials, Storage and Handling

A. Manufacturer's Recommendation: Care shall be exercised in the delivery, storage and handling of all materials prior to their incorporation into the work. Follow all manufacturers' recommendations for delivery and storage (except where these specifications differ). Acceptance of questionable material shall be based solely on the Engineer's interpretation of fabrication, delivery, storage and installation practices of the material in question.

B. Stored Pipe and Stored Fittings: Contractor shall take special care to assure that no foreign matter including, but not limited to, soil, trash, trench water or other debris enters the pipe at any time. Upon arrival of pipe shipment, Contractor shall completely seal pipe openings in a manner acceptable to the Engineer.

C. Installed Pipe: The installed pipe in the trench shall be plugged at the close of work each day or during any prolonged break period, including anytime workers are absent from the jobsite (lunch breaks, etc.). The only acceptable method for plugging the installed pipe is with a watertight M.J. cap or M.J. plug.

D. Failure to Follow Specifications: Failure to take such preventative measures mentioned in these specifications, or flooding or contamination of the main for any reason, shall require the Contractor to clean the line with a hydraulically propelled foam pig (or other suitable pigging device acceptable to the Engineer) and disinfect in accordance with Section 4.8 of AWWA C651 (latest version) as well as Rules of Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources, Chapter 0400-45-01-.17(8)(b).

2.02 Polyvinyl Chloride Pipe (PVC) and Fittings

A. Provide PVC pipe meeting ASTM D2241 or AWWA C900 (latest version).

B. ASTM D2241 Pipe

1. Manufactured from virgin, National Sanitation Foundation (NSF) approved Type 1, Grade 1 impact improved resin suitable for use in transporting potable water.

2. Pipe and fittings pressure rated for 200 psi.

3. Use only where the maximum pressure shall not exceed 100 psi.

4. Maximum Standard Dimensional Ratio (SDR) of 21.

5. Joints sealed with a rubber ring and non-toxic lubricant as provided by the manufacturer meeting or exceeding the requirements of ASTM D3139 and ASTM F477.
6. Clearly mark with the manufacturer's name, nominal diameter, SDR, ASTM D2241, pressure rating, and NSF approval seal.
7. Furnish in standard laying lengths of twenty (20) feet.
8. Color of pipe shall be blue or white.

C. AWWA C900 (latest version) Pipe

1. PVC 1120 pipe manufactured from virgin, National Sanitation Foundation (NSF) approved compounds meeting the requirements of ASTM D1784.
2. Pipe and fittings pressure rated for 200 psi.
3. Outside diameter equivalent to the same outside diameter of cast iron pipe.
4. The minimum wall thickness of the bell, at any point, shall conform to the DR requirements of the pipe.
5. Furnish in standard laying lengths of twenty (20) feet.
6. Clearly mark with the manufacturer's name, nominal diameter, DR, PVC 1120, pressure class, AWWA C900 (latest version), and NSF approval seal.
7. Color of pipe shall be blue or white.
8. To be used in areas where service pressure exceeds 90 psi.

D. PVC Fittings: Not allowed for water mains.

2.03 Ductile Iron (DI) Pipe, Fittings and Restraining Wedge-Action Gaskets

A. Pipe

1. All pipe 10-inch and larger shall be ductile iron.
2. Manufactured in accordance with ANSI A21.51 (AWWA C151 (latest version)).
3. A cement lining meeting the requirements of ASNI 21.4 (AWWA C104 (latest version)).
4. A minimum of 1 mil thick bituminous coating on the outside surface.
5. Clearly mark with manufacturer's name, D.I. or Ductile, weight, class or nominal thickness, and casting period.
6. Unless otherwise specified or shown on the plans, ductile iron pipe shall be pressure class 350 for sizes up through 12-inch. Sizes 14-inch and larger shall be class 250.
7. For directional bores, restrained joint ductile iron pipe equivalent to American Flex Ring or U.S. Pipe T.R. Flex with minimum pressure class 350 shall be used.

B. Fittings: All fittings and specials for pipe 4" in diameter and larger shall be cast or ductile iron.

1. Fittings 4" – 24": Pressure rated at 350 psi meeting the requirements of ANSI 21-53/AWWA C153 (latest version) for compact fittings.
2. Fittings 30" – 36": Pressure rated at 250 psi meeting the requirements of ANSI 21.10/AWWA C110 (latest version)for full size fittings or ANSI 21.53/AWWA C153 (latest version) for compact size fittings.
3. Joints meeting the requirements of ANSI 21.11/AWWA C111 (latest version).
4. All mechanical joint ductile iron fittings shall be equipped with mechanical joint restraint devices as specified in Section 2.10.

C. Restraining Wedge-Action Gaskets

1. Ductile iron pipe with push-on type joints, size 4-inch through 36-inch diameter, shall use restraining wedge-action gaskets meeting the requirements of ANSI A21.11/AWWA C111 (latest version).
2. Gaskets for 6" – 18" DI pipe: Pressure rated at 350 psi working pressure.
3. Gaskets for 20" – 24" DI pipe: Pressure rated at 250 psi working pressure.
4. Acceptable products are: McWane SURE STOP 350 Gasket, U.S. Pipe Field Lok 350 Gasket, Gripper Gasket LLC, American Fast-Grip Gasket.

2.04 High Density Polyethylene Pipe (HDPE) for Horizontal Directional Drilling

A. HDPE pipe shall only be used for directional bores as approved by the Engineer.

B. Pipe shall have a DR number 9 with a working pressure of 200 psi and be Ductile Iron Pipe Size (DIPS).

C. Materials: Polyethylene pipe and fittings shall be made from resin meeting the requirements of the Plastic Pipe Institute as PE 3408. The resin shall meet the requirements of ASTM D3350 with a cell classification of 345464C. The requirements of this cell classification are:

HDPE Resin Specifications

Property	Specification	Unit	Typical Value
Material Designation	PPI/ASTM		PE 3408
Material Approval	NSF #14		
Material Classification	ASTM D1248		III C5 P34
Cell Classification	ASTM D3350		345464C
Density	ASTM D1505	g/cm3	0.955
Melt Index	ASTM D1238	gm/10 min	0.11
Flexural Modulus	ASTM D790	psi	135,000
Tensile Strength	ASTM D638	psi	3,200

Slow Crack Growth			
ESCR	ASTM D1693	hours in 100% igepal	>5,000
PENT	ASTM F1473	hours	>100
HDB @73 deg F	ASTM D1693	psi	1,600
UV Stabilizer	ASTM D1603	%C	2.5%

D. Butt Fusion Fittings: HDPE fittings shall be PE 3408, HDPE, Cell Classification of 346464C as determined by ASTM D3350, and approved for potable water use by the AWWA. Butt fusion fittings shall have a manufacturing standard of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using data loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records. All fittings shall be suitable for use as pressure conduit, and per AWWA C906 (latest version), have a nominal burst value of 3.5 times the working pressure rating of the fitting.

E. Pipe Manufacturer's Quality Control: The pipe manufacturer shall have an ongoing Quality Control program for incoming and outgoing materials. HDPE resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. The manufacturer of the HDPE resin shall certify the Cell Classification as indicated in Paragraph C above. These incoming resins shall be approved by plant Quality Control and verified as approved by NSF before being converted to pipe. Pipe shall be checked for outside diameter, wall thickness, length, roundness and surface finish on the inside, outside and end cut.

F. HDPE pipe shall be joined together at the transition points to other mechanical joint adapters. Mechanical joint adapters shall have a manufacturing standard of ASTM D3261 and shall have a pressure rating equal to the pipe.

G. A minimum of 100 feet of restrained joint ductile iron pipe shall be provided on the pipe preceding and the pipe following the HDPE. Appropriate restraint methods include using restrained joints equivalent to American Flex Ring or U.S. Pipe T.R. Flex. ISCO Industries electrofused mechanical joint adapter to be used in all HDPE/DI transitions.

2.05 Service Pipe

A. Water service pipe material may be Municipex crosslinked polyethylene (PEXa) by Rehau, or alternatively may be Type K soft copper. PEXa water service pipe shall be blue in color. Where compression fittings are used on Municipex pipe, insert stiffeners are required to ensure a proper connection is made. Plastic insert stiffeners are not to be used. Stainless steel insert stiffeners are to be used in all sizes of PEXa pipe that is being used for water services. The stainless steel insert stiffener shall be provided by the same manufacturer that is providing the corporation stop and curb stop.

B. Copper Pipe

1. Seamless copper tubing meeting the requirements of ASTM B88, Type K for ¾" through 2". Copper tubing 1" and smaller shall be soft. Copper tubing larger than 1" may be hard or soft. All underground copper to copper connection is to be by compression coupling, no solder sweat joints.
2. Contain not less than 99.90% copper and not more than 0.04% phosphorous.
3. Suitable for use with a working water pressure of 160 psi.
4. ¾" nominal diameter unless otherwise specified or shown on the Drawings.
5. Service pipe shall be used to connect the corporation stop with the meter yoke. Use the minimum length required to make a straight-line connection including a goose neck. The minimum length of service shall be 5 feet in order to facilitate the location of the services with metallic pipe locators.
6. No 3-inch copper service pipe shall be allowed.
7. No 3-inch piping on Owner's side of the water meter shall be allowed.
8. All copper service piping shall be buried at a minimum depth of 24" below finished grade unless otherwise approved.

C. Ductile iron pipe meeting the requirements set forth in Paragraph 3.02 shall be used for service lines 4-inches and larger.

2.06 Water Service Assemblies

A. Water Meters

1. All publicly owned water meters are issued by the Owner in exchange for a fee payable at the City of Clarksville Gas & Water Department Service Center; such meters will be maintained by the Owner (City of Clarksville Gas & Water Department). A property owner may choose to purchase and install sub-meters beyond the Owner's meter; these privately owned sub-meters shall be maintained by the property owner.
2. AWWA C700 (latest version).
3. 5/8" x ¾" unless otherwise specified or shown on the Plans. For customers requesting water meters larger than 5/8" x ¾" the Owner-provided "CGW Water Customer Data Sheet" shall be completed and submitted with Construction Plans for review by the Engineer.
4. Meters shall be located in non-traffic areas.
5. Water services shall be located near the center of the lot in non-traffic areas so that they are not in driveways. Water meters shall be located in a landscaped area near the property line unless otherwise approved by the Engineer.

B. Water Main Connections

1. For all multiple-unit residential buildings (i.e. duplexes, triplexes, apartment buildings, etc.) where units are rentals, individual service taps and meters per unit

will not be allowed. The Owner (City of Clarksville Gas & Water Department) will allow no more than one service tap and meter per building. Gang meter vaults are required for multiple-unit residential buildings where each unit is individually owned (i.e. condominiums).

2. Tap water mains in the upper half of the pipe at a 45-degree angle.
3. Do not exceed the pipe manufacturer's recommended maximum tap size.
4. Use service saddles on all taps for PVC pipe. Water service tapping saddles for services 2" or less shall be of total brass or bronze construction with no ferrous materials. Saddles are to have double straps or extra wide single straps and shall employ a dual o-ring seal. Saddles shall be Power Seal Model 3401 or pre-approved equal.
5. Service taps on line under construction that has not been tested and inspected by the Owner may be made by a qualified Contractor. Taps on existing Owner mains must be made by authorized Owner personnel unless specifically authorized by the Engineer.
6. For all 2" taps on ductile iron lines, a ductile iron epoxy coated body saddle with double stainless steel straps equivalent to Smith Blair 317 shall be furnished. For ¾" to 1" connections, ductile iron mains shall be drilled and tapped with no need for a saddle.

C. Corporation Stops/Service Valves: Corporation stops are required for all ¾" and 1" services. Services of 2" diameter shall use a 2" ball valve with a square operating nut. All corporation stops shall have a minimum rating of 200 psi. All service valves shall have a standard valve box installed and brought to grade. Corporation stops shall meet the following criteria:

1. AWWA C800 (latest version).
2. Cast of certified waterworks red brass and certified lead free (=<0.25% lead content).
3. Water tight and individually tested for leaks.
4. Waterway diameter approximately equal to the nominal size of the stop.
5. Coat or cap all threads for protection prior to installation.
6. Manufactured by Mueller Company (Model B-25008) or pre-approved equal.

D. Meter Yokes (all meter yokes are issued by the Owner)

1. Copper tubing with an integral brace and meter stop.
2. Minimum rise of 7".
3. Provide with outlets designed for the use of polyethylene or copper service pipe.
4. Manufactured by Mueller Co. or pre-approved equal.

E. Curb Valves: All water services less than 2” diameter must terminate with a curb ball valve immediately prior to the meter yoke location. Approved model is Mueller B25140R3 or pre-approved equal. Curb ball valves that are buried prior to the installation of a yoke shall have a bolt or pin placed in the stop wing to prevent the ball valve from being accidentally opened during back fill.

F. Meter Boxes (all meter boxes are issued by the Owner):

1. Water meters shall be located in a landscaped area near the property line unless otherwise approved by the Engineer.

2. Water service depth shall be 18 - 24 inches for 5/8” – 1” meters and 24 - 36 inches for 2” – 6” meters as measured from the top of the water service line to the top of the meter box. To ensure no resetting of the service or meter box, plumbers and Contractors shall measure and confirm proper water service depth at the meter box prior to calling for the meter to be set.

3. Meter box to be of sufficient size to facilitate easy installation and removal of the water meter.

4. Where the service assemblies include a pressure reducing valve, include a separate box for the pressure reducing valve.

G. Pressure Reducing Valves for Service Assemblies: Pressure reducing valves are the responsibility of the customer and may be installed at any point downstream of the meter in accordance with the Standard Plumbing Code and the Owner’s Cross Connection Ordinance as well as Cross Connection Control Policy and Plan.

H. Service Materials: No galvanized pipe, galvanized nipples, black iron, glued plastic or sweated fittings are to be used between the main and the meter yoke. Threaded brass, slip joints, mechanical joints, and bronze/brass compression fittings are allowed if certified lead free (=<0.25% lead content).

2.07 Valves and Valve Boxes

A. Gate Valves

1. AWWA C509 (latest version) or C515 (latest version).

2. Iron body, resilient seat, non-rising stem type.

3. Stuffing boxes: O-ring seal type with two rings in the stem located above the thrust collar.

4. 2” square wrench nut for operation of the valve.

5. Minimum design working water pressure of 200 psi for valves with diameters of 4” – 12” and 150 psi for valves with diameter of 14” – 54”, unless otherwise specified or shown on the plans.

6. Joints: ANSI/AWWA C111/A21.11 (latest version).

7. Bonnet or body markings: Manufacturer’s name, year of casting, size, pressure

rating, and open direction labeled with an arrow.

8. Epoxy coat interior and exterior in accordance with AWWA C550 (latest version).
9. All main line valves and hydrants in old Clarksville, St. Bethlehem and Sango water systems including new construction are to open by turning to the right. Valve operating nuts and fire hydrants that open to the right shall be painted yellow. All main line valves and hydrants in the old New Providence, Edgoten, Kirkwood and North Montgomery areas including new construction are to open by turning to the left. Valve operating nuts and hydrants that open to the left shall be painted red. For other details contact the Engineer for clarification. A map showing opening directions for Owner's sewer valves, water valves and fire hydrants is included in Appendix A of these specifications.
10. Shall be Mueller A-2360, M&H 7571, American Flow Control 2500 or pre-approved equal.

B. Butterfly Valves

1. AWWA C504 (latest version).
2. Cast iron body, rubber seated tight-closing type.
3. Cast markings: valve size, manufacturer's name, class, direction of opening, and the year of casting.
4. Class 250, suitable for working water pressure of 250 psi unless otherwise specified or shown on the plans.
5. Epoxy coat interior and exterior in accordance with AWWA C550 (latest version).
6. All main line valves and hydrants in the old Clarksville, St. Bethlehem and Sango water systems including new construction are to open by turning to the right. Valve operating nuts and fire hydrants that open to the right shall be painted yellow. All main line valves and hydrants in the old New Providence, Edgoten, Kirkwood and North Montgomery areas including new construction are to open by turning to the left. Valve operating nuts and hydrants that open to the left shall be painted red. For other details contact the Engineer for clarification. A map showing opening directions for Owner's sewer valves, water valves and fire hydrants is included in Appendix A of these specifications.
7. Shall be Mueller LineSeal XP, M&H Style 4500, or pre-approved equal.

C. Valve Boxes

1. Cast iron, 2-piece or 3-piece, screw type with shaft diameter of not less than 5" (John Bouchard 562-S or equal).
2. Comply with AWWA M44 (latest version).
3. Heavy roadway type equipped with a cover containing the word "WATER" in raised letters on the top.

4. Base of such size as to permit its installation without allowing it to come in contact with either the valve or the pipe.

5. In paved areas, the top of the box casting shall be made level with the adjacent pavement. In unpaved areas, the box shall be level with the adjacent ground and encircled with a concrete collar 4" thick and 2' in diameter. Pre-cast concrete valve collars may also be used around valve boxes.

D. Tapping Valves and Sleeves

1. Tapping valves shall meet all the requirements of Paragraph A above and shall be Mueller T2360-16, M&H 4751-01 or pre-approved equal.

2. Tapping sleeves shall be Mueller H-304, Ford FTSS, JCM 452, Smith Blair 665, Dresser Style 630 or pre-approved equal.

3. Tapping sleeves shall be two-piece fabricated stainless steel with adjusting/tightening bolts on each side. The fabricated sleeve must contain all stainless materials and be rated for the anticipated working pressure. Sleeves must have a stainless steel outlet flange. Sleeves with ductile iron or carbon steel flanges will not be accepted. Care must be used to assure that all bolts are equally tightened. The tapping valve is to be solidly supported with brick or block and carefully bedded to prevent shifting due to settling back fill.

4. After valve is bolted to sleeve, and with valve closed, remove test plug from the tap on sleeve and air test sleeve to 100 psi prior to making tap.

5. For taps made on 10-inch lines and larger, a ductile iron or stainless steel tapping sleeve, Power Seal 3490-AS/CS, Mueller H-615 or Mueller H-304 shall be required.

2.08 Air Release Assemblies for Water Mains

A. Furnish 1" nominal diameter for 8" mains and smaller and 2" nominal diameter for 10" mains and larger, unless otherwise specified or shown on the Drawings.

B. Air release assemblies and combination air release assemblies shall consist of:

1. Double strap, bronze service clamp with neoprene gasket for PVC lines (see Paragraph 3.05).

2. Double stainless steel strap, epoxy coated ductile iron body saddle shall be used in 2-inch assemblies for ductile iron (see Paragraph 2.06).

3. Brass pipe of the nominal diameter required by the size of the valve. No galvanized pipe is allowed.

4. Red brass corporation stop.

5. Brass elbow. No galvanized materials are allowed.

6. Bronze gate valve with hand-wheel or a metallic-body ball valve with 2-inch square nut.

7. Air release valve.

C. Automatic Air Release Valves

1. All potable water lines shall have automatic air release valves as shown on the Drawings.
2. Valve shall be made from stainless steel or cast iron and all operating parts are to be made of engineered corrosion resistant plastic materials or stainless steel.
3. The valve shall be designed to allow larger than normal automatic orifice to provide efficient air release and minimize potential debris build up and clogging.
4. The working pressure shall be 250 psi and tested to 360 psi.
5. All air release valves shall be model ARI S-050-C, plastic body valves, or approved equal.

D. Install air release assemblies and combination air release valves in a pre-cast concrete manhole, 48" in diameter and 48" deep, nominal diameter cast iron frame and cover. Cover to be marked "WATER".

E. Place crushed stone from 12" below the bottom of the main to the top of the main inside the pre-cast manhole.

2.09 Fire Hydrants and Blow-Off Hydrants

A. Fire Hydrants

1. AWWA C502 (latest version). Mueller Super Centurion 250 (Model A-423) or M & H Model #129 are the standard for Owner.
2. Cast iron bodies, fully bronze mounted, designed for operation at a working water pressure of 150 psi.
3. Furnish with two 2-½" thread brass hose nozzles and one threaded 4-½" brass pumper nozzle.
4. Compression type main valve 5-¼" diameter faced with a suitable yielding material such as rubber, leather, or balata.
5. It shall be designed that, when it is installed, no excavation is required to remove the main valve or the movable parts of the drain valve.
6. Inside diameter of barrel: at least 120 percent of the hydrant valve size.
7. Inlet connection: minimum of 6" mechanical joint on all lines, unless otherwise specified or shown on the Drawings.
8. Equipped with safety flange located not more than 10" above ground and a two-piece shaft break-away assembly.
9. All main line valves and hydrants in the old Clarksville, St. Bethlehem and Sango water systems including new construction are to open by turning to the right. Valve operating nuts and fire hydrants that open to the right shall be painted yellow. All main line valves and hydrants in the old New Providence, Edgoten,

Kirkwood and North Montgomery areas including new construction are to open by turning to the left. Valve operating nuts and hydrants that open to the left shall be painted red. For other details contact the Engineer for clarification. A map showing opening directions for Owner's sewer valves, water valves and fire hydrants is included in Appendix A of these specifications.

10. Shop paint and mark in accordance with AWWA C502 (latest version). Open right hydrants yellow. Open left hydrants red.
11. Cast markings: manufacturer's name, size of the main valve, year of manufacture, and direction of opening.
12. Field touch-up, if the surface has been marred, with paint supplied by the manufacturer of the same color and type as that used during shop painting.
13. Four-foot (4') bury hydrants are the standard. Where the line depth justifies additional depth, hydrant extensions shall be installed.
14. All hydrants shall be installed utilizing hydrant (swivel) tees. Unless otherwise shown on the plans, tees with all mechanical joint ends shall be used if field conditions require hydrant isolation valve to be placed away from the water main.
15. All hydrants shall be installed with a 6-inch isolation gate valve in valve box.
16. Fire hydrants shall not be installed on water lines less than 6 inches in diameter.
17. A fire hydrant shall not be located closer than 5 feet from any driveway.
18. In accordance with the Clarksville-Montgomery County Regional Planning Commission Subdivision Regulations, fire hydrants located within a single-family residential district shall be spaced no more than 800' apart, as measured along the street right-of-way. Fire hydrants located within a multi-family, commercial or industrial district shall be spaced no more than 300' apart. A fire hydrant must be installed within 300' of the dead-end of a cul-de-sac. All fire hydrant locations shall be approved by the Clarksville Fire Department or the Montgomery County Emergency Management Agency.

B. Blow-Off Hydrants

1. Post type having cast iron bodies, fully bronze mounted and designed for operation at a working water pressure of 150 psi.
2. Furnish with either two 1-1/2" or 2-1/2" threaded brass hose nozzles.
3. Compression type main valve 2-1/8" minimum diameter faced with a suitable yielding material such as rubber, leather or balata.
4. So designed that, when it is installed, no excavation is required to remove the main valve or the movable part of the drain valve.
5. Inside diameter of the barrel shall be at least 3".
6. Inlet connection: 2" mechanical joint, unless otherwise specified or shown on the

Drawings.

7. Equipped with a safety flange located not more than 2” above the ground.
8. Open on counter-clockwise operation, unless otherwise specified.
9. Cast markings: manufacturer’s name, size of the main valve, year of manufacture, and direction of opening.
10. Field touch-up, if the surface has been marred, with paint supplied by the manufacturer of the same color type as that used during shop painting.
11. Type of post hydrant: Mueller A-411 or M & H (Style 33 or 233).

2.10 Mechanical Joint Restraint Device

A. Pipe restraint: It is the intention of these specifications that all mechanical joint fittings and valves be restrained at each opening with approved mechanical joint restraint devices. Restrained fittings do not eliminate or replace the requirement for sufficient concrete thrust blocking and/or restrained pipe joints.

B. PVC Restraint Devices

1. Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10 (latest version) or ANSI/AWWA C153/A21.53 (latest version).
2. Devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1.
3. Restraint devices shall have torque bolts.
4. Megalug series 2000 PV produced by EBAA Iron or equal.

C. Ductile Iron Pipe Restraint Devices

1. Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C110/A21.10 (latest version) or ANSI/AWWA C153/A21.53 (latest version).
2. Devices shall have a working pressure rating of 350 psi for 4” to 16” and 250 psi for 18” and larger. Ratings are for water pressure and must include a minimum safety factor of 2:1.
3. Restraint devices shall have torque bolts.
4. Megalug Series 1100 produced by EBAA Iron or equal.

D. Restraint Devices - General

1. Gland body, wedges and wedge activating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
2. Installation shall be performed using conventional tools and installation procedures as specified in AWWA C600 (latest version) while retaining full

mechanical joint deflection during assembly as well as allowing joint deflection after assembly.

3. Proper activation of the gripping wedges shall be ensured with torque-limiting twist-off nuts.

2.11 Cross Connection

A. All commercial properties must have backflow protection installed on incoming water lines (domestic, fire and irrigation). The type and location of commercial property backflow prevention devices shall be as follows:

1. Reduced Pressure Assemblies for domestic and irrigation.

2. Double Check Assemblies (with fire meter) or Double Check Detector Assemblies (where approved by the Engineer without fire meter) for all fire systems unless the system contains chemicals or is connected to an alternate water source.

3. Backflow prevention devices shall be installed downstream of the meter before the first branch off the main line serving the building(s). Outdoor installations require protective enclosures. Inside installations require adequate drains.

B. Residential properties are required to install backflow protection on irrigation and fire systems. Multi-story, multi-family (3-story or more) buildings are required to have backflow prevention on domestic, irrigation and fire system lines. Backflow prevention devices may also be required for other properties as directed by Engineer due to connections to alternate water sources such as wells or connection with equipment that could alter water quality. The type and location of residential property backflow prevention devices shall be as follows:

1. Reduced Pressure Assemblies for all irrigation services and any domestic lines deemed necessary by the Gas and Water Department.

2. Double Check Assemblies for all residential fire systems.

3. Backflow prevention devices shall be installed downstream of the meter before the first branch off the main line serving the building(s). Outdoor installations require protective enclosures. Indoor installations require adequate drains.

C. Except for fire systems, all backflow prevention installations are required to have a strainer installed immediately upstream of the device.

D. See Owner's Cross Connection Ordinance as well as Cross Connection Control Policy and Plan for more detail on installation and maintenance requirements for backflow prevention devices.

PART 3 - EXECUTION

3.01 Preparation

A. Follow all material storage and handling requirements in accordance with Section

02713, Part 2.

B. Prior to laying pipe, prepare a suitable bedding according to Section 02221.

C. Before placing pipe in the trench, remove temporary pipe plug, field inspect for cracks or other defect; remove defective pipe from the construction site.

D. Swab the interior of the pipe to remove all undesirable material.

E. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

F. Locate water lines in relation to other piped utilities.

3.02 Installing Water Lines

A. Install PVC pipe in accordance with AWWA C605 (latest version).

B. Install DIP pipe in accordance with AWWA C600 (latest version).

C. Lay all pipe on a uniform grade and with deflections not exceeding the pipe manufacturer's recommendations.

D. After applying gasket lubricant, take extreme care to keep the spigot end from contacting the ground.

E. Hone the pipe with suitable tools or equipment to provide a smooth beveled edge on plain end sections or field cut sections.

F. Closely follow the manufacturer's instruction in laying and joining pipe.

G. Cut pipe for inserting valves, fittings, etc., in a neat and workmanlike manner without damaging the pipe so as to leave a smooth end at right angles to the axis of the pipe.

H. Cover pipe with a watertight mechanical joint cap or plug during each installation of pipe segment and at conclusion of each day's construction activities.

I. The location of all water mains installed under these specifications shall be marked by the use of a continuous blue tape, minimum 6 inches in width, made of minimum 5 mil thick polyethylene plastic with a minimum 0.35 mil thick aluminum metallic core or backing. The tape shall be buried in the trench, above the pipe, no more than 2 feet below the surface. The tape shall be marked indelibly with the words "Water Main Below" or similar wording to warn unwary excavators.

J. Tracer wire shall be installed along all water main and water services.

1. Tracer wire installed in open cut applications shall be Copperhead 1230-HS, 12 AWG copper-clad steel tracer wire with 30 mil HDPE coating, no substitutions allowed.

2. Tracer wire installed in horizontal directional drill applications shall be Copperhead 1245-EHS, 12 AWG copper-clad steel tracer wire with 45 mil HDPE coating, no substitutions allowed.

3. Tracer wire color shall be blue for water pipe.

4. Connectors at service connections and tees shall be DryConn Direct Bury Lug Aqua by King Innovation and at main line splices shall be DryConn King 6 Blue by King Innovation, no substitutions allowed.
5. Tracer wire shall extend at least 5 feet beyond service stub terminations. A piece of PVC pipe shall be buried vertically against the 4”x4” marker post extending about 2 inches above ground level.
6. The tracer wire shall be fed through the PVC pipe with the end of the wire about 2 inches above the end of the pipe and the remainder coiled and buried beneath it.
7. A performance test will be performed on the completed tracer wire system to ensure the entire system is trackable. Any part of the system that is not trackable shall be repaired or replaced by the Contractor until it is trackable prior to acceptance of utilities.

K. The Contractor shall stamp the concrete curb with a “W” where water services are located. The end of each service stub shall be marked with a 6-foot long 4”x4” wooden post or metal fence post embedded 2 feet in the ground and be marked with blue paint.

L. Installing HDPE Water Lines (only for directional drilling applications)

1. HDPE pipe shall be assembled utilizing field-site butt fusion joints.
2. Personnel performing butt fusion joining shall be certified by pipe manufacturer.
3. Each piece of pipe must be held by a clamping device so it will not move.
4. Pipe ends shall be faced to establish clean mating surfaces.
5. Pipe profiles must be rounded and aligned with each other to prevent mismatch of pipe walls.
6. Heat the ends of the pipe to the pipe manufacturer’s recommended temperature, interface pressure, and time duration.
7. Keep heater faces clean to prevent molten plastic from sticking to the heater faces.
8. After heating, remove heater tool and bring molten pipe ends together with sufficient pressure to form a homogenous joint.
9. Hold the molten joint immobile under pressure until cooling has occurred and joint achieves strength.
10. Test line per the requirements of this Section.

3.03 Separation of Water and Sewer Lines

A. Maintain a 10-foot horizontal separation, measured edge to edge, between any new or proposed water main and any existing or proposed sanitary sewer.

B. Where conditions cause the required horizontal separation to be impractical, the water main may be laid closer provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main.

C. Where a sewer crosses under a water main, the top of the sewer shall be at least 18 inches below the bottom of the main.

D. Where conditions cause the required vertical separation to be impractical, the water main shall be relocated to provide the required separation or else reconstructed with mechanical joint ductile iron pipe for a distance of 10 feet on each side of the sewer with a full joint of the water main centered over the sewer.

E. Where sewers must be constructed over water mains or less than 18 inches below the water main, the sewer shall be designed and constructed equal to water main standards and pressure tested to assume water tightness.

F. Additional protection such as concrete encasement shall be installed where directed by the Engineer.

G. To prevent cross connection, comply with Owner's Cross Connection Ordinance as well as Cross Connection Control Policy and Plan.

3.04 Installing Appurtenances

A. Set all valves, fittings, hydrants, and other special fittings in a neat workmanlike manner. Tapping valves are to be supported with blocking and surrounding bedding carefully compacted to prevent settlement.

B. Use thrust blocks, pipe anchors, or other approved means to prevent displacement of other fittings as shown on the Project Documents. Do not allow concrete to cover nuts and bolts on fittings. Gate valves on fire hydrant leads are to be restrained or blocked independently of the hydrant blocking so that the hydrant may be excavated and removed with the valve closed. Mechanical restraint is to be by the use of MegaLug devices or other similar devices. Underground use of galvanized all thread rod is not allowed except where specifically approved by the Engineer. Fittings for taps made on the reverse side of the main must be restrained joints. All mechanical joints are to be restrained with mechanical joint restraint devices as set forth in Paragraph 2.10. These restraining devices do not eliminate the requirement for sufficient concrete thrust blocking and/or restrained joint pipe.

C. Erect hydrants to stand plumb with the pumper nozzle facing the road. Nozzles shall be installed a minimum of 12 inches above finished grade.

D. Enhance drainage of hydrants by using 6 cubic feet of gravel around base of hydrant. Do not allow concrete thrust block to obstruct drain holes.

E. Close dead end pipe with a mechanical joint solid sleeve and plug, and equip with blow-off assemblies, where shown on the Drawings.

3.05 Connecting New System to Existing System

A. Initial filling of the new line shall be made at only one point and shall be via a metered backflow assembly (large sizes may not be metered at option of Owner) which is provided by the Owner, installed by the Contractor, and then removed by the Contractor and returned to the Owner after acceptance of the line. Unless otherwise approved by Engineer, the Contractor is responsible for providing all necessary sleeves, reducers, or other fittings to install and remove the backflow assembly from the main.

B. All connection of new main extensions to existing systems shall be valved to prevent existing customers from being included in the new system area during testing and disinfection procedures.

C. Connections of new mains to existing mains shall normally be made by the use of a tapping valve in order to avoid disrupting service to existing customers.

D. Any wet connections involving the shutdown of existing system valves shall be specifically approved by and coordinated with the Engineer. Such coordination shall include the responsibility of the Contractor in notifying affected customers and scheduling shutdowns to minimize customer inconvenience. An authorized shutdown shall not relieve the Contractor from liabilities resulting from shutdowns such as damaged water heaters, discolored water, etc. The turning of valves shall be scheduled with the Engineer.

E. Manipulation of valves for filling or flushing lines shall be minimized to avoid accumulations of air and discolored water in the affected areas. No water valves shall be operated by anyone other than City of Clarksville Gas & Water Department personnel.

F. Once new systems are fully activated, following disinfection, flushing and testing, the Contractor shall inspect each valve that has been installed or manipulated to ensure that all valves are in fully open position.

G. The Contractor will be charged for the consumption volume of water by flushing, filling, leaks, etc. that exceeds twice the volume of the installed pipe.

3.06 Highway and Railroad Crossings

A. Perform highway crossings by the open cut method, unless otherwise shown on the Drawings or required by the appropriate authorities.

B. Boring and jacking, tunneling, or horizontal directional drilling of crossings, if necessary, will be performed in accordance with the appropriate specification sections.

3.07 Water Line Pressure Tests

A. All newly laid pipe or any valved section thereof shall be subjected to hydrostatic pressure testing. Conduct hydrostatic testing in accordance with AWWA C600 (latest version) for ductile iron pipe or AWWA C605 (latest version) for PVC pipe.

B. Where practicable, pipelines shall be tested in lengths between line valves or plugs of

no more than 3,000 feet.

C. Hydrostatic testing shall be conducted only with potable water. Due to the inherent safety hazard potential associated with testing components and systems with compressed air or other compressed gases, pressure testing shall never be accomplished using compressed air.

D. The Contractor shall furnish all gauges, recording devices, pumps, pipe, connections and other equipment required to conduct the test and shall maintain said equipment in condition for accurate testing as determined by the Engineer. Contractor shall provide oil-filled gauges for pressure testing.

E. Hydrostatic Test

1. City of Clarksville Gas & Water Department provides meter and backflow preventer.
2. City of Clarksville Gas & Water Department taps existing main and installs shutoff valve (corporation).
3. Contractor shall install ¾" or 1" service line from main to meter and backflow preventer, and then to new main.
4. Contractor shall connect the service line to the new main using tapping saddle and corporation and then fill the new line.
5. Hydrostatic test results are recorded on the Owner-provided "Disinfection. Flushing, Pressure and Bacteriological Testing Worksheet".

F. Prior to testing, the Contractor shall place sufficient backfill to prevent pipe movement. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed but before placement of permanent surfacing. The Contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

G. Cross Connection Control: When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check valve assembly between the test and supply main or by other means approved by the Engineer. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

H. Test Pressure Requirements

1. The test pressure shall not be less than 1.25 times the stated working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, but not greater than 150 psi.
2. The test pressure shall not exceed the thrust restraint design pressure or 1.5 times

the pressure rating of the pipe or joint, whichever is less (as specified by the manufacturer).

3. The test pressure shall not exceed the rated working pressure of the valves when the pressure boundary of the test section includes closed, resilient seated gate valves or butterfly valves.

4. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. A test pressure greater than the rated valve working pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests exceeding the rated valve working pressure, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve working pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or the valve can be fully opened if desired.

I. Test Procedure

1. Each valved section of pipeline shall be slowly filled with potable water using a metered backflow-protected assembly provided by the Owner. When venting air from pipelines, it is important to limit the pipeline fill rate to avoid excessive surge pressures when the water reaches the air venting opening(s).

2. Before applying the specified test pressure, air shall be expelled completely from the pipeline section under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at such points to expel air as the line is filled with water. After all the air has been expelled, close the corporation cocks and apply the test pressure. At the conclusion of the pressure test, remove the corporation cocks and plug or leave in place at the discretion of the Engineer.

3. The specified test pressure shall be applied using a suitable pump connected to the pipeline in a manner satisfactory to the Engineer. The specified test pressure shall be based on the elevation of the lowest point of the pipeline or section under test and corrected to the elevation of the test gauge, in accordance with test pressure requirements specified herein.

4. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test. This may require several cycles of pressurizing and bleeding trapped air prior to beginning the test. It is recommended that the line remain pressurized for a minimum of 24 hours before testing in order for joints to tighten and pockets of air to dissolve in the water.

5. The hydrostatic test shall be at least two hours in duration after reaching the specified test pressure where joints are exposed and at least eight hours where joints are covered.

6. No allowable pressure loss.

J. Visual Inspection: Any exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the hydrostatic pressure test. Any damaged or defective

materials that are discovered during or following the pressure test shall be repaired or replaced at no cost to the Owner, and the test shall be repeated until satisfactory results are obtained. Water main repair and replacement shall be performed in accordance with Paragraph 3.07.L. of this Section.

K. Should any test of pipe laid disclose leakage, the Contractor shall, at no cost to the Owner, locate and repair the defective joints. All visible leaks are to be repaired. Hydrostatic test results shall be recorded on an appropriate chart recorder as specified herein. A copy of the test chart shall be provided to the Engineer.

L. To repair or replace damaged or defective water main pipe, the Contractor shall maintain positive pressure on the main (valves left partially open) while he excavates around and under (2' clearance) the pipe so that water can be pumped out of the excavation pit before it enters the newly constructed main during the repair process. Contractor shall have adequate pumping capacity to prevent any trench water or debris from entering the main during this process. The interior of all pipe and fittings shall be sprayed with a 1% hypochlorite solution before they are installed in the repair process. To produce this one percent hypochlorite solution, one gallon of 5% hypochlorite bleach can be diluted with four (4) gallons of water. Flooding or contamination of the main during this process shall invoke Paragraph 2.01.D of Section 02713.

3.08 Contractor shall disinfect water lines in accordance with AWWA C651 (latest version) as well as Rules of Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources, Chapter 0400-45-01-.17(8)(b), unless otherwise directed by Engineer. Engineer will provide completed "Disinfection, Flushing and Pressure Testing Worksheet" to the Contractor, which will be required for Contractor to obtain HTH chlorinating granules from Owner's warehouse.

END OF SECTION

Return to Table of Contents

02715

FIRE SERVICE WATER METERS

PART 1 - GENERAL

1.01 Work Includes installation of fire service meters, vaults and related appurtenances as shown on the Drawings.

PART 2 - PRODUCTS

2.01 Cold Water Meters/Fire Service Compound Meter Type

A. Owner shall issue all fire service meters in exchange for a fee payable at the City of Clarksville Gas & Water Department Service Center.

B. All components of the meter assembly shall be both UL (Underwriter's Laboratory) listed and FM (Factory Mutual) approved for fire service use.

C. Capacity: The capacity of the meters in terms of normal operating range, maximum rate for continuous use, maximum loss of head, and extended low flow capability shall be as provided in the following table:

Size (inches)	Normal Operating Range (gpm)	Maximum Rate for Continuous Use (gpm)	Maximum Loss of Head at Max Rate (psi)	Extended Low Flow (gpm)
4"	¾ - 1200	1200	9	3/8
6"	1 ½ - 2000	2000	10.5	3/4
8"	2 – 4000	4000	10.5	1
10"	2 - 6500	6500	9	1

D. To prevent cross connections, comply with Owner's Cross Connection Ordinance as well as Cross Connection Control Policy and Plan.

PART 3 - EXECUTION

3.01 General Installation Requirements

A. Install meter in an 8'x 6'x 6' pre-cast, reinforced concrete vault by Cloud Concrete or equal. The bottom of the meter assembly shall be located a minimum of 6 inches above the floor of the vault. The vault shall be installed in a grassed or landscape area. If no such area exists, upon prior approval from Engineer, the vault may be placed in the edge of parking lots or sidewalk where only occasional wheel loadings may occur. In all instances the vault shall be protected from traffic. Such protections shall include concrete filled steel bollards or other approved method.

B. Vault shall be self-draining by gravity sump or sump pump.

C. Meter assembly shall include a bypass line.

D. The vault shall include a 72” x 48” Halliday Products Model H2W7248 (H-20 wheel loading rated) Double Leaf aluminum access door with spring assist and lock. The hatches shall be offset to provide accessibility to the steps.

E. Each installation shall have steps conforming to ASTM C478. The steps shall be made of copolymer polypropylene plastic conforming to the latest revision of ASTM D4101 and shall have a ½-inch diameter Grade 60 Steel reinforcing rod meeting the latest revision of ASTM A615 through its center. Each step shall be 12 inches in width and capable of supporting a load of 1,000 pounds in the center of the step when projected 6 inches from the wall. Each step shall be equipped with non-skid grooves. Rung spacing shall be 12 inches. The location of the steps shall be coordinated with the access hatch offset so that the steps are easily accessible.

F. Piping shall be ductile iron Class 350 with flanged ends inside the vault. All other joints and fittings shall be mechanically restrained (see Section 02713, Paragraph 2.10).

G. Pipe and meter shall be adequately supported to prevent transmitting stress to meter or pipe. Concrete blocks or bricks stacked beneath pipe will not be acceptable.

H. A post indicator valve, Mueller A20806, or approved equal shall be installed between the valve pit and building.

I. The by-pass line shall include gate valve with locking top valve box Tyler Union Box 91-C or approved equal.

J. Gate valves shall also be placed at the Owner main and on either side of the meter (just outside the pit).

END OF SECTION

Return to Table of Contents

02722
SANITARY SEWER SYSTEMS

PART 1 - GENERAL

1.01 Work includes installation and testing of sanitary sewerage systems. All sanitary sewerage systems shall conform to the design and construction standards promulgated by the Tennessee Department of Environment and Conservation (TDEC).

PART 2 - PRODUCTS

2.01 General

A. New sanitary sewer pipe may generally be constructed of PVC pipe as specified in Paragraphs 2.03 and 2.04 of this Section, with the following exceptions:

1. Sanitary sewers shall be specially coated and lined ductile iron pipe where indicated on the Drawings.
2. Open cut sanitary sewers crossing drainage ditches and swales, storm drain discharge, wet weather streams, USGS blue-line streams, and other erosive environments shall be specially coated and lined ductile iron pipe and will be provided with concrete encasement.
3. Sanitary sewers with less than the required 36 inches of cover in non-traffic areas and 48 inches in areas subject to vehicular traffic shall be specially coated and lined ductile iron pipe.
4. Sanitary sewers installed at depths greater than 20 feet shall be constructed of specially coated and lined ductile iron pipe.
5. Where sanitary sewers are installed in new fill, a compaction letter sealed by a Geotechnical Engineer registered in the State of Tennessee shall be submitted to the Owner prior to accepting said utilities. An acceptable compaction letter shall state that field density testing indicates the fill has been compacted to at least 95% of the maximum dry density according to the Standard Proctor. If a compaction letter is not available, special protection such as replacement with ductile iron pipe with joint restraint shall be required.
6. Where additional pipe protection is required due to loads, insufficient cover, erosive environments, crossing other utilities, etc., specially coated and lined ductile iron pipe, restrained joints, concrete encasement and other methods shall be required as directed by the Engineer.
7. Pipe material for sanitary sewers larger than 24 inches in diameter shall be determined on a case-by-case basis by the Engineer.
8. Sanitary sewer pipe installed by horizontal directional drilling shall be HDPE pipe unless otherwise approved by the Engineer. See Section 02727 for product

specifications of HDPE pipe.

2.02 Delivery, Storage and Handling

A. Care shall be exercised in the delivery, storage and handling of all materials prior to their incorporation into the work. Follow all manufacturers' recommendations for delivery and storage (except where these specifications differ). Acceptance of questionable material shall be based solely on the Engineer's interpretation of fabrication, delivery, storage and installation practices of the material in question.

2.03 Polyvinyl Chloride (PVC) Gravity Sewer Pipe

A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D1784, suitable for use as a gravity sewer conduit with provisions for contraction and expansion at each joint, with a rubber ring and standard lengths of 20 feet and 12.5 feet plus or minus 1 inch.

B. Joints shall meet the requirements of ASTM D3212. Joint design shall be tested and certified to result in no leakage under prescribed laboratory test conditions of joint alignment, load conditions, pressure and vacuum, and deflection. Pipe and fittings shall have integral bell with elastomeric seal joint. The gaskets used for joining PVC sewer pipe shall conform to ASTM F477.

C. PVC gravity sewer main pipe 8 inches to 15 inches in diameter shall meet and/or exceed the requirements of ASTM D3034, SDR 35. PVC gravity sewer pipe installed at depths greater than 12 feet shall conform to SDR 26.

D. Large diameter PVC gravity sewer main pipe 18 inches to 30 inches in diameter shall meet and/or exceed the requirements of ASTM F679, SDR 35 or PS 46. PVC gravity sewer pipe installed at depths greater than 12 feet shall conform to SDR 26 or PS 115.

E. Gravity sewer mains shall be at least 8 inches in diameter.

F. All PVC gravity service line pipe and fittings from the sewer main to the sewer cleanout assembly shall conform to SDR 35 unless depth exceeds 12 feet, in which case service lines and fittings shall conform to SDR 26.

G. Color of PVC gravity sewer pipe shall be green.

H. All PVC gravity sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, ASTM designation, and NSF approval seal.

2.04 Polyvinyl Chloride (PVC) Pressure Sewer Pipe, Fittings and PEXa Services

A. Manufactured from virgin National Sanitation Foundation (NSF) approved resin, PVC 1120 made from PVC compounds 12454-A or 12454-B as defined in ASTM D1784.

B. PVC pressure sewer pipe 4 inches to 12 inches in diameter shall meet and/or exceed the requirements of ASTM D2241, SDR 21, Pressure Class 200 or AWWA C900 (latest version), DR14, Pressure Class 200. PVC pressure sewer pipe 14 inches to 24 inches in diameter shall meet and/or exceed the requirements of AWWA C905 (latest version), DR18, Pressure Class 235.

C. PVC pressure sewer pipe shall have bell and spigot push-on joints manufactured in accordance with ASTM D3139. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. The gasket shall be reinforced with a steel band or other rigid material and shall conform to ASTM F477. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radially compressed to the pipe and locked in place against displacement, thus forming a positive seal.

D. Color of PVC pressure sewer pipe shall be green.

E. All PVC pressure sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, type of material, SDR or Class, ASTM or AWWA designation, and NSF approval seal.

F. All fittings for PVC pressure sewer mains shall be ductile iron with mechanical joints as described in Paragraph 2.05 of this Section. The gaskets shall be duck-tipped transition gaskets for use with PVC pipe. All adaptors, fittings and transition gaskets necessary to connect ductile iron fittings to PVC shall be furnished.

G. Sewer force main service material shall be Municipex crosslinked polyethylene (PEXa) by Rehau and shall be green in color.

H. Where compression fittings are used on Municipex pipe, insert stiffeners are required to ensure a proper connection is made. Plastic insert stiffeners are to be used where pipe is less than 2 inches in diameter and stainless steel insert stiffeners are to be used where pipe is 2-inch diameter and larger.

2.05 Ductile Iron Sewer Pipe and Fittings

A. Ductile iron gravity sewer pipe shall conform to the latest revisions of ASTM A746, ANSI/AWWA C151/A21.51 (latest version) and ANSI/AWWA C111/A21.11 (latest version).

B. Ductile iron pressure sewer pipe shall conform to the latest revisions of ANSI/AWWA C151/A21.51 (latest version) and ANSI/AWWA C111/A21.11 (latest version).

C. Unless otherwise specified or shown on the Drawings, ductile iron sewer pipe shall be Pressure Class 350 for sizes 12-inch and smaller. Sizes 14-inch and larger shall be Pressure Class 250.

D. Unless otherwise specified or shown on the Drawings, ductile iron sewer pipe shall be furnished with push-on joints, with mechanical joint fittings and valves. Exposed piping shall be flanged.

E. Ductile iron sewer pipe shall be specially coated and lined as detailed in Paragraph 2.06 of this Section.

F. All pipe shall be new and shall have the manufacturer's name, AWWA or ASTM designation, weight, pressure class and nominal diameter stamped on the outside of each pipe.

G. Standard and special fittings shall be mechanical joint ductile iron fittings meeting the requirements of ANSI/AWWA C110/A21.10 (latest version) or ANSI/AWWA C153/A21.53 (latest version), as applicable. Fittings shall have a pressure rating of 350 psi for 24-inch and smaller piping. Fittings shall at a minimum have the same pressure rating as the connecting pipe. Ductile iron fittings shall be specially coated and lined as detailed in Paragraph 2.06 of this Section.

2.06 Special Coatings and Linings for Ductile Iron Pipe and Fittings

A. All ductile iron pipe and fittings shall be coated outside with a minimum 1 mil-thick bituminous coating per AWWA C151 (latest version) for ductile iron pipe, AWWA C115 (latest version) for flanged pipe and AWWA C110 (latest version) and C153 (latest version) for fittings.

B. All ductile iron pipe and fittings shall be lined with 40 mils nominal dry film thickness of “Protecto 401 Ceramic Epoxy”. The lining material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.

C. Lining application shall be performed by an applicator approved by the coating manufacturer in accordance with the manufacturer’s instructions and under controlled conditions at the applicator’s shop or the pipe manufacturer’s plant.

D. All ductile iron pipe and fitting linings shall be inspected in accordance with the manufacturer’s recommendations. The pipe or fitting manufacturer shall submit a certified affidavit of compliance with the manufacturer’s instructions and requirements specified herein.

2.07 Joint Restraint Devices

A. Mechanical Joint Restraint Devices

1. All mechanical joint fittings and valves shall be restrained at each opening with approved mechanical joint restraint devices. Restrained fittings do not eliminate or replace the requirement for sufficient concrete thrust blocking and/or restrained pipe joints.

2. Restraint devices for joining plain end pipe to mechanical joint fittings, pipe and valves shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10 (latest version).

3. Devices for PVC pipe shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1.

4. Devices for ductile iron pipe shall have a working pressure rating of 350 psi for 3- to 16-inch and 250 psi for 18-inch and larger. Ratings are for water pressure and must include a minimum safety factor of 2:1.

5. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.

6. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600 (latest version), while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

7. Mechanical joint restraint shall be Megalug Series 2000PV or Megalug Series 1100 produced by EBAA Iron Inc. or approved equal.

B. Bell Restraint Harness Devices

1. Bell restraint harnesses for push-on joint PVC pipe shall be Series 1600, 2800, or 6500 as manufactured by EBAA Iron, Inc., Series 1350 or 1390 by Uni-Flange, or approved equal.

2. Bell restraint harnesses for push-on joint ductile iron pipe shall be Series 1700 by EBAA Iron, Inc., or approved equal.

2.08 Compression Couplings

A. When joining together dissimilar types of pipe, such as PVC and vitrified clay pipe, for repairing and rejoining sections of gravity sewer, for joining new pipe to existing pipe, and for connecting the first full joint of pipe to a short stub through a manhole wall, compression couplings complying with ASTM C1173 shall be used.

B. Compression couplings shall be resistant to corrosion by soil and sewage and shall provide a permanent watertight joint. The compression couplings shall be of natural or synthetic rubber or rubber-like material and the bands for attaching the couplings shall be of stainless steel.

2.09 Precast Concrete Manholes

A. All precast concrete manholes shall conform to the requirements of AASHTO M199 SR and ASTM C478, including steel reinforcement.

B. All concrete used in connection with the construction of precast manholes shall be at minimum 4,000 psi concrete.

C. The precast manufacturer shall use XYPEX additive. Xypex Admix C-1000 Red shall be added to the concrete during batching at the manufacturer's specified rate. The amount of cement shall remain the same and not be reduced. Precast concrete structures shall have a reddish tint to verify the XYPEX admix.

D. Base, riser and top sections shall have tongue and groove joints.

E. The Contractor may choose to order new precast base sections with monolithic bottoms and inverts already formed and manhole bases and risers with pipe openings and integrally cast resilient pipe connectors in place. It shall be the Contractor’s responsibility to provide manholes with properly located and sized pipe openings and properly formed inverts. Manholes not constructed in accordance with the Drawings are subject to rejection and replacement at no additional cost to the Owner.

F. Unless otherwise specified, all manholes shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 30 inches. Drop manholes shall be a minimum of 5 feet in diameter and 6-foot diameter manholes shall be used on sewers 30 inches and larger.

G. Top sections shall be eccentric cones where cover over the pipe exceeds 4 feet. Top sections shall be flat top where cover over the pipe is 4 feet or less.

H. The clear opening in the manhole shall be not less than 24 inches. 30-inch diameter openings may be required at the Engineer's discretion in special circumstances such as shallow manholes less than 4 feet deep or manholes on large diameter trunk sewers.

I. All manholes with force main entrances and air release valves (ARVs) shall be epoxy coated to prevent H_2S deterioration of the manhole interior.

2.10 Manhole Inverts

A. Manhole inverts shall be constructed of concrete with a minimum 28-day compressive strength of 3,000 psi. Inverts shall be shaped so as to form a smooth, even U-shaped channel with curves formed with as large a radius as is permitted by the size of the manhole. The height of the channel shall be at least ½ the pipe diameter for pipes less than 15 inches in diameter and at least ¾ the pipe diameter for pipes 15 inches in diameter and larger. The bench shall be sloped to drain to the channel, but no more steeply than a slope of 1 in 12.

2.11 Joint Sealant for Precast Manholes and Wet Wells

A. Joint sealant for precast manholes and wet wells shall provide permanently flexible, watertight joints, shall retain workability over a wide temperature range, shall form permanent bonds to concrete substrates and shall not shrink, harden or oxidize upon aging. Joint sealant material shall consist of pre-molded rubber or butyl rubber. Sealants shall meet the requirements of Federal Specification SS-S-210A and AASHTO M198.

2.12 Castings for Frames and Covers

A. Castings shall be gray cast iron conforming to the requirements of ASTM A48, Class 30. Castings shall be made accurately to the required dimensions, shall be sound, smooth, clean, free from scale, lumps, blisters and other defects. Castings shall be machined to provide solid bearing so that covers rest securely in the frames with no rocking.

B. Castings shall be thoroughly cleaned before rusting begins and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.

C. Standard frames and covers shall be traffic duty weighing not less than 410 pounds and shall have a minimum 24-inch clear opening. The covers shall be the solid indented type with no holes except watertight pick notches, with the words

"SANITARY SEWER" cast in raised letters thereon. Standard manhole frames and covers shall be John Bouchard & Sons No. 1155 or approved equal.

D. Watertight frames and covers shall be traffic duty weighing not less than 485 pounds and shall be the double cover type with rubber gaskets. The surface cover shall be the solid type with no holes except watertight pick notches, with the words "SANITARY SEWER" cast in raised letters thereon. The inner cover shall be of the solid type with no holes, shall have not less than two lifting handles and shall have a neoprene sealing gasket with at least 3/8-inch diameter cross section. The inner cover shall be mechanically sealed by means of a removable steel locking bar located over the inner cover with a centrally located stainless steel tightening bolt. This bolt shall be fitted for a tee-handle or bent-handle that shall be included with each cover. The bolt shall have ACME threads for durability. The inner cover shall have appropriate reinforcing ribs to prevent cracking or distortion when tightened. The inner cover shall have sufficient clearance to allow easy installation of the cover. Watertight manhole frames and covers shall be John Bouchard & Sons No. 1123 or approved equal.

E. Covers shall include the Owner's logo where directed by the Engineer. Covers bearing Owner's logo shall be furnished for all projects in the downtown Clarksville area.

F. Covers shall be bolted to the frame where indicated on the Drawings or as otherwise specified.

G. Frame shall be bolted to the precast concrete section with four ½-inch diameter expansion anchor bolts.

2.13 Resilient Pipe Connections at Manholes and Wet Wells

A. Resilient pipe connectors shall be manufactured in accordance with ASTM C923 and shall provide a positive watertight joint and minimum of 10 degrees deflection in any direction. There shall be no water leakage through the connector when pipe is in its maximum deflected position. Connectors shall be manufactured of durable rubber, which offers superior resistance to water, sewage, oils, acid, ozone, weathering and aging. Connectors shall be securely sealed to the cut out in the manhole wall by means of stainless steel expansion sleeves, bands or rings and to the pipe by means of stainless steel clamps or bands. Connectors shall be KOR-N-SEAL as manufactured by NPC, Inc., or approved equal.

B. Compression-type connectors cast integrally into the manhole wall shall be A-Lok or equal.

C. When making a main or service connection to an existing manhole or to any manhole for which a factory installed booted opening has not been provided, a hole shall be cored into the manhole with minimal damage to the structure and a resilient pipe connector such as KOR-N-SEAL installed.

D. When setting a manhole over an existing sewer line, the exterior of the pipe shall be thoroughly cleaned and a double wrap of Ram Neck or equivalent bitumastic material placed around the pipe to form a gasket over which the concrete for the new manhole

base is poured, in order to form a watertight connection.

2.14 Exterior Joint Wrap System for Manholes & Wet Wells

A. Manhole encapsulation systems may be required in special circumstances such as manholes within 100-year flood plains. Where required, the manhole encapsulation system shall consist of a heat-shrinkable wrap that is installed on the outside surface of all joints including the manhole casting to manhole connection. The wrap shall be a minimum width of 12 inches and shall be installed in accordance with the manufacturer's recommendations. The encapsulation system shall be WrapidSeal as manufactured by Canusa or equal.

2.15 Sewer Pump Stations

A. New pump stations and force mains are not allowed if the development can be served by the extension of gravity sewer. Where approved for use, the Developer's engineer shall submit proposed pump curves, system head curves, operational data, flow projections and hydraulic calculations for review. Where a development is to be constructed in phases, master planning of a subdivision will be required to assure that the number of lift stations is kept minimal and that lift station facilitates are abandoned as adjacent phases are constructed or adjacent property is developed.

B. The Developer shall provide a permanent dedicated site for the pump station and its access road, and ownership of this site and access road shall be transferred to the Owner. A quick claim deed shall accompany the final plat before signature by the Engineer.

C. Acceptable pumping systems include the following:

1. Grinder/E-One, or approved equal.
2. Suction Lift.
3. Submersible.

D. Pump Station Site Requirements

1. Sewage pump stations should be located as far as practicable from present or proposed built-up residential areas and shall be installed in a prepared, landscaped, and fenced area. Noise control, odor control, and station architectural design should be taken into consideration.
2. The area for the pump stations shall be large enough to accommodate odor control equipment, pump trucks and the placement of a generator if necessary. Sites for stations shall be of sufficient size for future expansion or addition, if applicable. At a minimum, the pump station site shall measure approximately 30'x30' for suction lift pump stations and approximately 60'x60' for submersible pump stations, not including access road.
3. The site shall be graded to provide satisfactory drainage such that the lift station and its access drive will not be inundated during storm events. The top of the lift

station wet well shall be 2 feet above the 100-year flood level and shall also be at least 3 inches but no more than 6 inches above surrounding grade elevation. Drainage swales shall be rip-rapped or otherwise protected against erosion.

4. The access road to the lift station shall be constructed at a grade not to exceed 13 percent and shall be paved. The typical required pavement section will consist of 6 inches of compacted crushed stone base course and 2 inches of asphalt. Prior to placement of pavement materials, the access road shall be proof-rolled using a fully loaded dump truck in the presence of Engineer and any unstable areas undercut and replaced. The access road shall not be shared with residential driveways.
5. The pump station yard shall be graveled with 6 inches of crushed stone gravel and paved with 4 inches of concrete.
6. At a minimum, the pump station site shall be enclosed by a chain link fence and gate in accordance with Section 02821. A privacy fence may be required where the pump station is located near residences. Landscaping may be required as a buffer to properties adjacent to the proposed lift station. Noise control, odor control, and station architectural design shall be considered and included on the Drawings.

E. Wet Well Sizing

1. A suitable wet well shall be provided for each sewer lift station. The wet well shall be of sufficient size to permit proper operation of the lift station while minimizing the probability of an overflow event.
2. Pre-cast concrete wet wells shall have a minimum inside diameter of 6 feet.
3. All wet wells shall be sized to provide sufficient capacity to retain a minimum of 2 hours of average flow as measured from the pump cutoff level to the invert of the lowest inlet pipe. Storage volumes from sewer main and associated manholes may also be considered, as well as wet well storage above the lowest invert, provided that Developer's engineer can demonstrate that overflow and/or service line backup into connected properties will not occur.
4. The Developer's engineer shall also consider future growth within the lift station drainage basin during sizing of the lift station.

F. Wet Well Materials

1. The wet well must be constructed of materials to prevent deterioration from acids formed from H_2S and other chemicals observed or expected for the operating conditions anticipated in the new wet well.
2. The preferred materials of construction include precast concrete. Pre-cast concrete wet wells shall conform to the requirements of AASHTO M199 and ASTM C478, including steel reinforcement. All concrete used in connection with the construction of precast wet wells shall be at minimum 4,000 psi concrete.

3. The precast manufacturer shall use XYPEX additive. Xypex Admix C-1000 Red shall be added to the concrete during batching at the manufacturer's specified rate. The amount of cement shall remain the same and not be reduced. Precast concrete structures shall have a reddish tint to verify the XYPEX admix.

4. Fiberglass and HDPE wet wells are acceptable for use in pre-fabricated or “canned” lift stations where approved by the Engineer. Fiberglass lift stations shall be certified by the manufacturer and accompanied by a warranty against deterioration.

G. Wet Well Construction

1. Wet well penetrations shall be mechanically sealed with resilient pipe connectors as specified in Paragraph 2.14 of this Section.

2. Joint sealant for precast wet wells shall comply with Paragraph 2.11 of this Section.

3. All external wet well joints shall be sealed using a wrap seal such as CANUSA Wrapidseal® or equivalent to prevent infiltration or inflow at the joint(s), as specified in Paragraph 2.14 of this Section.

4. Wet well bottoms shall be constructed with a minimum of a 4-inch, 45° fillet at wall joints to prevent solids accumulation.

5. Access steps for wet wells will not be allowed.

6. Anti-flotation collars shall be installed where groundwater is present or expected to be present above the bottom of the lift station during dry or wet seasons.

7. Access hatches for submersible wet well applications shall be supplemented with a lockable secondary 1-inch thick aluminum grating panel, such as the Halliday Products Retro-Grate. The grating panel shall be hinged and shall be supplied with a positive latch to maintain unit in an upright position. A 6-inch viewing area shall be provided on each lateral unhinged side of grating panel for visual observation and limited maintenance procedures.

H. Station piping shall be specially lined and coated, flanged ductile iron pipe. Buried piping to the common force main shall be specially lined and coated mechanical joint ductile iron pipe.

I. Consideration shall be given during inlet design to minimize flow turbulence that accelerates release of trapped gases in the flow stream. Interior drop assemblies or other methods may be required. The number of inlet pipes into the wet well should be minimized.

J. In areas where sanitary sewers drain to a wastewater pumping station, an approved backwater valve shall be installed in all buildings subject to backup during a failure of the pumping facilities. The location of said backwater valve shall be as indicated on the Drawing for a typical house connection or as directed by the Engineer.

K. Appropriate valves, valve vaults and valve boxes shall be installed in accordance with

the Drawings.

L. Pressure gauges are required on the discharge piping of all suction lift and submersible pump stations. Flow meters shall be installed on the common discharge pipe within a concrete vault for all pump stations with rated flows of 0.5 million gallons per day (MGD) and greater.

M. Suction-lift and submersible pump stations shall be equipped with a dual level sensor system, which shall consist of a pressure transducer with a float back-up system. Sensors should be located so as not to be affected by the flows entering the wet well or by the suction of the pumps.

N. All electrical wiring shall be copper conductor. Aluminum is not an acceptable substitute.

O. All control and instrument panels shall be supported by galvanized steel posts and unistrut set in concrete. Wooden posts are not acceptable.

P. To prevent potential settling damage, a suitable length of flexible conduit shall be used to connect rigid conduit to the lift station.

Q. A riser from the force main with quick connect capabilities and appropriate valving shall be provided for all lift stations with rated pump flows of 50 gpm or greater that are to be owned by Owner. Quick connects shall be as specified in Section 11200.

R. Contractor shall provide an OmniSite XR-50 telemetry unit with all lift stations. The telemetry unit will be installed by the City of Clarksville Gas & Water Department.

S. All conduits entering control panels must be sealed with a sealant for use in H_2S environments.

PART 3 - EXECUTION

3.01 Water and Sewer Line Separation

A. Maintain a 10-foot horizontal separation, measured edge to edge, between any new or proposed sanitary sewer and any existing or proposed water main.

B. Where conditions cause the required horizontal separation to be impractical, the sewer may be laid closer provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main.

C. Where a sewer crosses under a water main, the top of the sewer shall be at least 18 inches below the bottom of the main.

D. Where conditions cause the required vertical separation to be impractical, the water main shall be relocated to provide the required separation or else reconstructed with mechanical joint ductile iron pipe for a distance of 10 feet on each side of the sewer with a full joint of the water main centered over the sewer.

E. Where sewers must be constructed over water mains or less than 18 inches below the

water main, the sewer shall be designed and constructed equal to water main standards and pressure tested to ensure water tightness.

F. Additional protection such as concrete encasement shall be installed where directed by the Engineer.

G. To prevent cross connection, comply with the Owner's Cross Connection Ordinance as well as Cross Connection Control Policy and Plan.

3.02 Gravity Sewer Installation

A. Properly excavate trench to required lines and depths and install any necessary sheeting, shoring and bracing in accordance with Section 02221.

B. Prepare a satisfactory trench bottom and install suitable bedding in accordance with Section 02221.

C. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.

D. Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject and remove any damaged or defective pipe or fitting from the job site.

E. Dig bell holes large enough to allow ample room for the pipe joints to be properly made. Carefully grade the crushed stone bedding between bell holes such that each pipe barrel will rest for its entire length upon the prepared bedding to assure uniform support of the pipe.

F. Lay pipe progressively up grade, with bell upstream in such a manner as to form close, concentric joints with smooth bottom inverts. Swab the interior of the pipe to remove all foreign material. Prepare the bell and remove undesirable material from the gasket and gasket recess. Joining of all pipe shall be in accordance with manufacturer's specifications.

G. When cutting short lengths of PVC pipe, a pipe cutter will be used, and care shall be taken to make the cut at right angles to the centerline of the pipe. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder or course file to match the manufactured taper.

H. Compression couplings shall be used where indicated on the Drawings or as specified in Paragraph 2.08 of this Section.

I. Gravity sewer pipe shall be of the size and material indicated on the Drawings and as specified in Part 2 of this Section. No sewer main shall be less than 8 inches in diameter.

J. Gravity sewer pipe shall be installed at the grade indicated on the Drawings. Sewer pipe shall be installed with slopes equal to or exceeding the minimum slopes provided in the following table:

Nominal Sewer Size	Minimum Slope in Feet Per 100 Feet
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058

K. Sewer service assemblies shall be installed with the sewer main as it is being laid where indicated on the Drawings and in accordance with Paragraph 3.03 of this Section.

L. Additional pipe protection such as use of specially lined ductile iron pipe or concrete encasement shall be installed where indicated on the Drawings or as directed by the Engineer. Pipe protection may be required for shallow sewers, areas subject to erosion, very heavy traffic, utility crossings, along property lines where future fence posts could be anticipated, etc.

M. Sewers on 20 percent slope or greater shall be anchored securely with concrete anchors or equal. Anchors will have a minimum 24-inch thickness and extend a minimum of 24 inches beyond the outside diameter of the pipe in all directions. Minimum anchorage spacing is as follows:

1. Not over 36 feet center to center on grades 20 percent and up to 35 percent.
2. Not over 24 feet center to center on grades 35 percent and up to 50 percent.
3. Not over 16 feet center to center on grades 50 percent and over.

N. As the work progresses, thoroughly clean the interior of the pipe in place. After each joint of pipe has been laid, carefully inspect it and remove all foreign material from its interior. Upon completion of a section between any two manholes, it shall be possible to view a complete circle of light when looking through the pipe.

O. Do not allow walking on complete pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.

P. When laying pipe ceases at the end of the workday or any other disruption, close the open ends of the pipe with a suitable watertight plug to prevent the entrance of foreign materials.

Q. Trench backfill and check dams shall be placed in accordance with Section 02221.

R. Make connections to existing manholes by core drilling a hole in the wall of the existing structure, installing a resilient pipe connector such as Kor-N-Seal, and securing the sewer pipe in the connector in accordance with the manufacturer's recommendations. Shape or re-shape the invert of the manhole to accommodate the new flow channel.

S. Measurement of the depth to determine depth classification shall be the vertical distance between the original ground surface elevation and the invert of the pipe as shown on the Drawings except where the profile has been revised and approved by the Engineer.

3.03 Sewer Service Assembly Installation

A. The standard sewer service connection shall be 4 inches in diameter unless shown otherwise on the Drawings and shall connect to the sewer main at a tee or wye connection installed with the sewer main as it is being laid. The service fitting shall be of the same material as the sewer main pipe.

B. Sewer service connections into manholes are discouraged and shall not be made unless specifically approved by the Engineer.

C. Connection to an existing sewer main where no service fitting has been installed shall, with the approval of the Engineer, be accomplished by a service tap to the sewer main through a tapping saddle. The saddle shall be a gasketed saddle secured to the sewer main by at least two stainless steel clamps. Tapping saddles shall be approved for connections to existing sewer lines only.

D. Where specifically approved by the Engineer, connections to an existing gravity sewer main may be accomplished using a Romac Style CB sewer saddle by Romac Industies, Inc. or approved equal. Sewer saddles shall be installed in accordance with manufacturer recommendations.

E. Where sewer service connections are 8 feet in depth or greater, sewer risers shall be installed at the service connection to protect the service connection and to facilitate excavation of the sewer lateral. Deep sewer risers shall be by Bates & Harrington, Inc., of Madison Heights, VA or equal.

F. The Contractor shall stub a capped service pipe from the service connection to a point approximately 3 feet onto a customer's property across the Right-of-Way or easement line, with the exception that a minimum of one 13-foot joint shall be installed. Service stubs from manholes, where allowed, shall be a minimum of one 13-foot joint.

G. Service pipe shall be of the same material as the sewer main and shall be bed accordingly. The minimum grade on service pipe shall be 1% or 1/8" per foot. The service stub shall be plugged, backfilled and marked at the plugged end.

H. The end of each lateral stub shall be marked with a 6-foot long 4'x4' wooden post or metal fence post embedded 2 feet into the ground and be marked with green paint.

I. Identifying tape shall be installed in accordance with Paragraph 3.08 of this Section.

J. The Contractor shall stamp the curb with an “S” where sewer services are located.

K. It shall be Contractor’s responsibility to install a sewer cleanout at the right-of-way or easement line. Cleanout assemblies shall be constructed of Schedule 40, solvent weld pipe. The cleanout shall consist of a sanitary tee (sweep), vertical pipe or appropriate length, and a threaded cleanout plug. All property line cleanouts shall be installed inside a polyethylene box issued by the Owner.

3.04 Precast Concrete Manhole Installation

A. Manholes shall be installed at the end of each sewer main, at all changes in grade, size, or alignment, at all intersections, and at distances not greater than 400 feet for sewers 15 inches or less and 500 feet for sewers 16 inches and greater. Where a sewer main extension is expected in the foreseeable future, the manhole shall be installed at least to the property line shared by the current and future development.

B. Provide a stable, satisfactory subgrade for the new manhole. Dewater the excavation as required. Any unstable or otherwise unsuitable material encountered at the subgrade shall be undercut and replaced with compacted Class I angular material.

C. Provide a bedding of at least 6 inches of compacted Class I angular material as crushed stone base material for the manhole.

D. Manholes shall be installed such that they are fully and uniformly supported, set plumb in true alignment and at the proper grade in accordance with the Drawings.

E. Where concrete foundations are to be cast-in-place, the concrete shall have a compressive strength of at least 4,000 psi. The base section shall be carefully blocked above the prepared base stone so that it is plumb and in true alignment and the concrete foundation poured beneath it. The concrete foundation shall be at least 8 inches thick. Riser sections shall not be added until the concrete foundation has been allowed to set for at least 24 hours.

F. Concrete anti-flotation collars shall be installed as sized and where indicated on the Drawings, or where directed by the Engineer, to prevent flotation due to groundwater.

G. Seal joints between sections with an approved joint sealant.

H. Where pipe openings and integrally cast resilient pipe connectors have not been provided complete, the Contractor shall make connections to manholes by core drilling a hole in the wall of the structure, installing a resilient pipe connector such as Kor-N-Seal, and securing the sewer pipe in the connector in accordance with the manufacturer’s recommendations. Shape the invert of the manhole to accommodate the flow channel as specified herein.

I. Thoroughly wet and then completely fill all lift holes, any defects and all interior joints with non-shrink grout and smooth them to ensure watertightness.

J. Where indicated on the Drawings, the manhole encapsulation system shall be installed on the outside surface of all joints including the manhole casting to manhole connection. The manhole and casting shall be clean and dry prior to application of a primer as recommended by the manufacturer. Installation shall be in accordance with the manufacturer's recommendations.

K. Trench check dams shall be installed upstream of each manhole as specified in Section 02221, Paragraph 3.13.

L. Backfill manholes in accordance with the requirements for trenching and backfilling as specified in Section 02221, Paragraph 3.12.

M. When completed, the manhole shall be free from channel obstructions and leakage.

N. All manhole inverts shall be finished with mortar to provide a smooth transition from the manhole into the pipe entrances and exits.

O. Measurement of the depth to determine depth classification shall be the vertical distance from the finished casting elevation to the invert of the outlet pipe as shown on the Drawings unless the profile has been revised and approved by the Owner.

P. All openings shall be sealed at the end of each workday.

3.05 Manhole Frame and Cover Installation

A. All castings shall be of the types, dimension, and weights as shown on the Drawings and as specified in Paragraph 2.12 of this Section and shall be set at the required elevation. Bolted watertight manhole covers are required in areas subject to flooding. Bolted down covers are also to be installed in all unimproved areas such as wooded areas that are subject to unsupervised vandalism.

B. The manhole sidewall shall be adjusted with either steel or concrete grade adjustment rings as required to bring the casting to the required grade. No more than 6 inches of grade adjustment rings will be permitted on newly constructed manholes.

C. Where manholes are constructed in paved areas, the frame and cover shall be tilted so as to conform to the exact slope, crown and grade of the existing adjacent pavement.

D. A full circle of an approved joint sealant shall be placed between the manhole ring frame and the masonry portion of the manhole to assure water tightness. The frame shall be further secured to the manhole by the use of mortar or grout placed from the outside edge of the masonry structure to a point approximately 1 inch below the top of the casting. Manhole frames shall be bolted to the manhole using four ½-inch diameter stainless steel expansion anchor bolts.

E. Manhole frame seals shall be installed on sanitary manholes in accordance with the manufacturer's recommendations where indicated on the Drawings or as directed by the Engineer.

F. Existing manhole frames shall be adjusted utilizing John Bouchard & Sons, Inc.

manhole adjusting riser rings.

3.06 Drop Assembly Installation

A. Drop assemblies are required in pump station wet wells where the difference between the invert elevation of the inlet pipe and the level control cutoff point is greater than 24 inches. Down pipes shall be terminated approximately 3 inches above the level control cutoff point.

B. Drop assemblies shall be internal to the manhole or wet well. External drops shall not be permitted unless specifically approved by the Engineer.

C. Drop assemblies shall be constructed of PVC. The down pipe shall be 12 inches in diameter. A cross fitting shall be provided at the pipe entrance to the manhole to provide access for cleaning blockages. Stainless steel straps and anchors spaced no greater than 6 feet apart shall be installed to support the assembly. A 90 degree sweeping elbow shall be installed at the bottom of the drop pipe and a suitable invert shall be formed for drop manholes only (not wet wells).

D. Drop manholes shall be a minimum of 5 feet in diameter.

3.07 Sewer Force Main Installation

A. Properly excavate trench to required lines and grades and install any necessary sheeting, shoring and bracing in accordance with Section 02221.

B. Prepare a satisfactory trench bottom in accordance with Section 02221.

C. Lay the force main true to the lines and grades indicated on the Drawings. Particular care shall be taken to assure the line is maintained on a positive or negative grade and that increased depth is provided where indicated on the Drawings so that no undesired local high point is created. The Contractor shall relay any force main pipe with undesired high points at no additional expense to the Owner.

D. Unless otherwise directed by the Engineer, lay pipe with the bell ends facing the direction of laying.

E. Carefully inspect all pipe, valves and fittings prior to placement in the trench, and reject and remove any damaged or defective pipe from the job site.

F. Dig bell holes large enough to allow ample room for the pipe joints to be properly made. Carefully grade the bottom of the trench between bell holes such that each pipe barrel will rest for its entire length upon the trench bottom to assure uniform support of the pipe.

G. All pipe and fittings shall be carefully lowered into the trench to prevent damage to the materials and to any protective coatings and linings. Specially lined ductile iron pipe and fittings must be handled only from the outside. No forks, chains, hooks, timber, etc. shall be placed inside the pipe and fittings for lifting, positioning or laying.

H. The interior of all pipe, valves and fittings shall be thoroughly cleaned to remove any accumulated mud, debris, etc. before being laid. The spigot end shall be cleaned and

the bell cleaned and prepared. If the pipe cannot be laid without allowing earth and debris from entering the pipe, a suitable cover such as canvas or a plug shall be used to assure the pipe remains clean until it is joined to the next pipe. Joining of all pipe shall be in accordance with the manufacturer's recommendations.

I. Cut pipe for inserting valves, fittings, etc. in a neat and workmanlike manner without damaging the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the pipe in order to leave a smooth end at right angles to the axis of the pipe. Hone the pipe with suitable tools to provide a smooth beveled edge on field cut sections.

J. When pipe laying ceases at the end of the workday or any other disruption, such as inclement weather, close the open ends of the pipe with a suitable watertight plug or wrap to prevent entrance of foreign materials.

K. Wherever pipe must be deflected from a straight line, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made. The deflection shall in no case exceed that recommended by the pipe manufacturer.

L. At high points on the line profile, where a change from a positive to a negative grade occurs, an air release or combination air/vacuum valve shall be installed as specified in the Drawings and in Section 11200.

M. Force main valves shall be installed where indicated on the Drawings. Valves and stems shall be installed plumb and in accordance with Section 11200.

N. All valves and fittings are to be restrained with mechanical joint restraint devices. These restraining devices do not eliminate the requirement for sufficient concrete thrust blocking and/or restrained joint pipe. The distance from the fitting to the end of the restraint shall not be less than that indicated on the Drawings.

O. Concrete thrust blocks shall be installed at all fittings in accordance with the Drawings. The concrete shall be Class B concrete as specified in Section 03300. The thrust block shall be constructed between the fitting and undisturbed soil with a bearing area at least the size indicated on the Drawings, and shall be constructed such that the fittings, valves and joints are accessible for repairs. All pipe, fittings and valves that will be in contact with the concrete shall be lubricated to prevent bonding with the thrust block.

P. Backfill shall be as specified in Section 02221, Paragraphs 3.11 and 3.12.

Q. Carsonite markers shall be installed where indicated on the Drawings.

R. Where the force main discharges into a gravity sewer manhole, the force main entrance to the receiving gravity manhole shall be within 6 inches of the lowest invert of the manhole and shall be as close to 180° from the outlet pipe as possible. Deflector fittings or new inverts shall be installed if necessary to reduce the turbulence of the incoming flow. All manholes with force main discharges shall be epoxy coated to prevent H_2S deterioration of the manhole interior.

S. New force main connections to existing force mains shall be as shown on the Drawings.

3.08 Identifying Tape and Tracer Wire

A. The location of all service laterals and force mains, regardless of material type, installed under these specifications shall be marked by the use of a continuous green tape, minimum 6 inches in width, made of minimum 5 mil thick polyethylene plastic with a minimum 0.35 mil thick aluminum metallic core or backing. The tape shall be buried in the trench, above the pipe, no more than 2 feet below the surface. The tape shall be marked indelibly with the words “Sewer Main Below” or similar wording to warn unwary excavators.

B. Tracer wire shall be installed along any sewer force main and force main services.

1. Tracer wire installed in open cut applications shall be Copperhead 1230-HS, 12 AWG copper-clad steel tracer wire with 30 mil HDPE coating, no substitutions allowed.

2. Tracer wire installed in horizontal directional drill applications shall be Copperhead 1245-EHS, 12 AWG copper-clad steel tracer wire with 45 mil HDPE coating, no substitutions allowed.

3. Tracer wire color shall be green for sewer pipe.

4. Connectors at service connections and tees shall be DryConn Direct Bury Lug Aqua by King Innovation and at main line splices shall be DryConn King 6 Blue by King Innovation, no substitutions allowed.

5. Tracer wire shall extend at least 5 feet beyond service stub terminations. A piece of PVC pipe shall be buried vertically against the 4”x4” marker post extending about 2 inches above ground level.

6. The tracer wire shall be fed through the PVC pipe with the end of the wire about 2 inches above the end of the pipe and the remainder coiled and buried beneath it.

7. A performance test will be performed on the completed tracer wire system to ensure the entire system is trackable. Any part of the system that is not trackable shall be repaired or replaced by the Contractor until it is trackable prior to acceptance of utilities.

C. Tracer wire test stations shall be installed along force main alignments with a maximum spacing of 500 feet between test stations. Coordinate location of tracer wire test stations with Engineer.

3.09 Bypass Pumping

A. Where flow stoppage may be necessary and the flow is so great as to require pumping, the Contractor shall bypass the sewage around the section or sections of gravity sewer line that are out of service by plugging an existing upstream manhole and pumping

sewage to a downstream manhole. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Likewise, bypass pumping may be required at pump stations through pump-around ports, where available. Alternatively, situations may demand that pumping and hauling be performed. The Contractor shall perform whatever bypass operations are necessary to complete the required work and prevent overflow or spillage of raw sewage.

B. Under no circumstances will the dumping of raw sewage on private property or into streams, storm sewer or public streets be allowed.

C. Except as may be approved by the Engineer, temporary connections shall be made at the end of each working day so that overnight pumping is not required.

3.10 Stream Crossings

A. An Aquatic Resource Alteration Permit (ARAP) must be obtained from TDEC where utilities cross USGS-designated blue-line streams or where utility line construction work otherwise disturbs these streams. Construction work shall comply with the Drawings and with the provisions of the ARAP and SWPPP. Upon completion of construction work, the stream and its banks shall be stabilized and/or returned as nearly as possible to their original condition. Cleanup, grading, seeding, planting or restoration of the work area shall be carried out as early as practical as the construction work proceeds and in accordance with the ARAP.

3.11 Testing

A. Testing and inspection of the completed work shall be accomplished by one or more of the following methods:

1. Visual Inspection
2. Closed Circuit Television (CCTV)/Video Inspection
3. Leak Testing of Gravity Mains
4. Low-Pressure Air Testing
    i. Infiltration Testing
    ii. Exfiltration Testing
    iii. Deflection Testing of Gravity Mains
5. Vacuum Testing of Manholes
6. Hydrostatic Testing of Force Mains
7. Valve Testing

B. Upon completion of construction work, the Contractor shall remove all sand, dirt, rock and other foreign materials from the sewers and shall conduct his own inspection and testing to locate and repair any defects, and determine when sewers are ready for final inspection and testing by the Engineer. After all apparent defects have been corrected, the Contractor shall notify the Engineer and request a final inspection.

C. The Engineer will not conduct a final inspection until receiving written notice from the Developer's engineer that the construction work is completed in accordance with approved Drawings and Specifications. This notification shall include a report of the results of the inspection and testing performed on the sanitary sewer system components. CCTV/Video files shall be submitted to the Engineer at this time.

D. Visual Inspection

1. Unscheduled visual inspection of the sewer and construction site by the Engineer shall occur during the course of the construction work. Engineer shall make visual inspection of pipe, fittings, valves and other materials to be incorporated into the work before they are installed. Items found to be defective or otherwise not in accordance with Drawings and Specifications shall be immediately removed from the site.

2. Visual inspection of grade and alignment, bedding, pipe jointing, manholes, etc. will proceed as work progresses. Acceptance of work at this stage in no way relieves the Contractor of responsibility and does not preclude additional testing at the discretion of the Engineer. Any sags, humps, bends or other evidence of misalignment shall be cause for rejection. Improper construction and work not in accordance with the Drawings and Specifications shall also be cause for rejection.

3. Upon completion of the work, all sewers and manholes shall be inspected for foreign matter such as sand or mud brought in by infiltration or inflow, and any such matter shall be removed before acceptance. If visual inspection of lines, manholes or other items reveals leaks, structural failures or other defects, the Contractor shall repair such immediately.

E. CCTV/Video Inspection

1. The Contractor shall conduct an internal inspection and digital recording of the sewer system using a television instrument. The Contractor shall be responsible for correcting all deficiencies discovered by the CCTV inspection at no cost to the Owner.

2. A remote controlled, adequately lit camera that will travel the length of each section of gravity sewer main from manhole to manhole shall be used to televise all newly installed sewers. The camera shall be of suitable design and manufactured for the express purpose of televising gravity sanitary sewer mains. The camera's path shall be recorded with an onscreen display of footage traveled. Auditory notations by the camera operator regarding locations of service connections, pipe defects, indications of faulty installation and all other important points of interest shall be recorded as permanent record. The view recorded by the camera shall also include an object of reference to assist the viewer in determining the scale of objects within the pipe.

3. Video quality shall be such that the condition of all interior sections of the main and service laterals on that section of the main are easily discernible. The camera

shall allow for articulation that enables a clear view of service laterals in a direction perpendicular to the direction of the main and at a variety of vertical angles to allow viewing of laterals at varying slopes. The image must be clear to the test cap or first bend of the service lateral.

4. Audio quality shall be adequate to clearly understand remarks of the camera operator.

5. Video inspection shall commence immediately after line cleaning so that any sag or changes in grade shall be revealed and evidenced by puddling in areas where positive slope is not maintained. This inspection should be performed after water has been added to show puddling.

6. The Contractor shall be responsible for correcting all deficiencies discovered by the CCTV inspection at no cost to the Owner.

7. At the time of the request for final inspection, the Contractor shall submit to the Engineer on CD-ROM, DVD or USB flash drive two copies of digital files that represent the videotaping of all sewer mains in a project or development. The video record of each section of gravity main between manholes shall be represented by a separate MPEG or AVI format digital file. The disc and its jacket shall be clearly labeled with the name of the subdivision or project and its phase and/or section, as well as the installation date. All references to manholes and mains with regard to videotaping shall be by the same naming convention as that shown on construction plans approved by the Engineer. An index file shall be provided with each disc that explains the meaning of each file name and identifies the CCTV company that produced it.

F. Low-Pressure Air Testing

1. Low-pressure air testing is the preferred method of leak testing of gravity sewer mains up through 24 inches in diameter when above groundwater. If the groundwater level is 2 feet or more above the top of the pipe at the upstream end, air testing shall not be used.

2. Labor, equipment and supplies required for all tests shall be furnished by the Contractor. The test shall be observed by the Engineer.

3. Low-pressure air tests shall be made with equipment specifically designed and manufactured for the purpose of testing pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve set such that the internal air pressure in the pipeline cannot exceed 8 psig (gauge pressure). Test equipment shall be top quality, in good condition and approved by the Engineer. Plugs shall have a sealing length equal to or greater than the diameter of the pipe being tested and external bracing of the plugs should not be required in order for the plug to hold against internal air pressure. The test equipment shall include accurate, oil-filled pressure gauges to monitor test pressure, safety relief valve(s) and quick-release air bleed valve(s).

4. The procedure for low-pressure air testing shall be in accordance with ASTM F1417 unless modified herein.

   i. Clean the section of sewer line to be tested by flushing or other means prior to conducting the low-pressure air test.

   ii. Isolate the section of sewer line to be tested by suitable test plugs and plug all sewer services to be included in the test to prevent air leakage. Such sewer service caps shall be readily removable, and their removal shall provide a socket suitable for making a lateral connection or extension. All plugs and caps shall be securely braced to prevent blow-out against internal pressures. One of the plugs or caps should have an inlet tap, or other provision for connecting a hose to a portable air control source. Allow no one in the manholes while pressurizing the line or during the test.

   iii. Immediately following this check or cleaning, test the pipe installation with low-pressure air. Supply the air slowly to the plugged pipe installation until the internal air pressure reaches 4.0 psi more than the average backpressure of any groundwater that may submerge the pipe (an additional 0.43 psi should be added for each foot of groundwater above the pipe). Allow at least 2 minutes for temperature stabilization.

   iv. After the stabilization period and with 3.5 psi minimum pressure (above the average backpressure) in the pipeline, air supply shall be disconnected and the time measured which results in a 1 psi pressure drop.

   v. The time required in minutes for the pressure in the section under test to decrease from 3.5 psi to 2.5 psi shall not be less than that shown in the table below:

Low-Pressure Air Test Requirements							
				Specified Time for Length Shown (min:sec)			
Pipe Dia. (inches)	**Min. Time (min:sec)**	**Length for Min. Time (feet)**	**Time for Longer Length**	**100 ft**	**200 ft**	**300 ft**	**400 ft**
8	7:34	298	1.520*L	7:34	7:34	7:36	10:08
10	9:26	239	2.374*L	9:26	9:26	11:52	15:49
12	11:20	199	3.418*L	11:20	11:24	17:05	22:47
15	14:10	159	5.342*L	14:10	17:48	26:42	35:36
18	17:00	133	7.692*L	17:00	25:38	38:27	51:16
21	19:50	114	10.470*L	19:50	34:54	52:21	69:48
24	22:40	99	13.674*L	22:47	45:34	68:22	91:10

vi. It is not necessary to hold the test for the entire period of time indicated in the above table when it is evident that the rate of air loss is zero or less than the allowable, and is authorized by the Engineer.

vii. Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

viii. Failure of any section of the pipeline to meet the requirements of this test shall cause the Contractor to determine, at no cost to the Owner, the source(s) of leakage. The Contractor shall excavate and repair or replace all defective materials or workmanship, and repeat all testing until results are satisfactory at no cost to the Owner.

G. Infiltration Testing

1. Gravity sewers shall be leak tested by an infiltration test if the groundwater is more than 2 feet above the crown of the pipe for the full length of the section to be tested.

2. Pipe shall be tested for infiltration after the backfill has been placed and the groundwater allowed to return to normal elevation. If an inspection of the completed pipeline or any part thereof shows pipes or joints that allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed by the Engineer. All visible leaks shall be repaired prior to testing.

3. The length of line to be tested shall not be less than the length between adjacent manholes and not more than the total length of each size of pipe. The measured infiltration shall not exceed 2.0 gallons per inch of diameter per day per 100 feet of pipe in each section tested.

4. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe installed in an approved manner and at such times and locations as may be directed by the Engineer.

5. Failure of any section of the pipeline to meet the requirements of this test shall cause the Contractor to determine, at no cost to the Owner, the source(s) of leakage. The Contractor shall excavate and repair or replace all defective materials or workmanship, and repeat all testing until results are satisfactory at no cost to the Owner.

H. Exfiltration Testing

1. Where required by the Engineer, leakage testing by exfiltration shall be made by creating a head in the pipeline to be tested by filling the line and either manhole or temporary riser on one end of the line with water. The length of pipe to be tested shall be such that the head over the crown at the upstream end is not less than 2 feet and the head over the downstream crown is not more than 5 feet.

2. The pipe shall be filled with water in such a manner that the air can be released

from the pipe while it is being filled. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of at least one hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period. If the quantity of water required to maintain a constant head in the pipe does not exceed 2.0 gallons per inch of diameter per day per 100 feet of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory.

3. Failure of any section of the pipeline to meet the requirements of this test shall cause the Contractor to determine, at no cost to the Owner, the source(s) of leakage. The Contractor shall excavate and repair or replace all defective materials or workmanship, and repeat all testing until results are satisfactory at no cost to the Owner.

I. Deflection Testing

1. Flexible PVC pipe shall pass a go/no-go Mandrel sized to 95% of the actual pipe diameter with the pipe in place and properly backfilled. No testing shall be performed until the pipe has been laid and backfilled for 30 days and any necessary line cleaning is complete.

2. The Mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the manufacturing tolerances of the pipe.

3. The Mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than nine. The legs of the Mandrel shall be permanently attached to the Mandrel.

4. The Mandrel shall be constructed of steel, aluminum, or other material approved by the Engineer, and shall have sufficient rigidity so the legs of the Mandrel will not deform when pulling through a pipe.

5. A Mandrel with variable sizes shall not be allowed. The Mandrel dimensions shall be checked by the Engineer before use by the Contractor.

6. Failure of any section of the pipeline to meet the requirements of this test shall cause the Contractor to determine, at no cost to the Owner, the source(s) of deformity. The Contractor shall excavate and repair or replace all defective materials or workmanship, and repeat all testing until results are satisfactory at no cost to the Owner.

J. Vacuum Testing of Sewer Manholes

1. All new manholes are to be vacuum tested as soon as is practicable after assembly is completed. No standing water shall be allowed in the manhole excavation that may affect the accuracy of the test. Leakage testing on newly rehabilitated manholes shall be accomplished in accordance with ASTM C1244 rather than as specified in this Paragraph.

2. All lifting holes and exterior joints shall be filled and pointed with non-shrink grout for concrete manholes or sealed with compatible sealant for other materials.

3. All pipes and other entrances into the manhole should be suitably plugged and blocked in such a manner as to prevent displacement of the plugs while the vacuum is being pulled.

4. Installation and operation of the vacuum equipment and indicating devices shall be in accordance with equipment specifications and instructions provided by the manufacturer. Gauges used for manhole testing shall be oil-filled gauges.

5. The casting opening shall be sealed with an appropriate testing/sealing device and a vacuum of 10.0 inches of mercury (5 psig) pulled on the manhole (do not put a positive pressure on the manhole). The time for the vacuum to drop to 9.0 inches of mercury shall be recorded.

6. Acceptance manholes shall be defined as when the time to drop from 10.0 inches to 9.0 inches of mercury meets or exceeds the following:

Minimum Time (seconds) to Drop From 10.0 Inches to 9.0 Inches of Mercury			
Manhole Diameter	**Manhole Depth**		
	4 feet to 10 feet	**10 feet to 15 feet**	**15 feet to 25 feet**
4 feet	75	90	105
5 feet	90	105	120
6 feet	105	120	135

7. If the manhole fails the test, necessary repairs shall be made at the Contractor's expense and the vacuum test repeated until the manhole passes the test. A significant number of leaks on a single manhole may be considered as a basis for rejection and replacement at no cost to the Owner.

8. If the manhole joint mastic or gasket is displaced during the vacuum test, the manhole shall be disassembled and the seal replaced.

K. Hydrostatic Testing of Sewer Force Mains

1. All newly laid pipe or any valved section thereof shall be subjected to hydrostatic pressure testing. Conduct hydrostatic testing in accordance with AWWA C600 (latest version) for ductile iron pipe or AWWA C605 (latest version) for PVC pipe.

2. Where practicable, pipelines shall be tested in lengths between line valves or plugs of no more than 3,000 feet.

3. Hydrostatic testing shall be conducted only with potable water. Due to the inherent safety hazard potential associated with testing components and systems with compressed air or other compressed gases, pressure testing shall never be accomplished using compressed air.

4. The Contractor shall furnish all gauges, recording devices, meters, pumps, pipe, connections and other equipment required to conduct the test and shall maintain

said equipment in condition for accurate testing as determined by the Engineer. Gauges used for pressure tests shall be oil-filled gauges.

5. Hydrostatic test results shall be recorded on an appropriate chart recorder. The Contractor shall furnish a recording gauge and water meter for recording pressure charts and for measuring makeup water used during the hydrostatic testing. Recording pressure charts shall be submitted to the Engineer at the conclusion of testing. The pressure recording device shall be suitable for outside service, with a range from 0–200 psig, 24-hour spring wound clock, designed for 9-inch charts, and shall be approved by the Engineer. Such pressure recording devices may be available from Foxboro Company, Foxboro, Massachusetts, Bristol Division of ACCO, Waterbury, Connecticut, or Weksler Instruments Corporation, Freeport, New York.
6. Prior to testing, the Contractor shall place sufficient backfill to prevent pipe movement. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed but before placement of permanent surfacing. The Contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.
7. Cross Connection Control: When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check valve assembly between the test and supply main or by other means approved by the Engineer. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.
8. Test Pressure Requirements:
    i. The test pressure shall not be less than 1.25 times the stated working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section.
    ii. The test pressure shall not exceed the thrust restraint design pressure or 1.5 times the pressure rating of the pipe or joint, whichever is less (as specified by the manufacturer).
    iii. The test pressure shall not exceed the rated working pressure of the valves when the pressure boundary of the test section includes closed, resilient seated gate valves or butterfly valves.
    iv. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. A test pressure greater than the rated valve working pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests exceeding the rated valve working pressure, the test setup should include a provision, independent of the valve,

to reduce the line pressure to the rated valve working pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or the valve can be fully opened if desired.

9. Test Procedure

    i. Each valved section of pipeline shall be slowly filled with potable water using a metered backflow-protected assembly provided by the Owner. When venting air from pipelines, it is important to limit the pipeline fill rate to avoid excessive surge pressures when the water reaches the air venting opening(s).

    ii. Before applying the specified test pressure, air shall be expelled completely from the pipeline section under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at such points to expel air as the line is filled with water. After all the air has been expelled, close the corporation cocks and apply the test pressure. At the conclusion of the pressure test, remove the corporation cocks and plug or leave in place at the discretion of the Engineer.

    iii. The specified test pressure shall be applied using a suitable pump connected to the pipeline in a manner satisfactory to the Engineer. The specified test pressure shall be based on the elevation of the lowest point of the pipeline or section under test and corrected to the elevation of the test gauge, in accordance with test pressure requirements specified herein.

    iv. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test. This may require several cycles of pressurizing and bleeding trapped air prior to beginning the test. It is recommended that the line remain pressurized for a minimum of 24 hours before testing in order for joints to tighten and pockets of air to dissolve in the water.

    v. The hydrostatic test shall be at least 2 hours in duration after reaching the specified test pressure where joints are exposed and at least 8 hours where joints are covered.

    vi. The test pressure shall not vary by more than +/- 5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline. The amount of makeup water added shall be accurately measured (in gallons per hour) by suitable methods and shall not exceed the applicable testing allowance as specified herein.

10. Visual Inspection: Any exposed pipe, fittings, valves and joints shall be examined carefully during the hydrostatic pressure test. Any damaged or defective materials that are discovered during or following the pressure test shall be repaired or replaced at no cost to the Owner, and the test shall be repeated until satisfactory results are obtained.

11. Testing Allowance

i. Testing allowance shall be defined as the maximum quantity of makeup water that is added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, in order to maintain pressure within +/- 5 psi of the specified test pressure (after the pipeline has been filled with water and the air has been expelled).

ii. No pipe installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

$$L = \frac{S*D*(P)^{½}}{148{,}000}$$

Where:

L = testing allowance (makeup water), in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge pressure)

iii. This formula is based on a testing allowance of 10.5 gpd/mile/inch of nominal diameter at a pressure of 150 psi. Values of testing allowance at various pressures are shown in the following table. When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/hr/inch of nominal valve size shall be allowed.

Hydrostatic Testing Allowance per 1,000 feet of pipeline (gallons per hour)*

Average Test Pressure (psi)	Nominal Pipe Diameter (inches)										
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

12. Acceptance of the installation shall be determined on the basis of testing allowance. Should any test of pipe laid disclose leakage greater than that specified,

the Contractor shall, at no cost to the Owner, locate and repair the defective joints until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the allowance used for testing. Hydrostatic test results shall be recorded on an appropriate chart recorder as specified herein. A copy of the test chart shall be provided to the Engineer.

L. Valve Testing: Upon completion of the work, the Contractor shall operate all buried valves in the presence of the Engineer to verify proper operation of each valve.

END OF SECTION

Return to Table of Contents

02725
BORING AND JACKING

PART 1 - GENERAL

1.01 Work Included

A. All water and sewer mains installed in a bore under streets, highways and railroads must be cased as specified herein.

B. PEXa or copper water services 2” in diameter or smaller and schedule 80 PVC or PEXa sewer forcemain services may be installed without casing. The bore for any such uncased service shall not be greater than 2 inches larger than the maximum OD of the carrier pipe. Services encroaching TDOT right-of-way may be required to be cased at the discretion of TDOT.

1.02 Regulations and Permits

A. Permits for crossing highways or railroads will be obtained by the Owner. The Developer’s engineer shall provide the Engineer with any and all documents required by the Owner to obtain the necessary permit(s), including a profile of the road or railroad bore and completed TDOT Pipeline Encroachment Form. The Contractor shall verify that such permits have been obtained before construction work commences.

B. For highway crossings, the Contractor shall satisfy TDOT to the extent of the Owner’s posted Surety Bonds.

C. For railroad crossings, the Contractor shall furnish Certificates of Insurance in amounts established by the railroad company, naming the railroad as the insured, and complete required application forms to be used by the Owner to obtain the permit as specified by the railroad.

D. Notify all related agencies prior to commencing construction activities.

PART 2 - PRODUCTS

2.01 Steel Casing Pipe

A. Encasement pipe shall be smooth wall welded steel with minimum yield strength of 35,000 psi. A protective bituminous coating shall be applied to the outside of the pipe.

B. Steel casing pipe shall be of sufficient strength to meet the loading conditions of H-20 loading for highway crossings and Cooper E-80 loading for railroad crossings, and shall have the minimum pipe diameter and wall thickness shown in the following table. Where mechanical joint pipe requires a larger diameter casing pipe than push-on joint pipe, a separate line item for MJ pipe has been provided in the following table. Where bell restraint harnesses have been specified for the carrier pipe, an appropriately sized casing pipe shall be specified to accommodate the restraints and required casing spacers.

Carrier Pipe Nominal Diameter (inches)	Minimum Steel Casing Pipe Diameter (inches)	Minimum Wall Thickness (inches)	
		Highway Crossing	Railroad Crossing
4	12	0.188	0.188
6	14	0.250	0.250
8	16	0.250	0.250
8 MJ	18	0.250	0.250
10	18	0.250	0.250
10 MJ	20	0.250	0.281
12	20	0.250	0.281
12 MJ	24	0.250	0.312
14 - 16	24	0.250	0.312
16 MJ	30	0.312	0.406
18 – 21	30	0.312	0.406
24 - 27	36	0.375	0.469
30	42	0.500	0.562
36	48	0.500	0.594
36 MJ	54	0.500	0.719

2.02 Carrier pipe installed in the casing pipe shall be as indicated on the Drawings.

2.03 Casing Spacers

A. Casing spacers shall be provided so that the carrier pipe is in a centered/restrained position. The casing spacers shall be constructed of circular stainless steel bands that bolt together to form a shell around the carrier pipe and shall be lined with PVC or EPDM to protect the carrier pipe and prevent slippage. The spacer shall be designed with risers and runners to support the carrier pipe within the casing.

B. The shell shall be minimum 14-gauge T-304 stainless steel and shall be manufactured in minimum widths of 8 inches and 12 inches. The riser shall be constructed of minimum 10-gauge T-304 stainless steel and shall be sized to support all loads and shall support the carrier pipe within the casing in the centered/restrained position. The runners shall be a minimum width of 2 inches and be constructed of glass-reinforced polymer with beveled ends.

C. The spacers shall at a minimum be positioned at 1 to 2 feet on either side of the joint and at the midpoint. Additional spacers may be required where recommended by the manufacturer and/or Engineer.

D. Casing spacers shall be Models CSS8 and CSS12 by CCI Pipeline Systems or S8G-2 and S12G-2 by Pipeline Seal and Insulator, Inc.

2.04 End Seals: A wrap-around self-curing rubber end seal shall be applied to each end of the casing pipe. End seals shall be Model ESW by CCI Pipeline Systems or Model “W” by PSI, Inc.

PART 3 - EXECUTION

3.01 General Requirements

A. Perform all crossings according to the requirements of the governing highway department or railroad company.

B. Notify the appropriate authorities involved and request their supervisory services during construction work.

C. Provide necessary safeguards to protect the crossing.

D. Where bored highway installations are not shown on the Drawings, open cut the crossing and provide a casing pipe only if required by the governing highway department or Engineer.

E. All uncased roadway punches shall be approved by the Engineer prior to construction work.

F. Excavation shall be unclassified and no distinction shall be made between rock and other materials excavated.

G. Contractor shall provide whatever means necessary to complete road bores even if rock is encountered.

3.02 Installation

A. Perform all crossings in the manner shown on the Drawings, except as otherwise directed by the governing highway department or railroad company.

B. Dry bore an opening under the crossing.

C. Jack the casing pipe, of the type and size specified, into the bored opening.

D. Install the appropriate carrier pipe into the casing pipe.

E. Test the carrier pipe according to the appropriate utility sections (02713 or 02722).

F. Alignment and grade shall be installed and maintained per the Drawings.

G. Bores which are not on horizontal or vertical alignment shall be rebored. Abandoned bore holes shall be filled with flowable fill.

H. Install carrier pipe with casing spacers to maintain alignment inside casing pipe. Casing spacers shall be installed 1 foot from each end of the pipe joint and at the midpoint.

I. Install casing end seals and casing vents upon completion of installation of carrier pipe.

END OF SECTION

Return to Table of Contents

02726
TUNNELING

PART 1 - GENERAL

1.01 Work Included

A. This item shall include the furnishing and installation of a tunnel with steel liner plates and carrier pipe.

B. The Contractor shall conform to all requirements of TDOT or other governing highway department.

PART 2 - PRODUCTS

2.01 Tunnel Liner Plate

A. The tunnel liner shall be constructed of 12 gauge, bituminous coated, galvanized, or Type 2, aluminized two or four flanged steel plates bolted together to the diameter specified on the Drawings, unless Engineer approves the use of an alternate material. The space between the liner and the edge of excavation shall be filled with grout placed under pressure.

B. The steel lining shall consist of plates that have a minimum tensile strength of 42,000 psi, minimum yield of 28,000 psi, elongation at 2 inches of 30% and do not exceed 18 inches in width. Each circumferential ring shall be composed of the number and length of plates to complete the required diameter. The Contractor shall submit details of the lining to Engineer for approval.

C. All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be so fabricated as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type with offset equal to gauge of metal for full width of plates including flanges, and shall have staggered bolt construction, so fabricated as to allow the cross-section of the plate to be continuous through the seam. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

D. The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Plates shall be fabricated with material in accordance with ASTM A819 and AASHTO M274.

E. After the plates are formed to shape and after all holes are punched, the plates shall be galvanized on all surfaces by the hot-dip process. A coating of prime western spelter, or equal, shall be applied at the rate of not less than 2 ounces per square foot of double exposed surface. If the average spelter coating as determined from the required samples is less than the amount specified above, or if any one specimen shows a deficiency of 0.2 ounce, the lot shall be rejected. Spelter coating shall be of first-class commercial quality free from injurious defects such as blisters, flux and

uncoated spots.

F. All nuts and bolts shall be galvanized and shall be fabricated in accordance with ASTM A307, Grade A.

G. Plates shall be fabricated with grout holes to facilitate grouting above and around the tunnel liner. These grout openings shall be 2-inch I.P.T. half couplings welded into a hold in the center corrugation of a plate and a galvanized C.I. plug shall be provided for each opening to permit tight closure after grout is pumped. All rings are to be provided with grout holes so that the spacing of holes will be on a maximum spacing of 18-inch centers at the top of the tunnel and at the top quarter points, staggered with the holes at the top.

2.02 Grout shall consist of Portland cement, water, sand and 2% approved additive (Bentonite, Septamine Seaex, Hydrocide liquid, etc.). One part Portland cement with additive shall be combined to four parts clean sand and sufficient water added to provide a grout having the consistency of thick cream when well mixed.

2.03 The carrier pipe shall be as specified in the Drawings.

PART 3 - EXECUTION

3.01 Excavation

A. Excavation shall be unclassified and no distinction shall be made between rock and other materials excavated. Blasting is acceptable only with explicit written approval from the authority having jurisdiction over tunneled area.

B. Construction of the tunnel shall be carried out in such a manner that settlement of the ground surface above the tunnel shall be held to an absolute minimum. Where ground conditions are unstable, poling plates or poling boards shall be used to prevent caving of material above the tunnel before the liner plates can be installed. Steel liner plates shall be installed as soon as possible after the excavation is removed and excavation shall not be removed more than 24 inches ahead of the installed liner plates. Excavation shall be carried on in such a manner that voids behind the liner plates will be held to a minimum. However, should any boulders larger than 12 inches in diameter be encountered, they shall be removed so that none are closer than 6 inches to the outer face of the liner plate. Where boulders are excavated below the invert of tunnel liner plates, the holes shall be backfilled with crushed stone (#57 or 67).

3.02 Liner Plate

A. When installing liner plate by the tunneling method, the excavation shall be performed in such a manner that voids between the undisturbed earth and the liner plate shall be maintained at a minimum. Any void occurring shall be filled with a Portland cement and sand grout pumped under pressure through grouting openings in the liner plate.

B. The minimum provision for grouting openings shall be one opening in a top plate of the tunnel at locations not to exceed 54 inches apart. Additional plates with grouting openings are to be installed at the top quarter points on each side between the top openings. The opening shall be staggered, but shall not exceed 54 inches in any one line. Grout vent pipes will be required at a minimum of one per monolithic pour.

3.03 Grouting

A. A pump capable of exerting sufficient pressure to assure the filling of all voids between the liner plate and the undisturbed ground shall be provided for placing the grout. Minimum acceptance pressure to fill voids will be 5 pounds per square inch.

B. Pumping of grout shall be done:

1. at the completion of the installation of approximately each 9 feet of liner plate,
2. at more frequent intervals than 9 feet if conditions indicate the necessity, and
3. at the end of a work shift or for stopping work for any reason.

3.04 Carrier Pipe

A. Contractor shall jack the pipe by means of air bladders, blocks, or other suitable method. Once carrier pipe is established, Contractor shall pour a lean concrete bedding for the carrier pipe.

B. The carrier pipe shall be adequately strapped to the tunnel flanges behind each bell with 2" x ¼" stainless steel straps bolted to the liner plate flanges with ½" stainless steel bolts and nuts. Concrete bulkheads will be placed at each end of the tunnel; thickness and placement of which shall be subject to the Engineer's approval.

3.05 Backfill of the tunnel shall consist of sand, #57 crushed stone, or pea gravel and shall be blown into the tunnel to fill the void between the inside wall of the tunnel and the outside edge of the carrier pipe to the top of the carrier pipe.

END OF SECTION

Return to Table of Contents

02727
HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.01 Work Included

A. Furnish all materials and equipment necessary for the horizontal directional drilling of utility lines as called for on the Drawings.

B. Provide all labor, equipment and materials to perform the directional bore.

C. Comply with all permits and conditions related to the work for this location.

1.02 Submittals

A. The Contractor shall prepare a schedule for the work and submit to the Engineer for approval. The schedule shall include all major tasks to be performed including the following:

1. Pipe delivery.
2. Rig mobilization and setup.
3. Pipe assembly.
4. Pilot hole drilling.
5. Pre-reaming.
6. Pre-testing and pigging before installation.
7. Pipe pulling.
8. Pre-testing and pigging pipe after reinstallation.
9. Restoration and demobilization.

PART 2 - PRODUCTS

2.01 Ductile iron Pipe: Where indicated on the Drawings, restrained joint ductile iron pipe equivalent to American Flex Ring or U.S. Pipe T.R. Flex with minimum pressure class 350 shall be used for directional bores.

2.02 High Density Polyethylene Pipe (HDPE)

A. HDPE pipe shall only be used for directional bores as approved by the Engineer.

B. Pipe shall have a DR number 9 with a working pressure of 200 psi and be sized to provide inside diameter equal to or greater than the size shown on the Drawings.

C. Materials: Polyethylene pipe and fittings shall be made from resin meeting the requirements of the Plastic Pipe Institute as PE 3408. The resin shall meet the requirements of ASTM D3350 with a cell classification of 345464C. The requirements

of this cell classification are:

HDPE Resin Specifications

Property	Specification	Unit	Typical Value
Material Designation	PPI/ASTM		PE 3408
Material Approval	NSF #14		
Material Classification	ASTM D1248		III C5 P34
Cell Classification	ASTM D3350-02		345464C
Density	ASTM D1505	g/cm3	0.955
Melt Index	ASTM 1238	gm/10 min	0.11
Flexural Modulus	ASTM D790	psi	135,000
Tensile Strength	ASTM D638	psi	3,200
Slow Crack Growth			
ESCR	ASTM D1693	hours in 100% igepal	>5,000
PENT	ASTM F1473	hours	>100
HDB @73 deg F	ASTM D1693	psi	1,600
UV Stabilizer	ASTM D1603	%C	2.5%

D. Butt Fusion Fittings: HDPE fittings shall be PE 3408, HDPE, Cell Classification of 346464C as determined by ASTM D3350, and approved for potable water use by the AWWA. Butt fusion fittings shall have a manufacturing standard of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using data loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be suitable for use as pressure conduit, and per AWWA C906 (latest version), have a nominal burst value of 3.5 times the working pressure rating of the fitting.

E. Pipe Manufacturer's Quality Control: The pipe manufacturer shall have an ongoing quality control program for incoming and outgoing materials. HDPE resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. The manufacturer of the HDPE resin shall certify the cell classification as indicated in Paragraph C above. These incoming resins shall be approved by plant quality control and verified as approved by NSF before being converted to pipe. Pipe shall be checked for outside diameter, wall thickness, length, roundness and surface finish on the inside, outside and end cut.

F. HDPE pipe shall be joined together at the transition points to other mechanical joint adapters. Mechanical joint adapters shall have a manufacturing standard of ASTM D3261. They shall have a pressure rating equal to the pipe.

G. A minimum of 100 feet of restrained joint ductile iron pipe shall be provided on the pipe preceding and the pipe following the HDPE. Appropriate restraint methods

include using restrained joints equivalent to American Flex Ring or U.S. Pipe T.R. Flex.

PART 3 - EXECUTION

3.01 Scope of Work

A. Fabricate, directionally drill and install pipe as called for on the Drawings.

A. Hydrostatically pressure test the pipe in accordance with the requirements of Sections 02713 or 02722, as appropriate.

B. Provide complete copies of as-built drawings for the pipeline crossing. As-built drawings shall include plan view and profile view.

C. Clean up all affected sites, and restore all areas to pre-construction condition.

3.02 The Contractor shall furnish all equipment and material required to complete the work that shall include, but not be limited to, the following:

A. Drilling equipment.

B. Water pumps, hoses, fittings, storage tanks, filters, and erosion prevention and sediment control measures as required.

C. Drilling fluids containment, collection, cleaning and disposal equipment, and materials.

D. Fuel and lubricants.

E. Bentonite and related mixing equipment.

F. Carrier pipe

G. All welding equipment for HDPE as required.

H. All hydrostatic and pneumatic testing equipment and materials.

I. Sidebooms, cranes, backhoes, trucks, and other equipment and materials necessary to load and unload and to support and smoothly transition the pipe while being pulled into the reamed hole.

J. All equipment and materials necessary to restore project areas to pre-existing condition or better.

3.03 Installation

A. The Contractor shall install appropriate sections of the pipeline indicated on the Drawings by the horizontally drilled, directionally controlled method of construction. This method shall consist of the drilling of a pilot hole within the designated tolerances for radius requirements, followed by enlargement of the hole to accommodate the carrier pipe.

B. Instrumentation: The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole in the X, Y and Z axis relative

to the ground surface. Drill fluid flow rate and pressure must also be monitored.

C. Tolerances:

1. A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment indicated on the Drawings. At no point in the bore will the combined radii in the plan and profile exceed the allowable minimum radius recommended by the pipe manufacturer.

2. The course of the pilot hole must stay within the given right-of-way at all points along the drilled route. Contractor shall provide and use a separate steering system employing a ground survey grid system, such as “Tru-Tracker”.

3. The Contractor shall have accurate working gauges that register tensile force being used to pull the pipeline back through the reamed borehole. It is the Contractor’s responsibility to prepare the reamed out hole such that pullback operations do not exceed the tensile strength of the pipe. The Contractor shall provide estimated calculations for the pulling loads and allowable loads before pull back operations begin. If during the pipeline pulling process this force reaches 75 percent of the allowable load for the pipeline, Engineer’s inspector shall be notified immediately. Logs must be kept intact referencing all forces exerted on the pipeline during pullback.

4. The Contractor shall provide adequate supports along the stringing area to protect the pipe and allow free movement of the pipeline during pullback.

5. During pullback operations, Contractor shall monitor roller operation and use sidebooms if required to assist movement of the pipe. Situations which could cause damage to the pipe material shall be corrected immediately. Damaged pipe shall be replaced by the Contractor before pulling operations resume.

3.04 Drilling and Mud Cuttings

A. The horizontal directional drilling operation is to be operated in a manner to eliminate discharge of water, drilling mud and cuttings into the creek or land areas involved during the construction process. Contractor shall immediately contain and clean up any inadvertent returns, spills or releases. Contractor shall also provide equipment and procedures to maximize the re-circulation and reuse of drilling mud to minimize waste disposal.

B. Disposal of drilling fluids shall be the responsibility of the Contractor and shall be conducted in strict compliance with all applicable environmental regulations and permit requirements. All costs related to disposal shall be borne by the Contractor.

C. Water supply is the Contractor’s responsibility, whether purchased locally, hauled in, or pumped from the creek. If pumped from the creek, the Contractor must comply with the rules and regulations of the Tennessee Department of Environment and Conservation.

D. Drilling fluids must be free of all additives that will adversely affect the environment.

3.05 Ream and Pullback

A. Pre-reaming operations shall be conducted at the discretion of the horizontal drilling Contractor. All provisions of this specification relating to simultaneous reaming and pulling back operations shall also pertain to pre-reaming operations.

B. Contractor shall be responsible for determining safe pulling loads required for proper installation. Such loads shall be minimized as required to prevent failure of the pipeline during installation.

C. A properly sized and fully operational swivel will be installed between the reaming assembly at the end of the drill pipe and the pipeline to restrict torsional stress from being transmitted to the pipeline.

D. The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe material is not damaged.

3.06 Installing HDPE Pipe

A. HDPE pipe shall be assembled utilizing field-site butt fusion joints. Personnel performing butt fusion joining shall be certified by pipe manufacturer.

B. Each piece of pipe must be held by a clamping device so it will not move and pipe ends shall be faced to establish clean mating surfaces. Pipe profiles must be rounded and aligned with each other to prevent mismatch of pipe walls.

C. Heat the ends of the pipe to the pipe manufacturer's recommended temperature, interface pressure, and time duration. Keep heater faces clean to prevent molten plastic from sticking to the heater faces.

D. After heating, remove heater tool and bring molten pipe ends together with sufficient pressure to form a homogenous joint. Hold the molten joint immobile under pressure until cooling has occurred and joint achieves strength.

E. After installation, the pipe shall be tested in accordance with the requirements of Section 02713 or 02722, as appropriate.

3.07 Cleanup, Repairs and Restoration

A. The Contractor is responsible for leaving all areas affected by its construction activities in a condition equal to or better than the condition before construction work.

B. The Contractor shall fully restore all area around entry and exit pits as soon as work is completed. Fill to previous existing ground elevation and grade any areas where settlement occurs due to subsidence.

END OF SECTION

Return to Table of Contents

02821

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 Work included comprises the construction of chain link fences, gates and appurtenances in accordance with the Drawings and these specifications.

1.02 Submittals

A. Product Data: For each product indicated

B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, finishes of components, installation and operational clearances, gate swings, and details of post anchorage and attachment and bracing.

PART 2 - PRODUCTS

2.01 Chain Link Fence Fabric

A. Steel Chain-Link Fence Fabric: Comply with Chain Link Fence Manufacturers Institute's "Product Manual" and AASHTO M181.

B. Mesh and Wire Size: 2-inch (50-mm) mesh, 0.120-inch (3.05-mm) diameter. Vinyl coated, Type 1, Class D, color as specified by Engineer.

C. Fabric Selvage: Twisted at top selvage and knuckled at bottom.

2.02 Line Posts

A. The line posts shall be one of the following types, and of the lengths shown on the Drawings. They shall be 1.5 inch (1.900 O.D.) galvanized steel pipe meeting the requirements of ASTM A53, or (1.875 inch by 1.625 inch) galvanized rolled form steel Standard C-Section meeting the requirements of ASTM A1011 Grade E, or (1.875 inch by 1.625 inch) galvanized H-Section or O.D. (1.5 inch (1.900 O.D.)) aluminum-alloy standard (ANSI Schedule 40) pipe meeting the requirements of ASTM B241, Alloy 6063, Temper T6, or 1.5 inch (1.900 O.D.) triple coated steel pipe with a (0.120 inch) minimum wall thickness.

B. The pipe shall be manufactured by cold rolling and electric resistance welding of steel strip conforming to ASTM A1011, ASTM A1008/ASTM A1011 or ASTM A653, Grade D. All tubing shall be given corrosion protection by in-line application of hot-dip galvanizing, followed by a chromate conversion coating and an electrostatically applied clear acrylic or polyester coating on the outside surface. The inside surface shall be given corrosion protection by hot-dip galvanizing or by in-line application of a zinc rich paint after fabrication.

C. External Protective Coatings:

1. Hot-Dipped Zinc Coating per ASTM B6 high grade and special high grade. The

weight of the hot-dipped zinc coating shall be a minimum of 245 grams per square meter (0.8 oz/s.f.). The weight of zinc coating shall be determined in accordance with ASTM A90.

2. The electrostatically applied clear acrylic or polyester coating thickness shall be at least 2.5 µm (0.1 mils).

D. Internal Protective Coatings: The interior surface shall be hot-dipped galvanized with a minimum of 25 grams (0.9 ounce) of zinc, or painted after welding with a 7.5 µm (0.3 mil) thickness of zinc rich paint. The coating shall be not less than 80% zinc powder by weight and capable of providing galvanic protection.

2.03 End Posts, Corner Posts, Gate Posts and Braces

A. The end and corner posts shall be 2.5 inch galvanized standard steel pipe meeting the requirements of ASTM A53, or 2.5 inch, aluminum alloy standard (ANSI Schedule 40) pipe, meeting the requirements of ASTM B241, Alloy 6063, Temper T6, or 2.5 inch triple coated steel pipe with a (0.130 inch) minimum wall thickness and meeting the specified requirements as set forth under Paragraph 2.02. End and corner post length shall be 9'-6".

B. End and corner post braces shall be 1.25 inch (1.660 O.D.) galvanized standard steel pipe meeting the requirements of ASTM A53, or 1.25 inch (1.660 O.D.) aluminum-alloy standard (ANSI Schedule 40) pipe, meeting the requirements of ASTM B241, Alloy 6063, Temper T6, or 1.25 inch (1.660 O.D.) triple coated steel pipe with a 2.8mm (0.111 inch) minimum wall thickness and meeting the specified requirements as set forth in Paragraph 2.02.

C. Gate Posts shall be 3.0 inch galvanized standard steel pipe meeting the requirements of ASTM A53, or 3-inch aluminum-alloy standard (ANSI Schedule 40) pipe meeting the requirements of ASTM B241, Alloy 6063, Temper T6. Gate post length shall be 10'-0".

2.04 Barbed Wire

A. The barbed wire shall consist of three No. 12-1/2 gauge twisted steel line wires with No. 14 gauge four-point barbs spaced not more than 125 mm (5 inches) apart. It may be either galvanized or aluminum coated. The galvanized wire shall meet the requirements of ASTM A121, chain link fence grade.

B. At the option of the Contractor, high tensile strength barbed wire may be used. If the Contractor elects to furnish high tensile strength barbed wire, it shall meet the requirements of ASTM A121 with the following exceptions:

1. The coated line wires shall have a nominal diameter of 1.70mm (0.067 inch). The coated barbed wires shall have a nominal diameter of 1.45mm (0.057 inch).

2. The minimum weight of zinc coating shall be 230 grams per square meter (0.75 ounce/s.f.) for the line wire and 215 grams per square meter (0.70 ounce/s.f.) for the barbed wire.

3. The line wire shall have a minimum tensile strength of 2.10 kN (475 pounds) per

individual strand.

C. Aluminum alloy barbed wire shall consist of three twisted strands of 2.8mm (0.110 inch) line wire with 2 mm (0.080 inch) diameter four-point barbs spaced not more than 125mm (5 inches) apart. The wire and barbs shall meet the requirements of ASTM B211 alloys of 5052-0 for the wire and 5052-H38 for the barbs.

2.05 Miscellaneous Fittings and Hardware

A. Zinc-coated miscellaneous fittings and hardware shall be commercial grade steel or better quality, pressed, wrought or cast as appropriate to the article, and sufficient in strength and other properties to provide a balanced design when used in conjunction with fabric, posts and wires of the quality specified herein. All steel fittings and hardware shall be galvanized in accordance with AASHTO M111.

B. Aluminum alloy miscellaneous fittings and hardware shall be wrought or cast aluminum to the requirements of AASHTO M181, Table I.

2.06 Wire ties shall be No. 9 gauge and shall be zinc-coated steel, aluminum-coated steel, or aluminum alloy, sufficient in strength and other properties to provide a balanced design when used in conjunction with fabric, posts and wire of the qualities specified herein.

2.07 Tension wire shall meet the requirements of AASHTO M181.

2.08 Truss Rods and Turnbuckle: Truss rods shall be 9.5mm (3/8 inch) diameter, shall be equipped with a turnbuckle having a take-up of not less than 100 mm (4r inches) and shall be galvanized in accordance with AASHTO M111.

2.09 Post Tops and Extension Arms

A. Posts shall be fitted with ornamental tops or extension arms as shown on the Drawings. The post tops shall fit over the outside of posts and shall exclude moisture from posts.

B. Extension arms shall be vertical or extend out from the fence line at approximately 45 degrees as shown on the Drawings. The extension arms shall be suitably notched or slotted to support and space the barbed wire.

C. Fabrication of all materials shall be within reasonable close conformity to the sizes, shapes and dimensions and other factors set out in these specifications or shown on the Drawings, and shall display careful, finished workmanship.

D. The weights specified for steel posts, braces and rails are nominal weights, and a tolerance of +/- 5% will be permitted.

2.10 Gates

A. Fence gates shall be of the types and sizes shown on the Drawings. They shall be swing-type, complete with latches, stops, keepers, hinges, and fabric. The latch shall have a provision for fastening with a padlock. The gates shall be covered with fabric matching the fence. The hinges shall be of adequate strength to support the gate and shall not twist or turn under action of the gate. The gates, gate posts and braces shall

be of the same kind and finish as the adjoining fence. All gate posts and rails shall be furnished with ball caps and rail ends.

B. Posts, braces and framing members for chain-link fence gates shall be standard weight pipe meeting the requirements of Paragraph 2.03.

C. Fabric for chain-link fence gates shall meet the requirements of Paragraph 2.01.

D. Barbed wire for chain-link fence gates shall meet the requirements of Paragraph 2.04.

E. Miscellaneous fittings and accessories for chain-link fence gates shall meet the applicable requirements of Paragraphs 2.05, 2.06, 2.07, 2.08, and 2.09. The hinges shall be of such design to allow the gate to swing back 180 degrees, parallel with the fence line.

2.11 Cast-In-Place Concrete

A. Comply with ACI 301 for cast-in-place concrete. Use materials consisting of Portland cement complying with ASTM C150, aggregates complying with ASTM C33, and potable water.

B. Concrete Mixes: Class A as set forth in Section 03300.

PART 3 - EXECUTION

3.01 Installation

A. Install chain-link fencing to comply with ASTM F567 and more stringent requirements if indicated on the Drawings or required by the Engineer. Do not begin installation before final grading is completed, unless otherwise permitted by Engineer. All fence installers shall carry insurance coverage as required by Owner.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed or compacted soil.

C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil.

1. Concrete Footings: Place concrete around posts and vibrate or tamp for consolidation. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured. Set the following post types in concrete footings and protect portion of posts above ground from concrete splatter:

   i. Terminal.

   ii. Line; using mechanical devices to set line posts per ASTM F567 is permitted.

   iii. Gate.

   iv. Gate operator mounting.

2. Pull shall not be applied to posts set in concrete until the concrete has cured for a

minimum of 72 hours.

D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment. Terminal and gate posts shall be set in a minimum of 30” of concrete.

E. Line Posts: Space line posts uniformly at 10 feet (3.05m) o/c. Line posts shall be set in a minimum of 24” of concrete.

F. Intermediate Rails: Install in one piece at post-height center span, spanning between posts, using fittings, special offset fittings, and accessories.

G. Bottom Rails: Install, spanning between posts, using fittings and accessories.

H. Chain-link Fabric: Apply fabric to outside of enclosing framework.

I. Tie Wires: Attach wire to chain-link fabric per ASTM F626. Tie fabric to line posts at maximum interval of 12 inches (304 mm) o/c. and to braces at maximum interval of 24 inches (609mm) o/c.

J. When aluminum-alloy fabric is used, a tension wire shall be attached to the bottom of the fabric by means of a hog-ring type fastener at a maximum of 600mm (2 foot) intervals and secured at the terminal posts by means of a brace band.

K. Gate Installation: Install gates level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust gate to operate smoothly, easily, and quietly throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

L. Electrical grounds shall be constructed at each corner. A No. 6 solid copper conductor shall be clamped to the nearby ground system and to the fence in such a manner that each element of the fence is grounded.

END OF SECTION

Return to Table of Contents

03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 This work shall consist of all labor, materials, equipment, and incidentals required to install all concrete work, whether plain or reinforced, as shown on the Drawings.

1.02 Submittals

A. Submit concrete mix design for each mix proposed for use identifying constituent quantities per cubic yard, including admixtures, water-cement ratio, and type of cement.

1.03 Quality Assurance

A. Measuring, batching, mixing, and transporting concrete shall conform to ASTM C94.

B. Perform work in accordance with ACI 301.

C. Conform to ACI 305 when concreting during hot weather.

D. Conform to ACI 306 when concreting during cold weather.

E. All detailing, fabrication, and erection of reinforcing steel shall conform to ACI 315.

F. Reinforced concrete shall conform to ACI 318.

PART 2 - PRODUCTS

2.01 Materials

A. Water used in mixing concrete shall be reasonably clean and free from objectionable substances such as oils, acids, alkalis, organic matter, clay and silt, or other deleterious substances.

B. Cement shall be domestic Portland cement and shall conform to ASTM C150. Cement shall be Type I or Type II unless otherwise specified by the Engineer. Fly ash is not an acceptable substitute for Portland cement.

C. Fine aggregate shall be washed, inert natural sand conforming to ASTM C33.

D. Coarse aggregate shall be well-graded crushed stone or gravel conforming to ASTM C33 and shall be size No. 57.

E. Admixtures:

1. Air entraining admixtures, mandatory for concrete exposed to weather, shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

2. Water reducing admixtures shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

3. The use of admixtures to retard setting of concrete during hot weather and to accelerate setting of concrete during cold weather shall not be used without approval of the Engineer. Where approved, these admixtures shall comply with ASTM C494. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

F. Steel welded wire fabric for reinforcement shall conform to ASTM A1064.

G. Steel reinforcing bars shall be deformed, intermediate grade steel conforming to ASTM A615 Grade 60.

H. Tie wires for reinforcing steel shall be 16 gauge or heavier, black annealed wire.

2.02 Classes of Concrete Mixes and Uses

A. Select proportions of constituents to meet the design strength and material limits specified in Table I and to produce concrete having proper placability, durability, strength, appearance, and other required properties.

Class	Design Strength psi (1)	Cement Type (2)	Cement Content (3)	W/C (4)	Slump Range Inches (5)	Air Content % (6)
A	4000	II	564	0.45	3-5	5-7
B	3000	I	470	0.56	3-5	5-7

(1) Minimum compressive strength at 28 days in accordance with ASTM C39

(2) In accordance with ASTM C150

(3) Minimum cement content is lbs/cu. yd. of concrete

(4) Water-to-cement ratio

(5) In accordance with ASTM C143

(6) Where concrete is exposed to freeze-thaw conditions, the concrete shall be air-entrained with air content of 6% +/- 1% according to ASTM C231. Otherwise, air entrainment is not required.

B. Concrete shall be as follows:

1. Class A concrete shall be used for all concrete work except as noted below. All reinforced concrete shall be Class A.

2. Class B concrete may be used for thrust blocks, concrete cradles, concrete anchors, concrete caps, concrete encasement, fill concrete, and where directed on the Drawings.

C. Pumping of concrete will be permitted when approved design mix and aggregate sizes, suitable for pumping, are used.

PART 3 - EXECUTION

3.01 Forms

A. Construction

1. Forms shall be mortar-tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other stresses incidental to the construction activities, including vibration.

2. The forms shall be built true to line and grade and shall be held in place by means of studs or uprights, and whaling, which shall be sufficiently and substantially braced and tied.

B. Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges, and shall be so constructed as to produce mortar-tight joints and smooth, even concrete surfaces.

C. Metal ties or anchorages within the forms shall be so constructed as to permit the removal to a depth of at least one inch for the face without injury to the concrete.

D. Walls: Sufficient openings shall be provided at intervals along the bottom of wall forms to permit thorough cleaning prior to concrete placement. Such openings shall be closed before placing concrete in the forms.

E. Surface Treatment: Prior to placing reinforcement, all forms shall be treated to prevent the adherence of concrete. Forms not provided with a special treatment shall be treated with an approved oil. Any material that will adhere to or discolor the concrete shall not be used.

F. Metal Forms: The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt heads shall be countersunk on the face forming the concrete surface. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete.

G. Forms shall be removed in such a manner as not to impair safety and serviceability of the structure. Concrete to be exposed by form removal shall have sufficient strength not to be damaged by removal operation.

3.02 Reinforcement

A. All reinforcement shall consist of deformed steel bars meeting the requirements of ASTM A615 Grade 60, unless otherwise indicated or directed.

B. Steel welded wire fabric may be furnished in rolls or sheets.

C. Reinforcing steel shall be stored above the ground surface upon platforms, skids or other supports.

D. Reinforcing steel, where indicated, shall be accurately bent, without heating, to the forms and dimensions indicated on the plans.

E. All reinforcement shall be furnished in the full length shown on the plans, unless

otherwise approved in writing by the Engineer.

F. Steel welded wire fabric shall be spliced by overlapping of the sheets by not less than 1-1/2 courses or 12 inches, whichever is greater, and tied together with wire ties spaced no more than 24 inches on center.

G. All reinforcing steel, before being placed, shall be thoroughly cleaned of mill scale, rust, dirt, paint, oil, or other foreign substances or coating of any character that will reduce the bond. When there is a delay in depositing concrete after the reinforcement is in place, bars shall be re-inspected and cleaned when necessary.

H. Unless otherwise shown, splices in reinforcing steel shall be lapped in conformity with ACI 318, but no less than 24 bar diameters. All bar splices shall be staggered where possible. When splicing bars of different diameters, the length of lap is based on the larger bar.

I. Reinforcement shall be accurately placed and firmly held in position with metal clips or tie wire at each intersection as indicated on the plans or as directed by the Engineer.

J. Supports for reinforcement when in contact with the foundation material shall be pre-cast concrete block bar supports or steel chairs. Maintain minimum concrete cover of 3 inches or as indicated on the plans. In no case shall reinforcement be in contact with ground or formwork.

3.03 Drainage and Weep Holes

A. Drainage openings and weep holes shall be constructed using materials in the manner, and at the locations shown on the Drawings or established by the Engineer.

3.04 Expansion Joints

A. Expansion devices shall be as indicated on the Drawings.

3.05 Measuring, Batching, Mixing and Transporting Concrete

A. Measuring, batching, mixing, and transporting concrete shall conform to ASTM C94.

B. Concrete shall be placed within 1-1/2 hours of the time at which water was first added. Otherwise, it shall be rejected.

C. Concrete, which has been re-tempered by adding water to a ready mix truck, is the sole responsibility of the Contractor. In no case shall more than 1 gallon per cubic yard of concrete be added.

3.06 Placing Concrete

A. No concrete shall be placed until forms, reinforcing steel, condition of sub-grade and method of placement has been approved by the Engineer. The Contractor shall advise the Engineer at least 24 hours prior to each concrete placement so that any necessary inspection or testing can be scheduled in a timely manner.

B. Concrete shall be placed as soon as practicable following excavation for footings,

slabs, and other structural components. If an extended period of time will elapse between excavation and the placement of concrete, a thin “mud mat” at least 2 inches thick consisting of low strength concrete shall be placed to protect the sub-grade from degradation due to exposure. The mud mat shall not be placed prior to sub-grade approval by the Engineer.

C. All debris, foreign matter, loose soil, and standing water shall be removed prior to placement of concrete. Concrete shall not be placed on frozen ground.

D. Deposit concrete as near to its final position as possible to avoid segregation due to re-handling or flowing. Movement of concrete by use of mechanical vibrators is not allowed.

E. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. Concrete shall not be dropped more than 6 feet. Tremies shall be used where drop exceeds 6 feet.

F. Pumping of concrete will be permitted when an approved design mix and aggregate sizes, suitable for pumping, are used.

G. All concrete shall be thoroughly consolidated by suitable mechanical vibrators during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of form.

H. Concrete within any unit of work between construction joints shall be placed continuously so as to prevent “cold joints.”

I. If the forms show bulging or settlement while concrete is being placed, the placing shall be stopped until correction has been made.

3.07 Curing and Protection

A. Protect all concrete work against injury from the elements and defacements of any nature during construction activities.

B. All concrete shall be cured in conformity with ACI 301. Reinforced concrete shall additionally conform to ACI 318.

C. Concrete placed during cold weather shall be batched, delivered, placed, cured, and protected in compliance with the recommendations of ACI 306.

D. Concrete placed during hot weather shall be batched, delivered, placed, cured, and protected in compliance with the recommendations of ACI 305.

3.08 Testing

A. Field-testing of fresh concrete shall be performed by an independent testing laboratory where required by the Engineer.

B. Unless otherwise specified, the field testing program shall, at a minimum, consist of the following activities:

1. Fresh concrete shall be sampled not less than once for each concrete mix placed

each day, nor less than once each 100 cubic yards of each concrete mix placed each day. Sampling shall be performed in accordance with ASTM C172.

2. Ambient and concrete temperature shall be measured at the time of sampling.
3. Slump tests shall be performed in accordance with ASTM C143.
4. Tests for air content shall be performed in compliance with either the pressure method complying with ASTM C231 or the volumetric method complying with ASTM C173.
5. A set of four compressive strength cylinders shall be molded and cured in accordance with ASTM C31.

C. Unless otherwise specified, the break schedule for sets of four compressive strength cylinders shall be as follows: one at 7 days, two at 28 days, and one reserve. The compressive strength test shall be performed in accordance with ASTM C39.

3.09 Defective Concrete

A. Concrete shall be placed, completed, finished, and cured so as to form a dense, compact, impervious artificial stone with smooth exposed faces. Any part of the work found to be honeycombed, porous, or otherwise defective that cannot be satisfactorily repaired, in the opinion of the Engineer, or does not meet strength requirements, shall be removed and replaced in whole or in part at no cost to the Owner.

END OF SECTION

Return to Table of Contents

11200
SEWER VALVES

PART 1 - GENERAL

1.01 Work Included

A. Sewer valves and appurtenances shall be installed by the Contractor in accordance with the Drawings and Specifications.

PART 2 - PRODUCTS

2.01 Swing Check Valve

A. The check valve shall be a counterweighted, rubber seated swing check valve unless otherwise specified. The valve shall permit flow in one direction only and shall close tightly without slamming when the discharge pressure exceeds the inlet pressure. The cushioned swing check valve shall be installed with the flow direction either horizontally or vertically up and shall function to prevent reverse flow. The valve shall provide a full equivalent pipe area when open fully.

B. The valve body shall be a one-piece cast iron or cast steel casting with integral flanges. The flanges shall be faced and drilled in accordance with ANSI B16.1 Class 125 or Class 250 as shown on the Drawings.

C. The hinge shaft shall be located completely above the waterway and shall be constructed of stainless steel with the disc arm and counterweight arm keyed thereon. The hinge shaft shall be one piece and shall extend through both sides of the valve body.

D. The body seat shall be bronze or stainless steel, and the disc shall be cast iron conforming to ASTM A126 Class B. The seat ring shall be a resilient field-replaceable ring that can be replaced without the use of special tools.

E. A lever and weight shall be provided to initiate closure unless otherwise specified.

F. The valve shall be a Golden Anderson Series 250 or approved equal.

2.02 Plug Valves

A. All plug valves shall be eccentric plug valves with 100% full port unless otherwise specified.

B. Valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as designated on the Drawings.

C. Valve bodies shall be of ASTM A126 Class B cast iron. Bodies in 4” and larger valves shall be furnished with a 1/8” welded overlay seat of not less than 90% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to ensure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable.

D. Plugs shall be of ASTM A126 Class B cast iron. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. Plug shall be resilient faced with neoprene or hycar, suitable for use with sewage.

E. Valves shall have sleeve type metal bearings and shall be of sintered, oil impregnated permanently lubricated Type 316 ASTM A743 Grade CF-8M or AISI Type 317L stainless steel. Non-metallic bearings shall not be acceptable.

F. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable and re-packable without removing the bonnet or actuator from the valve under pressure. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable.

G. Valve pressure ratings shall be 175 psi through 12” and 150 psi for 14” through 72”. Each valve shall be given a hydrostatic and seat test with test results being certified.

H. Non-buried manual valves shall have hand-wheel gear actuators. Buried valves shall be provided with tee wrenches and extension stems. All valves 6” and smaller may be equipped with gear actuators. All manual actuators shall be rated for the full pressure rating of the valve. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts and washers shall be zinc plated.

I. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers shall be stainless steel.

J. All valves shall be as manufactured by DeZURIK or approved equal.

2.03 Resilient Seat Gate Valves

A. Resilient seat gate valves shall meet the requirements of AWWA C509 (latest version).

B. Gate valves shall have a non-rising stem with valve opening as shown on the system map in Appendix A.

C. Ends shall be mechanical joint by flanged ends suitable for use with tapping machine.

D. Gate valves shall only be used in sewage applications where a tapped connection is made to an existing forcemain.

E. Gate valves are not allowed for sewage applications without prior approval of the Engineer.

2.04 Sewage Air and Vacuum Release Valves

A. All force mains shall have air and vacuum release valves installed as indicated on the Drawings.

B. The body of the valves shall be conical shaped to maintain maximum air gap with the spring loaded float and seal plug connection combining to ensure no contact between the sewage and the seal.

C. The valve shall have a double float design with the upper float being enclosed in the upper section of the valve and shall be made of polypropylene.

D. The lower float shall be in the main body of the valve and shall be constructed of 316 stainless steel.

E. The body, cover flange, and lower flange shall be constructed of 316 stainless steel, and shall have a funnel shaped lower body to automatically drain sewage back into the system.

F. All internal metal parts are to be made from corrosion resistant 316 stainless steel, with all operating parts in the upper section to be non-metallic plastic materials.

G. The hinge for operation for the opening and closing of the seal on the orifice shall be made of Buna N rubber.

H. The rolling resilient seal shall provide smooth positive opening, closing and leak-free sealing over the fluctuation of the pressure differentials.

I. The working pressure shall be 250 psi and tested to 375 psi.

J. All hardware shall be of stainless steel bolts and nuts, and the entire valve, except to upper outlet, shall be constructed of 316 stainless steel.

K. The type of valve and its connection shall be installed as specified on the Drawings.

L. All air and vacuum combination release valves shall be model ARI D-020, ARI D-023, ARI D-025, or approved equal, and the automatic air release valves shall be ARI model S-020 or approved equal.

M. All valves shall be installed in accordance with manufacturer recommendations and shall have an isolation valve connection for control.

N. Air release valves shall be directly vented outside of the enclosure when deemed necessary by the Engineer.

2.05 Pump Station Air Valves

A. Special application of the air release valves at pump station piping shall allow for a combination valve.

B. These valves are to be located as shown on the Drawings.

C. The body/base of these valves shall be made from 316 stainless steel and all operating parts shall be made of engineered corrosion resistant plastic materials.

D. The rolling resilient seal shall provide smooth positive opening, closing, and leak free sealing over the fluctuation of pressure differentials. The valve shall be designed to allow larger than normal automatic orifice providing efficient air release and minimize potential debris build up and clogging.

E. The working pressure shall be 250 psi.

F. All air and vacuum release valves shall be model ARI D-020 or ARI D-023 as per the Drawings.

G. The connection to the system shall be a direct threaded connection on the top of the pipe with a saddle and isolation valve.

2.06 Pump Station Bypass Port Fittings

A. Each pump station shall be equipped with pump bypass port fittings and valves of the size and quantity as shown on the Drawings.

B. Lift station emergency pump port installations shall generally include an above-ground flanged ball male discharge connection. A flanged female suction fitting connected with the wet well shall be installed where indicated on the Drawings. Quick-connect fittings shall be of the ball and socket design securely seated by O-ring for a vacuum-tight seal. Quick connects shall be capable of up to 30° articulation. Couplings shall be galvanized and manufactured to ASA 150 flange patterns. Male fitting shall be provided with a lever-locking mechanism, which can be secured with a locking pin to prevent accidental or deliberate uncoupling. Quick-connect fittings shall be manufactured by Bauer, Wil-Loc Company, or approved equal.

2.07 Valve Boxes

A. Buried valves shall be installed in cast iron, 2-piece or 3-piece, screw type valve boxes with a shaft diameter of not less than 5 inches. The base shall be of such size as to permit its installation without allowing it to come in contact with either the valve or the pipe. Valve boxes shall be the heavy roadway type equipped with a cover containing the word “SEWER” in raised letters on the top and shall be John Bouchard 562-S or equal.

B. In paved areas, the top of the box casting shall be made level with the adjacent pavement. In unpaved areas, the box shall be level with the adjacent ground and encircled with a concrete collar 4 inches thick and 24 inches in diameter. Pre-cast concrete valve collars may also be used around valve boxes.

C. Minimum 3-inch diameter brass or aluminum valve markers shall be anchored in the concrete valve collars. The markers shall be stamped or engraved with the valve size (in inches), valve type (P.V. for plug valve, G.V. for gate valve) and opening direction (O.L. or O.R.). Valve markers are available from Wagco Marker in Longwood, Florida.

2.08 Valve Vaults

A. Reinforced concrete vaults with double leaf aluminum access hatches shall be installed as sized and where indicated on the Drawings.

B. All concrete used in connection with the construction of precast concrete vaults shall be at minimum 4,000 psi concrete. The precast manufacturer shall use XYPEX additive. Xypex Admix C-1000 Red shall be added to the concrete during batching at the manufacturer's specified rate. The amount of cement shall remain the same and not be reduced. Precast concrete structures shall have a reddish tint to verify the XYPEX admix.

C. The vault shall be self-draining by gravity sump and drain line or shall have a minimum 6-inch crushed stone bottom as indicated on the Drawings.

D. The vault shall include a double leaf aluminum access frame and cover consisting a ¼-inch thick one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor. Door panels shall be ¼-inch aluminum diamond plate, reinforced to withstand a uniform live load of 300 psf with a maximum allowable deflection of 1/150 of the span. Doors shall open to 90 degrees and automatically lock with T-316 stainless steel hold open arms with aluminum release handles. Doors shall close flush with the frame. Hinges and all fastening hardware shall be T-316 stainless steel. Unit shall lock with a non-corrosive locking bar and have a non-corrosive handle. Unit shall carry a lifetime guarantee against defects in material and/or workmanship. The unit shall be the S2R series as manufactured by Halliday Products, Inc., or equal.

E. Pipe openings shall include watertight resilient pipe connectors as specified in Section 02722, Paragraph 2.13.

PART 3 - EXECUTION

3.01 General Installation

A. Valves shall be installed per manufacturer’s recommendations.

B. Buried valves shall be installed with a cast iron valve box.

C. Check valves shall not be mounted in wet well but shall be mounted in a valve vault as shown on Drawings.

D. Air release and vacuum valves shall be installed in a 48-inch diameter pre-cast manhole with a minimum depth of 48 inches, but with sufficient depth to accommodate the specified valve. A standard traffic casting with cover marked “Sanitary Sewer” shall be installed on the manhole. At least 1 cubic yard of stone shall be installed around pipeline.

E. Buried valves shall include mechanical joint ends. Valves for aboveground or vault installation shall include flanged ends.

F. Valves shall be plumbed for level installation so as not to place end connection in a bind.

G. Air release and vacuum valves shall be mounted on a flanged tee or tee with a tapped blind flange and include a 316 stainless steel ball valve for isolation. Any nipples shall also be 316 stainless steel. No galvanized piping shall be used.

END OF SECTION

Return to Table of Contents

11311
SUBMERSIBLE SEWAGE PUMP STATIONS

PART 1 - GENERAL

1.01 Description of Work

A. The Contractor shall provide and install a complete submersible sewage pump station. The pump station shall be complete with all equipment shown on the Drawings and as specified herein.

B. The principle items of equipment to be furnished for the pump station shall include:

1. Submersible non-clog sewage pumps, motors, internal and external piping, pump accessories, bypass pump ports, and valves;

2. Concrete wet well and valve vaults with access hatches;

3. Control panel with circuit breakers, motor starters, automatic pump control system, and other components as required;

4. All internal and external wiring and appurtenances necessary to provide an operating pump station.

C. Where indicated on the Drawings, the pump station shall also include water service to the site, a paved access road, fencing, lighting, emergency motor generator, odor control, flow meter and other instrumentation, telemetry and other items.

D. Where the required power supply does not exist, the Contractor shall coordinate with the appropriate power company to route the power supply to the site.

1.02 References

A. ANSI B16.1: Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

B. ASTM A48: Gray Iron Castings.

C. ASTM A276: Stainless Steel Bars and Shapes.

D. ASTM A311: Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements.

E. ASTM A532: Abrasion-Resistant Cast Irons.

F. ASTM A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.

G. The Hydraulic Institute Standards.

1.03 General

A. Make certain that equipment does not exceed space allocation, including hatch openings, and provide the manufacturer with Drawings where necessary.

B. Pumps must operate at specific speeds below the “Upper Limits of Specific Speeds” established by the Hydraulic Institute so that the pumps may operate at the stated

capacity, head, and suction lift with reasonable assurance of freedom from cavitation.

C. Pumps, motors and control equipment shall conform to the requirements set forth in the following pages as to capacity, head, and other requirements. Motors shall be of ample size to operate without overload through the entire range of the pump characteristic curve. Ample means of lubrication shall be provided for all bearings and parts where required. Alemite industrial type fittings shall be used for grease lubrication. Pumps and motors shall perform the work intended without undue wear and undue heating.

D. Asbestos shall not be in any part of the pumps or in the seals.

1.04 Tests

A. Factory Test: Each pump and motor shall be given the following tests at the factory prior to shipment:

1. The mechanical and electrical integrity of the pump shall be established by the use of physical inspection and the use of a megger for verification of the stator resistance to short circuit.

2. The power leads shall be connected to the motor in accordance to the jobsite voltage and the pump started to verify rotation and no load amp readings.

3. The pump shall be installed in a test tank on a wet pit discharge elbow and complete hydraulic tests conducted. The KW input, power factor, flow rate and head shall be measured and recorded. The pump shall be operated at the duty point for the project and checked for compliance with Hydraulic Institute Standards prior to being certified. The pump shall then be removed and given a physical inspection and additional megger insulation test to re-verify the mechanical and electrical integrity.

4. Certified copies of the results of the pump performance tests run in the factory shall be submitted to the Engineer for approval prior to pump delivery.

B. Field Test: Operate equipment for a period of five successive 24-hour days prior to request of acceptance. Should the equipment fail to operate as prescribed, the equipment shall be repaired and the field test procedures shall be repeated until the equipment operates as required by these documents.

1.05 Warranty Requirements

A. All equipment supplied under this section shall have a base warranty from the Contractor and each equipment manufacturer covering a period of one year from acceptance. The warranty period for the station’s equipment shall commence on the date of acceptance.

B. The equipment shall be warranted free from defects in workmanship, design and materials. If any part of the equipment should fail during the basic warranty period, it shall be repaired at no cost to the Owner.

1.06 Submittals

A. The submittals required in this section include (but are not limited to) the following:

1. Certified characteristic pump curves;
2. Components and component materials of construction;
3. Seal descriptions;
4. Impeller diameter;
5. Maximum impeller permissible;
6. NPSH requirements;
7. Operating point;
8. Certified pump test;
9. Electrical characteristics of motors;
10. Manufacturer's standard recommended start-up report form;
11. Printed warranty;
12. Outline dimensions;
13. Layout and operation of control panel.

B. The Contractor shall submit for approval complete characteristic curves of the pumps before fabrication is started. Curves shall also indicate required NPSH, efficiency, horsepower, maximum diameter impeller that can be installed in the pump, and proposed impeller diameter for the application.

C. Any equipment submittals for manufacturers other than those specified must be approved in all respects by the Engineer to meet the proposed requirements.

1.07 Acceptable Manufacturers

A. ITT Flygt

B. ABS

PART 2 - PRODUCTS

2.01 Submersible, Non-Clogging Sewage Pumps

A. The specifications contained herein are patterned around pumps manufactured by ITT Flygt. Products manufactured by Flygt shall set the minimum standard of quality. Some modifications to the specifications have been made to allow other manufacturers to be considered, provided their equipment is judged equal by the Engineer.

B. Furnish and install submersible non-clog wastewater pump(s) as shown on the Drawings and specified herein. The pumps shall be totally submersible solids handling

centrifugal pumps with submersible close-coupled motors. The overall pump design shall combine high efficiency, low required NPSH, large sphere passage and the ability to handle high solids concentrations efficiently. The impeller/casing design shall result in a passage free of surfaces to which solid or fibrous materials can adhere.

C. Discharge Connection: The pump shall be supplied with a mating cast iron discharge connection and be capable of delivering flow and total dynamic head as specified by the Engineer. The pump casing shall have a machined connection system to attach to the ASTM A48, Class 30 cast iron discharge connection. The sealing system shall consist of two machined metal-to-metal flanges form fitted to the machined discharge coupling to insure and guarantee a positive leak-proof system and to provide ease of pump removal. The discharge connection shall be bolted to the floor of the sump with 316 stainless steel J-bolt connections and shall be designed so as to receive the pump connection without the need of any bolts, nuts or other fastenings.

D. Guide Bars and Brackets:

1. A sliding guide bracket shall be an integral part of the pumping unit. The pump(s) shall be tightly sealed against the discharge connection to provide a non-leaking connection and shall be accomplished automatically by a simple linear downward motion of the pump with the pumping unit guided by no less than two 316 stainless steel guide bars extending from the top of the station to the discharge connection. All hardware shall be 316 stainless steel. No portion of the pump shall bear directly on the sump floor.

2. Intermediate guide bar brackets fabricated of 316 stainless steel shall be furnished and installed so that the maximum length of unsupported guide bars will be no longer than 20 feet.

3. The pumps shall be designed to be easily removed from their discharge connections and the wet well for inspection and maintenance. Lifting the pumps from their discharge connections and the wet well shall require neither the removal of any bolts, nuts or other fastenings nor the need for personnel to enter the wet-well.

E. Lifting System: Each pump shall be fitted with a stainless steel chain or stainless steel cable safely rated to lift the pump from the wet well. The working load of the lifting system shall be 50% greater than the pump unit weight. The length of the lifting chain or cable shall be at least equal to the wet well depth (top slab finished grade to wet well bottom) plus 2 feet to permit raising the pump for inspection and removal.

F. Pump Construction

1. Major pump components shall be of gray cast iron, ASTM A48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate

primer with a polyester resin paint finish on the exterior of the pump.

2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

3. No secondary sealing compounds, elliptical O-rings, grease, or other devices shall be used.

G. Cooling System: Motors are sufficiently cooled by the surrounding environment or by submergence in the pumped media. A water cooling jacket is not required. If a dry pit application is specified, a self-contained cooling system shall be included.

H. Submersible Power Cable: The power cable shall be sized according to the NEC and ICEA standards and have P-MSHA approval and shall be suitable for submersible pump applications. Submersible power cables shall be of sufficient length so that the cables will be continuous between the cable entry junction chamber at the motor and the control panel without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

I. Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.

J. Motor

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation is not acceptable. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty while handling pumped media of 40°C (104°F) and shall be capable of at least 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Three thermal switches shall be embedded in the stator end coils, one

per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

2. The motor service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for continuous operation in up to 40°C (140°F) ambient and shall have a NEMA Class B maximum operating temperature rise not to exceed 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

3. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

K. Bearings: The integral pump/motor shaft shall rotate on two bearings. Motor bearings shall be sealed and permanently grease-lubricated with high-temperature grease. The upper bearing shall be a single roller bearing. The lower bearing shall be a two-row angular contact bearing to compensate for axial thrust and radial forces.

L. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion-resistant ring. The upper secondary seal unit, located between the lubricant chamber and the motor hosing, shall contain one stationary and one positively driven rotating, corrosion-resistant seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft.

2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

3. Seal lubricant shall be FDA approved and nontoxic.

M. Pump and motor shaft shall be a single-piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be ASTM A-479 stainless steel.

N. The impeller(s) shall be of gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-open multi-vane, back swept, screw shaped, non-clog design. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Impeller(s) shall be locked to the shaft, held by an impeller bolt, and treated with a corrosion inhibitor. All impellers shall be coated or hardened to provide long life.

O. A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a brass, or nitrile rubber-coated steel ring insert that is drive fitted to the volute inlet.

P. Pump volute(s) shall be single-piece gray cast iron, ASTM A48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

Q. Protection

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if the leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

2. The thermal switches and float switch shall be connected to a control and status monitoring unit. The unit shall be designed to be mounted in the pump control panel.

2.02 Pump Control System

A. The electrical control components specified herein are manufactured by ITT Flygt. Products manufactured by Flygt shall set the minimum standard of quality. Other manufacturers may be considered, provided their equipment is judged equal by the Engineer.

B. General

1. A pressure transducer shall automatically start and stop the pumps, via control and time delay relays within the Pump Control Panel.

2. Appropriate electrical power service shall be provided to the pump control panel. The Contractor shall coordinate this work with the appropriate power company.

3. Solid-state reduced voltage starters, non-reversing shall be provided.

4. Lightening and surge protection shall be provided.

C. The control panel shall consist of a main circuit breaker, an electrically operated manual transfer switch (except where automatic transfer switches are required for

dedicated emergency motor generators), a motor circuit protector, and full voltage starter for each pump motor, a 480-volt primary-120/240 volt control power transformer (fused on primary and secondary), and 20-ampere, 120-volt and 240-volt circuit breakers as required. Size transformer for actual loads plus an additional 50% spare capacity. A low and high level alarm and pump shut-off shall be accomplished by a pressure transducer liquid level control system with all control components mounted in one common enclosure. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually select or automatically alternate the position for the sets of pumps after each pumping cycle.

D. A pressure transducer-type liquid level control system shall continuously monitor wet well liquid level and control operation of the low-level cut off for the pumps.

E. Provide auxiliary dry contracts as required for remote sensing and control.

F. Panel Enclosure

1. The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X deadfront enclosure constructed of not less than 14-gauge 304 stainless steel and shall be equipped with quarter-turn quick-release latches with all hardware and exterior components constructed of 304 stainless steel. The enclosure shall be equipped with an inner door and shall incorporate a removable back panel on which control components shall be mounted. The back panel shall be secured to the enclosure with collar studs. The door shall be interlocked with the main circuit breaker. Crouse-Hinds Type “CGB” cable connectors shall be provided to terminate the motor and float cables in the control panel. The connectors shall be suitable for a 2-inch (minimum) conduit with a neoprene bushing suitable for the cables supplied. The enclosure shall be oversized to prevent and dissipate excess heat building up and to provide sufficient space for maintenance and removal of internal control panel equipment. The enclosures shall be floor-mount type with floor stands for mounting on a concrete pad. The interior door shall be provided with a locking feature to hold the door open.

2. Provide 20-ampere circuit breakers for the following equipment:

   i. Alarm Light Fixture – 120 volts

   ii. GFCI Receptacle – 120 volts

   iii. Telemetry Radio Transmitter – 120 volts

   iv. Control Panel Heater – 120 volts

   v. Control Panel Cooling Fan – 120 volts

   vi. Spare – 120 volts

   vii. Spare – 120 volts

3. Components

   i. All motor branch circuit breakers, motor circuit protectors, motor starters and control relays shall be of the highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

   ii. A thermal-magnetic molded case circuit breaker, Type KH as manufactured by Square D Company, or equal, shall be furnished for the main circuit breaker and service entrance disconnect. Provide a Service Entrance (SE) label. The manufacturer shall seal all circuit breakers after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the station operating conditions. Motor Circuit Protectors (MCP) shall be molded case with adjustable magnetic trip only, Square D Class 680 "Mag-Guard" or equal. The control panel shall have a fully rated short circuit capacity of 65,000 AIC.

   iii. Except where an automatic transfer switch is required, provide an electrically operated non-automatic transfer switch in the control panel to provide for manual transfer to standby power when utility power is not available. The transfer switch shall be rated 240 volt, 3-phase, 3-pole, 4-wire with solid neutral. The transfer switch shall have an ampacity rating as shown on the Drawings. The transfer switch shall be equal to ASCO Series 386. The standby side of the transfer shall be connected to a power receptacle for connection to portable generation equipment. The power receptacle shall be the pin and sleeve type in a NEMA 4X enclosure and located on the exterior side of the control panel. Coordinate receptacle rating, configuration and manufacturer with the Engineer to match the existing cord-and-plug set.

   iv. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors.

   v. Time delay relays shall be electronic, 600 volt, 20 amp contacts, with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing shall be as required for proper operation of the actual equipment furnished. Relays shall be Agastat Model 7012 or 7022 or equal.

   vi. A 20 ampere duplex GFCI utility receptacle (15 amp circuit breaker protected) providing 120 volts, 60 Hz, single phase current shall be mounted inside the enclosure.

   vii. Provide a suitable sized electric enclosure heater with pre-set thermostat.

   viii. Provide a suitable sized electric cooling fan with pre-set thermostat.

   ix. The control panel shall include an adjustable time delay relay to prevent

pumps from starting simultaneously. Relays shall be Paragon Electric Company, Series JW or equal.

x. Each pump shall be provided with an automatic motor insulation monitoring device. The device shall be the EMU/Metropolitan, or equal by MotoSafe. The unit shall be a completely enclosed, solid state, plug-in electronic module designed to automatically monitor the motor winding insulation resistance. Each device shall be provided with a reset button, emergency bypass switch, power-on indicator and low meg light. Each unit shall be provided with two output circuits, one rated at 3 amps for the motor starter circuit and one rated at one amp for connection to alarm devices. The unit shall be designed to operate on a 120-volt power supply.

xi. The control diagrams and overload tables shall be laminated to the inside of the exterior door.

xii. Print storage pockets shall be provided on the inside of each panel. Pocket shall be sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.

xiii. The controls shall operate off a 120-volt control circuit. A transformer shall be provided.

xiv. Alternators shall be provided for the control panel. Alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con or equal.

xv. A phase monitor shall be provided for the control panel. Monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc. or equal.

xvi. The control panel shall be provided with lightening and surge protection. The surge protection devices shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker. The devices shall have minimum surge current capacity rating of 80 kA per phase. The surge protection devices shall be listed in accordance with UL 1449 Second Edition and as defined by IEEE C62.41 and C62.45. The transient voltage surge suppressors shall be as manufactured by Advanced Protection Technologies (APT) for the power supply voltage:

a. TE/5XF – 480 VAC, 3-Phase

b. TE/4XF – 480/277 VAC, 3-Phase

c. TE/3XF – 120/240 VAC, 3-Phase

d. TE/2XF – 120/208, 3-Phase

e. TE/1XF – 120/240, 1-Phase

xvii. All control panel wiring shall be numbered at both ends with type written

heat-shrinkable wire markers.

xviii. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600-volt, 90-degree C, Flame-retardant, Type MTW thermoplastic insulation.

xix. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters on a black background.

xx. All control panels shall be provided with a master nameplate located on the exterior door.

xxi. Where applicable, provide a nameplate that reads as follows "CAUTION – THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE". Letters shall be black on a high visibility yellow background.

xxii. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each control panel.

xxiii. All control relays shall have 10-amp-rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status. Relays shall be manufactured by Potter Brumfield or equal.

xxiv. Terminal blocks shall be 600-volt heavy-duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal. Each terminal shall be individually labeled.

xxv. The completed control panel assembly shall be UL certified. The control panel and main circuit breaker shall be Service Entrance (SE) labeled.

xxvi. Intrinsically safe relays shall be solid-state type with 5-amp output contacts, suitable for use on 120-volt, 60-hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

xxvii. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

xxviii. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space. The space shall be provided for field conduit and wiring access only.

xxix. Provide adequate space in the control panel for a telemetry radio transmitter to be installed by others. Provide a 120-volt circuit for radio power.

xxx. Where included on the Drawings, the pump control panel shall house the flow meter unit.

4. Operating Controls and Instruments

   i. All operating controls and equipment shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.

   ii. Pump mode selector switches shall be hand-off-auto type to permit over-ride of automatic level control and manual actuation of shutdown of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload shutdown and low level pump shutdown via pressure transducer, back-up float switch and control relays. Switches shall be NEMA 4X as manufactured by Allen Bradley or equal providing three switch positions, each of which shall be clearly labeled according to function.

   iii. Indicator lamps shall be incandescent type and mounted in NEMA 4X (800H) modules, as manufactured by Allen Bradley. Lamp modules shall be equipped to operate at 120-volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing the lamp module from its mounted position. Indicators shall be provided for individual motor run and indicator for each failure condition.

   iv. A 6-digit, non-reset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in “hours” and “tenth of hours”. The elapsed-time meters shall be Series T50 as manufactured by ENM Company or equal.

   v. A pump station lead selector hand switch shall be provided with inscriptions 1/2/ALT for the pump station lead pump selection or pump alternation (or similar for 3 or more pumps). Alternation mode selection shall alternate pumps after each run cycle. Pump alternator shall be furnished as specified herein.

   vi. A beacon light shall illuminate when there is a high wet well level alarm. The control panel shall be provided with an alarm silence pushbutton and an alarm reset pushbutton. The beacon light shall be NEMA 4X, 120 VAC, xenon strobe flasher with unbreakable, red Lexan globe, manufactured by Federal Electric Co. or equal.

   vii. All conduits entering control panels must be sealed with a sealant for use in H_2S environments.

5. Full Voltage Magnetic Motor Starters: The motor starters shall be mounted within the pump control panel. Motor starters shall be equal to Square D Class 8536 with

"Motor Logic" solid-state overload relay protection.

6. Make provisions in the pump control panel for future telemetry system provided by the Owner, including termination blocks, as a minimum for the following I/O:
   i. Pump No. 1 run status
   ii. Pump No. 2 run status
   iii. High wet well alarm
   iv. Two pumps running
   v. RTU signal loss/failure alarm
   vi. Power failure alarm
   vii. Pump No. 1 failure alarm
   viii. Pump No. 2 failure alarm
   ix. Spare
   x. Spare
   xi. 4-20mA analog signal for flow rate
   xii. Spare analog signal
   xiii. Additional discrete I/O as required for additional pumps
7. Where required, make provisions for flow transmitters as specified herein. Transmitter unit shall be flush mounted on the inner door of the pump panel. The pump control panel manufacturer shall be responsible for all coordination to ensure adequate space is provided in the pump control panel and the unit functions properly.

G. Level Sensing System/Pump Control

1. The control system shall be designed to operate the required number of pumps specified on the drawing at the power characteristics shown on the plans. The pump control system shall utilize a current input signal, supplied from a submersible pressure transducer. The controller shall supply separate alarm outputs for each fault condition.
2. The pumps shall be controlled by an Allen Bradley CompactLogix PLC approved by the Engineer. This product shall set the minimum standard of quality. Other manufacturers may be considered, provided their equipment is judged equal by the Engineer. Products of other manufacturers shall be assembled to provide all specified functions, including reliability equal to or exceeding that of the manufacturers listed above.
3. The control function shall provide for the operation of the pumps under normal conditions, and shall alternate the pumps on each pump down cycle to equalize the run time. In the event the incoming flow exceeds the pumping capacity of the

lead pump, subsequent pumps shall automatically start to handle the increased flow. As the flow decreases, the pumps shall cut off at the elevations as shown on the plans.

PART 3 - EXECUTION

3.01 Installation

A. Install base elbows with embedded anchor bolts. Use of expanding anchor bolts to secure base elbows is not permitted.

B. Install pumps in accordance with manufacturer's instructions.

C. Provide for connection to electrical service.

D. Lubricate pumps before start-up.

3.02 Field Quality Control

A. Perform field inspection testing.

B. Manufacturer's Field Services: Furnish factory-authorized service representatives to inspect equipment during installation, to assist in adjusting and testing, to supervise initial operation, and to make final adjustments as necessary to assure satisfactory operation.

C. Minimum Length of Field Services: 2 trips, 1 day per trip, exclusive of travel time from pump manufacturer.

D. Test pumps in presence of Engineer to verify specified capacities and operating characteristics are developed.

E. Make repairs and retest pumps and drives until specified capacities and operating characteristics are achieved.

F. Furnish labor, piping, equipment, and materials necessary for conducting tests.

3.03 Demonstration

A. Furnish 1 day of on-the-job instructions (exclusive of travel time) to Owner personnel on all pump-related equipment.

B. Equipment demonstrations and instructions are in addition to other Manufacturer's Field Services specified in Article 3.02.

3.04 Instruction Manuals

A. Contractor shall furnish, prior to initial testing, three copies of an indexed maintenance manual composed of suppliers' maintenance manuals on all equipment and suppliers' brochures on all specialty equipment, including performance curves with size, model, figure number, etc., indicated to identify unit furnished. Maintenance manuals are to be of a hardback, loose-leaf type and of a durable quality. Manuals are to be for the specific equipment provided. Manuals describing

general equipment lines will not be accepted.

B. Each set is to include the following:

1. Manufacturer's parts list identified with the make, model and serial number of the equipment furnished.
2. Control and wiring diagrams.
3. Installation, operation, lubrication and maintenance instructions.
4. Manufacturer's recommended spare parts lists.
5. Certified pump curves for each pump to be owned and operated by the Owner.

END OF SECTION

Return to Table of Contents

11410

WET WELL MOUNTED, SUCTION LIFT SEWAGE PUMP STATIONS WITH DUPLEX PUMPS

PART 1 - GENERAL

1.01 The Contractor shall furnish and install factory-built, automatic pumping stations as described herein and as manufactured by Smith & Loveless, Inc. Each station shall be complete with all needed equipment, factory installed on a welded steel baseplate with fiberglass cover as shown on the Drawings.

1.02 The principal items of equipment shall include:

A. Two vertical, close-coupled, motor driven, vacuum primed, non-clog sewage pumps;

B. Valves;

C. Internal piping;

D. Central control panel with circuit breakers, motor starters and automatic pumping level controls;

E. Heater;

F. Ventilating blower;

G. Priming pumps and appurtenances;

H. All internal wiring.

1.03 Operating Conditions

A. Each station shall be equipped with pumps capable of delivering the flows of wastewater against the total dynamic heads indicated on the Drawings and at the efficiencies specified. Operating design points will be developed for each specific application. Hydraulic calculations will be required to demonstrate the methods used to determine the design point.

B. All openings and passages shall be large enough to permit the passage of a sphere 3” in diameter and the pump shall have a flanged suction and discharge connection no smaller than 4”.

C. The pump motors shall not be overloaded beyond their nameplate rating at the design conditions nor at any head in the operating range.

1.04 Manufactured Equipment Evaluation

A. The specifications and Drawings detail Smith & Loveless equipment and represent the minimum standard of quality for both equipment and materials of construction.

B. Substitution of other makes may be considered if the equipment proposed for substitution is superior or equal in quality and efficiency to the standards of quality named in the specifications and is demonstrated to the satisfaction of the Engineer.

C. Contractor’s written application to Engineer for review of a proposed substitute shall

include all necessary information for the proper determination of the acceptability of the proposed substitution to include, but not be limited to, the following:

1. Complete description of the equipment, system, process or function, including a list of system components and features, drawings, catalog information and cuts, manufacturer's specifications, including materials descriptions.
2. Performance data and curves, and horsepower requirements.
3. Outside utility requirements, such as water, power, air, etc.
4. Functional description of any internal instrumentation and controls supplied including list of parameters monitored, controlled or alarmed.
5. Addresses and phone numbers of nearest service centers and listing of the manufacturer's or representative's services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.
6. A list of five installations in the states where similar equipment by the manufacturer is currently in similar service; include contact name, telephone number, mailing address of the municipality or installation, as well as engineer, owner, and installing contractor. If five installations do not exist, provide a list of those that currently exist, if any.
7. Detailed information on site, architectural, structural, mechanical, plumbing, electrical and control, and all other changes or modifications to the design and construction work necessary to adapt the equipment or systems to the arrangement shown and/or functions described on the Drawings and in the technical specifications. This shall include plan view and section sketches illustrating any additional space requirements necessary to provide the minimum adequate clear space within and around the equipment for operation and maintenance, as shown on the Drawings and specified.
8. All differences between the specifications and the proposed substitute equipment shall be clearly stated in writing under a heading of "differences".
9. Other specific submittal requirements listed in the detailed equipment and material specifications.

D. Approval of the substitution as an alternate shall in no way relieve the Contractor from submitting the specified shop drawings for approval or complying fully with all provisions of the specifications and Drawings. If substituted equipment is accepted, the Contractor shall, at no cost to the Owner, make any changes in the structures, piping, electrical, etc. necessary to accommodate the equipment. If engineering services are required due to substitution of alternate equipment, the Contractor shall be responsible for all engineering costs. In all technical and other evaluations, the decision of the Engineer is final.

1.05 Warranty

A. The manufacturer of the pump station shall guarantee the structure and all equipment to be free from defects in materials and workmanship for a period of one year from the date of start-up, not to exceed 18 months from the date of shipment. Warranties and guarantees of suppliers of various components in lieu of a single source responsibility by the pump station manufacturer will not be accepted. The pump station manufacturer shall be solely responsible for the guarantee of the station and all components.

B. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the pump station manufacturer shall, at no cost to the Owner, provide a replacement part as well as such labor as may be required to replace, repair or modify major components such as the steel structure, pumps, pump motors, suction and discharge piping and valve assembly.

PART 2 - PRODUCTS

2.01 Station

A. All openings and passages shall be large enough to permit the passage of a sphere 3” in diameter. The station shall be constructed in one complete, factory-built assembly. It shall be sized to rest on the top of the wet well as detailed on the Drawings.

B. The supporting floor plate shall be a minimum 3/8” thick steel with reinforcing, as required, to prevent deflection and ensure an absolutely rigid support. Steel plate shall meet or exceed ASTM A36 specifications.

C. The pump volutes and discharge piping shall be mounted in relation to the floor plate as detailed in the Drawings. The suction and discharge connections, where they pass the floor plate, shall be sealed by gaskets rather than being welded to allow adjustment and replacement.

2.02 Fiberglass Cover

A. The pump station shall be enclosed by a hinged fiberglass cover made of molded reinforced orthophthalic polyester resins with a minimum of 30% glass fibers with a minimum average length of 1-1/4”. The outside of the enclosure shall be coated with a polyester protective in-mold coating for superior resistance to weathering, ultraviolet radiation, yellowing and chalking. The completed fiberglass cover shall be resistant to mold, mildew, fungus and corrosive liquids and gasses normally found in pump station environments.

B. The dimensions of the enclosure shown on the Drawings shall be considered for internal component clearances and accessibility and nothing smaller will be acceptable. The cover shall have a suitable drip-lid around the edge and shall be provided with a hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock.

C. The cover shall be attached with a multi segment stainless steel hinge, constructed of 7 gauge (minimum) type 304 stainless steel with a 3/8" diameter stainless steel pin and supporting at least 75% of the width at one end. Stainless steel bolts with tamperproof heads and a full width 3/8" thick anodized aluminum backing plate shall anchor the hinge to the fiberglass cover. Dual high pressure gas struts shall be provided to counteract the dead weight of the cover assembly and limit the maximum lifting force required for opening to less than 20 pounds. The cover shall be self-latching upon opening, with a manually operated release for closing. Duplex heavy gauge safety chains shall be provided to prevent over extension.

D. All hardware and components of the cover assembly which are exposed to the weather shall be constructed of corrosion resistant materials. Heavy extruded aluminum adjustable louvers shall be provided on each end of the fiberglass cover, which are capable of being closed during cold weather operation.

2.03 Manway

A. An aluminum manway cover fabricated of 1/4" treadplate, located exterior to the fiberglass pump chamber shall be provided, complete with padlocking provisions. The manway shall be an integral part of the pump station floor and shall provide access to the wet well. The minimum open area of the manway access into the wet well shall be at least 4.2 square feet.

B. The manway cover shall have a three color 7"x10" (minimum) corrosion resistant sign permanently affixed to it, reading "DANGER – Before Entering, Test for Explosive Gasses. Test for Oxygen Deficiency. Supply Fresh Air to Work Area."

2.04 To allow on-site maintenance of the pumps, a stanchion with lifting arm shall be provided to lift each pump. The stanchion requirement will apply to both vertical and horizontal pumps, whichever is supplied by the Contractor. The lifting arm shall have a hook over the center of the motor to support a hoist for removal of the motors, impellers and pumps from the station.

2.05 All steel structural members shall be joined by electric arc welding with welds of adequate section for the joint involved. Structural welding shall be performed in accordance with American Welding Society (AWS) standards and procedures.

2.06 Corrosion Protection

A. After welding, all inside and outside surfaces of the structure shall be blasted with steel grit to remove rust, mill scale, weld slag etc. All weld splatter and surface roughness shall be removed by grinding.

B. Immediately following the cleaning, a single heavy inert coating shall be factory applied to all inside and outside surfaces prior to shipment. This coating shall be Versapox epoxy resin specially formulated for abrasion and corrosion resistance. The dry coating shall contain a minimum of 86% epoxy resin with the balance being pigments and thixotropic agents.

2.07 Main Pumps

A. The pumps shall be 4” vertical, non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by linear movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearing within the bearing.

B. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of:

1. 1-7/8” for motor sizes 1.5 H.P. through 15 H.P. (motor frame sizes 213 through 286);
2. 2-1/8” for motor sizes 20 H.P. through 30 H.P. (motor frame sizes 324 and 326);
3. 3” for motor sizes 40 H.P. and larger (motor frame sizes 364 and larger).

C. The dimension from the lowest bearing to the top of the impeller shall not exceed 6”.

D. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move linearly with the thermal expansion of the shaft and shall carry only radial loads. The shaft shall be solid stainless steel through the pump and bottom bearing to eliminate corrosion within the pump or the mechanical seal. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

E. The pump impellers shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device.

F. The impeller shall not be screwed or pinned to the motor pump shaft, and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud. The shroud shall remain full diameter so that close minimum clearance from shroud to volute is maintained. Both the end of the shaft and bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft. The pump shall have an adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication. Pumps which do not use hollow priming adapters for positive lubrication of the seal will not be acceptable.

G. The pump shall be constructed so as to permit priming from the low pressure area behind the impeller. Priming from high pressure connections tending to cause solids to enter and clog the priming system will not be acceptable. The priming bowl shall be transparent to enable the operator to monitor the priming level. The pump shall be arranged so that the rotating element can easily be removed from the volute

without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal so that any foreign object may be removed from the pump or suction line.

H. The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. The seal housing shall be bronze. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures. The seal shall be of carbon and ceramic materials with mating surfaces lapped to a flatness of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring.

I. The pump volute shall be furnished with mounting lugs and shall be bolted to the station floor plate, forming a gas-tight seal.

2.08 Motors

A. The pump motors shall be vertical, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 Phase, 60 Cycle, 230 volt electric current. They shall have Class F insulation suitable for temperatures up to 105 degrees C. Insulation temperature shall, however, be maintained below 80 degrees C. The motors shall have normal starting torque and low starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

B. The motors shall have a 1.15 service factor. The service factor shall be reserved for the Owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design conditions, nor at any head in the operating range specified under Operating Conditions.

C. The motor pump shaft shall be centered, in relation to motor base, within 0.005". The shaft runout shall not exceed 0.003". The motor shaft shall equal or exceed the diameter specified under Main Pumps, at all points from immediately below the top bearing to the top of the impeller hub. A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

D. The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor rotating assembly.

2.09 Controls

A. The control equipment shall be mounted in a NEMA Type 1 steel enclosure with a removable access cover. The circuit breakers, starter reset buttons and control switches shall be operable without removing the access cover, for deadfront

protection.

B. A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 120 volt AC devices. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

C. Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive protection. All starters shall be NEMA rated – IEC type starters shall not be acceptable. Each single phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

D. To control the operation of the pumps with variation of liquid level in the wet well, a Devar Model 332 Controller shall be installed in the control panel by the pump station manufacturer. The liquid level shall be monitored by a submersible hydrostatic pressure transducer with stainless steel sensor diaphragm providing a 4-20 mA signal to the pump controller. The submersible transducer shall be a Blue Ribbon "Bird Cage" unit. Three float displacement switches shall be provided to automatically operate the pumps in back-up mode in the event the digital control system or the submersible level transducer fails. The back-up system shall be independent of the digital system. A minimum of 30 feet of cord shall be provided with each switch. The cord shall have a corrosion resistant vinyl jacket and shall be multi-stranded in order to prevent fatigue. The displacement switch cords and the cable for the submersible pressure transducer shall enter the wet well through cord grip seals.

E. An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps after every cycle. The manual switch shall allow either pump to be selected as a base pump or for automatic operation.

F. Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the low level "Lead" pump.

2.10 Pump Station Accessories

A. An adjustable displacement switch shall be provided to sense a high water level condition. The switch shall hang into the wet well and shall activate a contact to indicate the high water condition.

B. A vapor-proof light fixture with a 12 volt 50 watt lamp, red globe and guard shall be furnished for outdoor mounting to signal the alarm condition.

C. A running time meter shall be supplied for each pump to show the number of hours of operation. The meter shall be enclosed in a dust and moisture-proof molded plastic case. The flush mounted dial shall register in hours and tenths of hours up to 99999.9 hours before repeating. The meter shall be suitable for operation on 120 volt AC supply.

D. A 2 or 3 KVA insulating type transformer shall be provided to supply power to lights,

controls and auxiliary devices. A 2 KVA transformer shall be used where the suction pipes are 4" size. A 3 KVA transformer shall be used where the suction pipe sizes are 6" or larger. The transformer shall have 240/460 volt primary, 120/240 volt secondary, Class F insulation, with temperature rise not to exceed 115 degrees C above a 40 degree C ambient. The core and coil shall be protected by a metal housing to prevent damage.

E. A relay with double pole double throw contacts to monitor and protect against phase loss (single phase), under voltage (brown outs) and phase reversal (improper sequence) shall be provided in the control system. The relay shall activate the high water alarm light in the event of a failure. The relay shall automatically reset whenever three-phase service returns to normal.

F. Adjustable time delay relays shall be provided to prevent simultaneous starting of the pump motors after power failure.

G. Glycerin filled pressure/vacuum gauges with diaphragm protectors shall be provided for each pump. Each gauge shall be furnished with isolation valve and tubing.

2.11 Vacuum Priming System

A. A separate and independent priming system shall be furnished for each pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pumps shall have corrosion resistant internal components. The vacuum priming system shall be complete with large port vacuum control solenoid valves, Sonic Start™ prime level sensor, float operated check valves to protect the vacuum pumps, and all necessary shut-off valves. The float operated check valves shall have a transparent body for visual inspection of the liquid level and shall have an automatic drain check valve. All hoses and tubing used in the priming system shall be at least 3/8" nominal diameter.

B. The solenoid valves used in the vacuum priming system shall be of the high flow, direct acting brass body type, with threaded ports, NBR seals and 300 Series stainless steel plunger, rod, plate and springs. The minimum orifice diameter shall be 5/16". The solenoid valves shall be UL Listed, with Class F coil rating and suitable voltage and thermal capacity for the application.

C. Each solenoid valve shall be protected by a vapor filter, installed in the vacuum line between the valve and the priming dome. The vapor filter shall be constructed of corrosion resistant materials and shall have a minimum filtration area of 2.74 square inches and shall be suitable for operation from 25"Hg to 100 psi. The filter shall be readily replaceable without the use of special tools.

D. Liquid level in the pump priming chamber shall be monitored by a Sonic Start™ resonant frequency liquid level sensor with piezoelectric drive and sensitive circuits to detect frequency shifts when the sensor is covered by liquid. This type of system shall be used rather than an electrode system or mechanical means such as a float, to avoid electrical or moving parts inside the chamber, which may accumulate debris,

short out, bind or fail. Only a resonant frequency level sensor with no electrical components or floats in the priming chamber shall be used.

E. The priming system shall automatically provide positive lubrication of the mechanical seal each time a main pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which the pumped liquid must pass shall be smaller than the equivalent of a 2-1/2" opening.

F. The vacuum priming system shall have two field selectable modes of operation. In the "ON DEMAND" mode, the priming system will operate only after a pump is called on to run, and if it is not primed. Once primed, the pump will be allowed to run. In the "CONSTANT PRIME" mode, both pumps are kept primed continuously, and ready to start immediately when called for.

2.12 Environmental Equipment

A. A ventilating blower capable of delivering 250 CFM at 0.1" static water pressure shall be provided in order to remove the heat generated by continuous motor operation. The ventilating blower shall be turned on and off automatically by the preset thermostat. A heavy extruded aluminum louvered grill with adjustable openings shall cover the discharge of the blower. A similar grill shall be provided in the other end of the station enclosure for air intake.

B. A 500 watt electric heater controlled by a preset thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal.

2.13 Main Piping

A. The pump suctions shall be drilled and tapped for a 125 pound American Standard flange for easy connection of the suction risers.

B. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location and quantity of check valves and plug valves shall be as shown on the Drawings.

C. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against priming leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed through the bearings with O-rings. To facilitate back flushing of either pump, only check valves with outside lever arms will be acceptable. Ball-type check valves are specifically unacceptable for this application.

D. All station piping and fittings shall be capable of passing a 3" solid.

E. An operating wrench shall be provided for the plug valves.

F. Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump volutes or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field

connections can be made without disturbing the gas-tight seals.

G. The manufacturer of the pump station shall provide a compression type sleeve coupling for installation in the common discharge pipe. Provisions shall be made for securing the coupling to the station floor plate.

2.14 To prevent potential settling damage, at least 4 feet of flexible conduit shall be used to connect rigid conduit to the lift station.

2.15 Spare Parts

A. A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions.

B. A spare volute gasket and seal gasket shall be provided.

PART 3 - EXECUTION

3.01 Factory Tests

A. All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.

B. Factory test instrumentation must include:

1. Flow measuring with indicator;
2. Compound suction gauge;
3. Bourdon tube type discharge pressure gauge;
4. Electrical meters to measure amperes, volts, kilowatts and power factor;
5. Speed indicator;
6. Vibrometer capable of measuring both amplitude and frequency.

3.02 Installation and Operating Instructions

A. Installation of the pump station shall be done in accordance with the written instructions provided by the manufacturer.

B. The Contractor shall supply three copies of Operation and Maintenance manuals, which will include parts lists of components and complete service procedures as well as a troubleshooting guide.

3.03 Start-Up

A. The pump station manufacturer shall provide complete start-up service.

B. The pump station manufacturer authorized representative or factory service technician will inspect the completed installation to determine if the installed equipment meets the purpose and intent of the specifications.

C. Tests shall demonstrate that:

1. All equipment is electrically, mechanically, structurally and otherwise acceptable;
2. The station installation is safe and in optimum working condition;
3. The station installation conforms to the specified operating conditions.

D. The pump station manufacturer authorized representative or factory start-up service technician shall instruct the Owner's personnel in the proper operation and maintenance procedures.

END OF SECTION

Return to Table of Contents

11411

WET WELL MOUNTED, SUCTION LIFT SEWAGE PUMP STATIONS WITH SERIES PUMPS

PART 1 - GENERAL

1.01 The Contractor shall furnish and install factory-built, automatic pumping stations with pumps in series as described herein and as manufactured by Smith & Loveless, Inc. Each station shall be complete with all needed equipment factory installed on a welded steel baseplate with fiberglass cover as shown on the Drawings.

1.02 The principal items of equipment in each station shall include:

A. Vertical, close-coupled, motor driven, vacuum primed, non-clog sewage pumps;

B. Valves;

C. Internal piping;

D. Central control panel with circuit breakers, motor starters and automatic pumping level controls;

E. Heater;

F. Ventilating blower;

G. Priming pumps and appurtenances;

H. All internal wiring.

1.03 Operating Conditions

A. Each station shall be equipped with four (4) pumps (two pumps in series) capable of delivering the flows of wastewater against the total dynamic heads indicated on the Drawings and at the efficiencies specified. Operating design points will be developed for each specific application. Hydraulic calculations will be required to demonstrate the methods used to determine the design point.

B. All openings and passages shall be large enough to permit the passage of a sphere 3” in diameter and each pump shall have a flanged suction and discharge connection no smaller than 4”.

C. The pump motors shall not be overloaded beyond the nameplate rating at the design conditions nor at any head in the operating range.

1.04 Manufactured Equipment Evaluation

A. The specifications and Drawings detail Smith & Loveless equipment and represent the minimum standard of quality for both equipment and materials of construction.

B. Substitution of other makes may be considered if the equipment proposed for substitution is superior or equal in quality and efficiency to the standards of quality named in the specifications and is demonstrated to the satisfaction of the Engineer.

C. Contractor’s written application to Engineer for review of a proposed substitute shall

include all necessary information for the proper determination of the acceptability of the proposed substitution to include, but not be limited to, the following:

1. Complete description of the equipment, system, process or function, including a list of system components and features, drawings, catalog information and cuts, manufacturer's specifications, including materials descriptions.
2. Performance data and curves, and horsepower requirements.
3. Outside utility requirements, such as water, power, air, etc.
4. Functional description of any internal instrumentation and controls supplied including list of parameters monitored, controlled or alarmed.
5. Addresses and phone numbers of nearest service centers and listing of the manufacturer's or representative's services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.
6. A list of five installations in the states where similar equipment by the manufacturer is currently in similar service; include contact name, telephone number, mailing address of the municipality or installation, as well as engineer, owner, and installing contractor. If five installations do not exist, provide a list of those that currently exist, if any.
7. Detailed information on site, architectural, structural, mechanical, plumbing, electrical and control, and all other changes or modifications to the design and construction work necessary to adapt the equipment or systems to the arrangement shown and/or functions described on the Drawings and in the technical specifications. This shall include plan view and section sketches illustrating any additional space requirements necessary to provide the minimum adequate clear space within and around the equipment for operation and maintenance, as shown on the Drawings and specified.
8. All differences between the specifications and the proposed substitute equipment shall be clearly stated in writing under a heading of "differences".
9. Other specific submittal requirements listed in the detailed equipment and material specifications.

D. Approval of the substitution as an alternate shall in no way relieve the Contractor from submitting the specified shop drawings for approval or complying fully with all provisions of the specifications and Drawings. If substituted equipment is accepted, the Contractor shall, at no cost to the Owner, make any changes in the structures, piping, electrical, etc. necessary to accommodate the equipment. If engineering services are required due to substitution of alternate equipment, the Contractor shall be responsible for all engineering costs. In all technical and other evaluations, the decision of the Engineer is final.

1.05 Warranty

A. The manufacturer of the pump station shall guarantee the structure and all equipment to be free from defects in materials and workmanship for a period of one year from the date of start-up, not to exceed 18 months from the date of shipment. Warranties and guarantees of suppliers of various components in lieu of a single source responsibility by the pump station manufacturer will not be accepted. The pump station manufacturer shall be solely responsible for the guarantee of the station and all components.

B. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the pump station manufacturer shall, at no cost to the Owner, provide a replacement part as well as such labor as may be required to replace, repair or modify major components such as the steel structure, pumps, pump motors, suction and discharge piping and valve assembly.

PART 2 - PRODUCTS

2.01 Station

A. All openings and passages shall be large enough to permit the passage of sphere 3” in diameter. Each station shall be constructed in one complete factory-built assembly. It shall be sized to rest on top of the wet well as detailed in the Drawings.

B. The supporting floor plate shall be a minimum 1” thick steel with reinforcing as required to prevent deflection and to insure an absolutely rigid support. Steel plate shall meet or exceed ASTM A36 specifications.

C. The pump volutes and discharge piping shall be mounted in relation to the floor plate as detailed in the Drawings. The suction and discharge connections, where they pass the floor plate, shall be sealed by gaskets rather than being welded to allow adjustment and replacement.

2.02 Fiberglass Cover

A. Each pump station shall be enclosed by a hinged fiberglass cover made of molded reinforced orthopthlalic polyester resins with a minimum of 30% glass fibers with a minimum average length of 1-1/4”. The outside of the enclosure shall be coated with a polyester protective in-mold coating for superior resistance to weathering, ultraviolet radiation, yellowing and chalking. The completed fiberglass cover shall be resistant to mold, mildew, fungus and corrosive liquids and gasses normally found in pump station environments.

B. The dimensions of the enclosure shown on the Drawings shall be considered for internal component clearances and accessibility and nothing smaller will be acceptable. The cover shall have a suitable drip-lid around the edge and shall be provided with a hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock.

C. The cover shall be attached with a multi segment stainless steel hinge, constructed of 7 gauge (minimum) type 304 stainless steel with a 3/8" diameter stainless steel pin and supporting at least 75% of the width at one end. Stainless steel bolts with tamperproof heads and a full width 3/8" thick anodized aluminum backing plate shall anchor the hinge to the fiberglass cover. Dual high pressure gas struts shall be provided to counteract the dead weight of the cover assembly and limit the maximum lifting force required for opening to less than 20 pounds. The cover shall be self-latching upon opening, with a manually operated release for closing. Duplex heavy gauge safety chains shall be provided to prevent over extension.

D. All hardware and components of the cover assembly which are exposed to the weather shall be constructed of corrosion resistant materials. Heavy extruded aluminum adjustable louvers shall be provided on each end of the fiberglass cover, which are capable of being closed during cold weather operation.

2.03 To allow on-site maintenance of the pumps, a stanchion with lifting arm shall be provided to lift/pull each pump. The stanchion requirement will apply to both vertical and horizontal pumps, whichever is supplied by the Contractor. The lifting arm shall have a hook over the center of the motor to support a hoist for removal of the motors, impellers and pumps from the station.

2.04 Manway

A. An aluminum manway cover fabricated of 1/4" treadplate, located exterior to the fiberglass pump chamber shall be provided, complete with padlocking provisions. The manway shall be an integral part of the pump station floor and shall provide access to the wet well. The minimum open area of the manway access into the wet well shall be at least 4.2 square feet.

B. The manway cover shall have a three color 7"x10" (minimum) corrosion resistant sign permanently affixed to it, reading "DANGER – Before Entering, Test for Explosive Gasses. Test for Oxygen Deficiency. Supply Fresh Air to Work Area."

2.05 All steel structural members shall be joined by electric arc welding with welds of adequate section for the joint involved. Structural welding shall be performed in accordance with AWS standards and procedures.

2.06 Corrosion Protection

A. After welding, all inside and outside surfaces of the structure shall be blasted with steel grit to remove rust, mill scale, weld slag etc. All weld splatter and surface roughness shall be removed by grinding.

B. Immediately following the cleaning, a single heavy inert coating shall be factory applied to all inside and outside surfaces prior to shipment. This coating shall be Versapox epoxy resin specially formulated for abrasion and corrosion resistance. The dry coating shall contain a minimum of 86% epoxy resin with the balance being pigments and thixotropic agents.

2.07 Main Pumps

A. The pumps shall be 4” vertical, non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by linear movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearing within the bearing.

B. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of:

1. 1-7/8” for motor sizes 1.5 H.P. through 15 H.P. (motor frame sizes 213 through 286);
2. 2-1/8” for motor sizes 20 H.P. through 30 H.P. (motor frame sizes 324 and 326);
3. 3” for motor sizes 40 H.P. and larger (motor frame sizes 364 and larger).

C. The dimension from the lowest bearing to the top of the impeller shall not exceed 6”.

D. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move linearly with the thermal expansion of the shaft and shall carry only radial loads. The shaft shall be solid stainless steel through the pump and bottom bearing to eliminate corrosion within the pump or the mechanical seal. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

E. The pump impellers shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device.

F. The impeller shall not be screwed or pinned to the motor pump shaft, and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud. The shroud shall remain full diameter so that close minimum clearance from shroud to volute is maintained. Both the end of the shaft and bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft. The pump shall have an adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication. Pumps which do not use hollow priming adapters for positive lubrication of the seal will not be acceptable.

G. The pump shall be constructed so as to permit priming from the low pressure area behind the impeller. Priming from high pressure connections tending to cause solids to enter and clog the priming system will not be acceptable. The priming bowl shall be transparent to enable the operator to monitor the priming level. The pump shall be arranged so that the rotating element can easily be removed from the volute

without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal so that any foreign object may be removed from the pump or suction line.

H. The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. The seal housing shall be bronze. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures. The seal shall be of carbon and ceramic materials with mating surfaces lapped to a flatness of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring.

I. The pump volute shall be furnished with mounting lugs and shall be bolted to the station floor plate, forming a gas-tight seal.

2.08 Motors

A. The pump motors shall be vertical, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 Phase, 60 Cycle, 230 volt electric current. They shall have Class F insulation suitable for temperatures up to 105 degrees C. Insulation temperature shall, however, be maintained below 80 degrees C. The motors shall have normal starting torque and low starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

B. The motors shall have a 1.15 service factor. The service factor shall be reserved for the Owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design conditions, nor at any head in the operating range specified under Operating Conditions.

C. The motor pump shaft shall be centered, in relation to motor base, within 0.005". The shaft runout shall not exceed 0.003". The motor shaft shall equal or exceed the diameter specified under Main Pumps, at all points from immediately below the top bearing to the top of the impeller hub. A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

D. The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor rotating assembly.

2.09 Controls

A. The control equipment shall be mounted in a NEMA Type 1 steel enclosure with a removable access cover. The circuit breakers, starter reset buttons and control switches shall be operable without removing the access cover, for deadfront

protection.

B. A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 120 volt AC devices. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

C. Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive protection. All starters shall be NEMA rated – IEC type starters shall not be acceptable. Each single phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

D. To control the operation of the pumps with variation of liquid level in the wet well, a Devar Model 332 Controller shall be installed in the control panel by the pump station manufacturer. The liquid level shall be monitored by a submersible hydrostatic pressure transducer with stainless steel sensor diaphragm providing a 4-20 mA signal to the pump controller. The submersible transducer shall be a Blue Ribbon “Bird Cage” unit. Three float displacement switches shall be provided to automatically operate the pumps in back-up mode in the event the digital control system or the submersible level transducer fails. The back-up system shall be independent of the digital system. A minimum of 30 feet of cord shall be provided with each switch. The cord shall have a corrosion resistant vinyl jacket and shall be multi-stranded in order to prevent fatigue. The displacement switch cords and the cable for the submersible pressure transducer shall enter the wet well through cord grip seals.

E. An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps after every cycle. The manual switch shall allow either pump to be selected as a base pump or for automatic operation.

F. Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the low level “Lead” pump.

G. A time delay relay shall be provided to cause the second stage pump in each pump set to start and come up to speed before the lower stage pump in the set is started in order to prevent starting of a pump with pressure on the seal.

2.10 Vacuum Priming System

A. A separate and independent priming system shall be furnished for each pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pumps shall have corrosion resistant internal components. The vacuum priming system shall be complete with large port vacuum control solenoid valves, Sonic Start™ prime level sensor, float operated check valves to protect the vacuum pumps, and all necessary shut-off valves. The float operated check valves shall have a transparent body for visual inspection of the liquid level and shall have an automatic drain check valve. All hoses and tubing used in the priming system

shall be at least 3/8” nominal diameter.

B. The solenoid valves used in the vacuum priming system shall be of the high flow, direct acting brass body type, with threaded ports, NBR seals and 300 Series stainless steel plunger, rod, plate and springs. The minimum orifice diameter shall be 5/16”. The solenoid valves shall be UL Listed, with Class F coil rating and suitable voltage and thermal capacity for the application.

C. Each solenoid valve shall be protected by a vapor filter, installed in the vacuum line between the valve and the priming dome. The vapor filter shall be constructed of corrosion resistant materials and shall have a minimum filtration area of 2.74 square inches and shall be suitable for operation from 25”Hg to 100 psi. The filter shall be readily replaceable without the use of special tools.

D. Liquid level in the pump priming chamber shall be monitored by a Sonic Start™ resonant frequency liquid level sensor with piezoelectric drive and sensitive circuits to detect frequency shifts when the sensor is covered by liquid. This type of system shall be used rather than an electrode system or mechanical means such as a float, to avoid electrical or moving parts inside the chamber, which may accumulate debris, short out, bind or fail. Only a resonant frequency level sensor with no electrical components or floats in the priming chamber shall be used.

E. The priming system shall automatically provide positive lubrication of the mechanical seal each time a main pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which the pumped liquid must pass shall be smaller than the equivalent of a 2-1/2” opening.

F. The vacuum priming system shall have two field selectable modes of operation. In the “ON DEMAND” mode, the priming system will operate only after a pump is called on to run, and if it is not primed. Once primed, the pump will be allowed to run. In the “CONSTANT PRIME” mode, both pumps are kept primed continuously, and ready to start immediately when called for.

2.11 Pump Station Accessories

A. An adjustable displacement switch shall be provided to sense a high water level condition. The switch shall hang into the wet well and shall activate a contact to indicate the high water condition.

B. A vapor-proof light fixture with a 12 volt 50 watt lamp, red globe and guard shall be furnished for outdoor mounting to signal the alarm condition.

C. A running time meter shall be supplied for each pump to show the number of hours of operation. The meter shall be enclosed in a dust and moisture-proof molded plastic case. The flush mounted dial shall register in hours and tenths of hours up to 99999.9 hours before repeating. The meter shall be suitable for operation on 120 volt AC supply.

D. A 2 or 3 KVA insulating type transformer shall be provided to supply power to lights, controls and auxiliary devices. A 2 KVA transformer shall be used where the suction

pipes are 4” size. A 3 KVA transformer shall be used where the suction pipe sizes are 6” or larger. The transformer shall have 240/460 volt primary, 120/240 volt secondary, Class F insulation, with temperature rise not to exceed 115 degrees C above a 40 degree C ambient. The core and coil shall be protected by a metal housing to prevent damage.

E. A relay with double pole double throw contacts to monitor and protect against phase loss (single phase), under voltage (brown outs) and phase reversal (improper sequence) shall be provided in the control system. The relay shall activate the high water alarm light in the event of a failure. The relay shall automatically reset whenever three-phase service returns to normal.

F. Adjustable time delay relays shall be provided to prevent simultaneous starting of the pump motors after power failure.

G. Glycerin filled pressure/vacuum gauges with diaphragm protectors shall be provided for each pump. Each gauge shall be furnished with isolation valve and tubing.

2.12 Environmental Equipment

A. A ventilating blower capable of delivering 250 CFM at 0.1” static water pressure shall be provided in order to remove the heat generated by continuous motor operation. The ventilating blower shall be turned on and off automatically by the preset thermostat. A heavy extruded aluminum louvered grill with adjustable openings shall cover the discharge of the blower. A similar grill shall be provided in the other end of the station enclosure for air intake.

B. A 500 watt electric heater controlled by a preset thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal.

2.13 Main Piping

A. The pump suctions shall be drilled and tapped for a 125 pound American Standard flange for easy connection of the suction risers.

B. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location and quantity of check valves and plug valves shall be as shown on the Drawings.

C. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against priming leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed through the bearings with O-rings. To facilitate back flushing of either pump, only check valves with outside lever arms will be acceptable. Ball-type check valves are specifically unacceptable for this application.

D. All station piping and fittings shall be capable of passing a 3” solid.

E. An operating wrench shall be provided for the plug valves.

F. Protrusions through the floor plate shall be gas-tight where necessary to effect sealing

between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump volutes or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas-tight seals.

G. The manufacturer of the pump station shall provide a compression type sleeve coupling for installation in the common discharge pipe. Provisions shall be made for securing the coupling to the station floor plate.

2.14 To prevent potential settling damage, at least 4 feet of flexible conduit shall be used to connect rigid conduit to the lift station.

2.15 Spare Parts

A. A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions.

B. A spare volute gasket and seal gasket shall be provided.

PART 3 - EXECUTION

3.01 Factory Tests

A. All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and full operational tests with all systems operating.

B. Factory test instrumentation must include:

1. Flow measuring with indicator;
2. Compound suction gauge;
3. Bourdon tube type discharge pressure gauge;
4. Electrical meters to measure amperes, volts, kilowatts and power factor;
5. Speed indicator;
6. Vibrometer capable of measuring both amplitude and frequency.

3.02 Installation and Operating Instructions

A. Installation of the pump station shall be done in accordance with the written instructions provided by the manufacturer.

B. The Contractor shall supply three operation and maintenance manuals, which will include parts lists of components and complete service procedures as well as a

troubleshooting guide.

3.03 Start-Up

A. The pump station manufacturer shall provide complete start-up service.

B. The pump station manufacturer authorized representative or factory service technician will inspect the completed installation to determine if the installed equipment meets the purpose and intent of the specifications.

C. Tests shall demonstrate that:

1. All equipment is electrically, mechanically, structurally and otherwise acceptable;

2. The station installation is safe and in optimum working condition;

3. The station installation conforms to the specified operating conditions.

D. The pump station manufacturer authorized representative or factory start-up service technician shall instruct the Owner's personnel in the proper operation and maintenance procedures.

END OF SECTION

Return to Table of Contents

11420
LOW PRESSURE GRINDER PUMP STATIONS

PART 1 - GENERAL

1.01 The Contractor shall furnish complete grinder pump station(s), consisting of a grinder pump, a tank constructed of high density polyethylene, NEMA 6P electrical quick disconnect, pump removal system, discharge piping assembly with shut-off valve, anti-siphon valve, check valve, electrical alarm panel, and all necessary internal wiring and controls. For ease of serviceability, all pump motor/grinder units shall be of like type and horsepower throughout the system.

1.02 Prior to design of a low pressure sewer system, discussion shall be undertaken with the Engineer to determine the applicability of this type of system.

1.03 The Engineer at his discretion shall require that the Developer and/or Contractor utilize a low pressure system (LPS) in whole or in part when this approach would best fit the requirements of the Owner, eliminate the need for one or more sewer lift stations and best satisfy the needs of customers. The use of the LPS approach will not be allowed in lieu of off-site gravity sewer needed to serve a larger sewershed/drainage basin. The application of LPS will be used to supplement the existing gravity sewer systems in areas where gravity conveyance sewers cannot properly and efficiently meet customer needs, including but not limited to the following situations:

A. Portions of subdivisions where terrain features preclude gravity sewers;

B. Locations where unique circumstances dictate LPS.

1.04 Where LPS is approved, the Developer and/or Contractor shall bear the entire cost of the system including the hydraulic model.

1.05 Where a property owner wishes to connect a private grinder pump(s) to existing gravity system or force main adjacent to the property, the property owner shall install the pump at his/her own expense subject to obtaining all required permits and inspections. The property owner is responsible for the electrical connection, all excavations, provision and installation of tap material, backfilling and payment of applicable connection fees per Clarksville Code. In addition, if the pump discharges into an existing force main, the Engineer may request that a hydraulic analysis be performed to assure proper performance. The tap shall be made by City of Clarksville Gas & Water Department personnel provided the main has been accepted by the Engineer for operation and maintenance.

1.06 After inspection, testing and approval by all parties of the new service installation, the property owner shall bear the responsibility for operation, maintenance and replacement (including grinder pump assembly) up to the point of connection to Owner's main.

1.07 Connection fees shall be charged as per the Clarksville Code.

1.08 Manufacturer

A. Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by a single grinder pump station manufacturer. The Developer and/or Contractor shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems.

B. The manufacturer of the grinder pump station shall be Environment One Corporation, or approved equal.

C. The specifications contained herein are patterned around pumps manufactured by Environmental One Corporation. Products manufactured by Environmental One Corporation shall set the minimum standard of quality. Some modifications to the specifications have been made to allow other manufacturers to be considered, provided their equipment is judged equal by the Engineer. To request consideration of another manufacturer, Developer and/or Contractor shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The manufacturer shall provide a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification to Engineer for review and approval.

1.09 The pump(s) shall be capable of delivering 15 gpm against a total dynamic head of 0 feet (0 psig) and 9 gpm against a total dynamic head of 138 feet (60 psig) at a maximum of 8.0 amps. The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.10 The grinder pump manufacturer shall provide a part(s) and labor warranty on the complete station, accessories and control panel for a period of twelve (12) months from the date of acceptance.

PART 2 - PRODUCTS

2.01 Pump

A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. The rotor shall be constructed of stainless steel. Plating on the rotor will not be acceptable due to its tendency to delaminate. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable

as a stator material because it does not exhibit the properties as outlined above and as required for wastewater service.

B. Requirements for grinder pump (LPS) installation:

1. Proposed tank location should be no more than 25 feet from control panel unless permitted otherwise by the Engineer;
2. Stainless steel lateral assembly/meter box is to be placed within property line, near right of way;
3. Minimum amount of bends in all service line installations;
4. House connection to tank subject to approval by the Owner;
5. Service line and tank installation must be inspected by the Owner;
6. The tank shall be located to preclude entry of surface water through the lid of the tank under all circumstances. The grade must slope away from the station. Covering or burying the top of the station is prohibited.

2.02 The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece, stainless steel motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft. The grinder will be of the rotating type with a stamped, stainless steel shredder ring assembly spaced in accurate, close annular alignment with the driven impeller assembly, which shall carry two hardened, 400 series stainless steel cutter bars. This assembly shall be dynamically balanced and shall operate without vibration over the entire range of specified operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including pump starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

A. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

B. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to prevent jamming and as such must be adhered to.

C. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and eliminates blinding of the pump by large objects blocking the inlet shroud.

D. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

E. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic,

glass, rubber and the like, to finely divided particles that will pass freely through the passages of the pump and the 1-1/4" diameter discharge piping.

2.03 As a maximum, the electric motor shall be a 1 hp, 1725 rpm, 240 volt 60 hertz, 1 phase, capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

2.04 The pump shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.05 Tank and Integral Accessway

A. Simplex Unit: The tank shall be made of high density polyethylene, with a melt index of 2.0 grams/10 minutes or lower to assure high environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. Corrugations of the outside wall are to be of a minimum amplitude of 1-½" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be a minimum 0.250 inch thick. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

B. Duplex Unit: The tank shall be made of rotationally molded high density polyethylene, with a melt index of 2.0 grams/10 minutes or lower to assure high environmental stress cracking resistance. The tank shall have a nominal thickness of ½". All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

C. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. Tank capacities shall be as shown on the Drawings.

D. The accessway shall be an integral extension of the wet well assembly and include a lockable cover assembly providing low profile mounting and watertight capability.

Accessway design and construction shall enable field adjustment of the station height by adding either 2-inch or 4-inch vertical extensions without the use of any adhesives or sealants requiring cure time before installation can be completed.

E. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation, no field penetrations shall be acceptable.

F. All discharge piping shall be constructed of 304 Series Stainless Steel and terminate outside the accessway bulkhead with a stainless steel, 1-¼ inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG; PVC ball valves will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

G. The accessway shall include a single NEMA 6P electrical quick disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. The accessway shall also include a 2-inch PVC vent to prevent sewage gases from accumulating in the tank.

2.06 Check Valve

A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of glass filled PVC. Ball type check valves are unacceptable due to their limited sealing capacity in slurry applications.

B. Each grinder pump installation shall also include one separate check valve of the type detailed above for installation in the 1-1/4" service lateral between the grinder pump station and the sewer main, preferably next to the curb stop.

2.07 Anti-Siphon Valve

A. The pump discharge shall be equipped with a factory-installed, gravity operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping.

B. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from a glass-filled thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

2.08 The grinder pump station shall have an easily removable core assembly consisting of the pump, motor, grinder, all motor controls, check valve, anti-siphon valve, EQD and wiring. The watertight integrity of the core unit shall be established by 100 percent factory test at a minimum of 5 psig.

2.09 Controls

A. All necessary controls, including motor and level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump on/off and high level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices.

B. To assure reliable operation of the differential pressure switches each core shall be equipped with a pressure equalization chamber. The equalization chamber shall continuously calibrate the level sensing pressure switches to fluctuations in barometric pressure and prevent fluid from entering the control compartment during high water level conditions. The equalization chamber shall be constructed from EPDM, high impact polystyrene and stainless steel and measure 12” in diameter by 6” high. The chamber shall be assembled by the core manufacturer and factory tested at the point of assembly to verify proper operation. The grinder pump will be furnished with a 6 conductor, 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a factory installed NEMA 6P EQD half attached to it.

2.10 Alarm Panel

A. Each grinder pump station shall include a NEMA 4X alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of corrosion resistant thermoplastic and be furnished with a hinged cover and padlock.

B. For each core, the panel shall contain one 15 amp, double pole circuit breaker for the power circuit and one 15 amp single pole circuit breaker for the alarm circuit. The alarm panel shall include an audio and visual alarm, push-to-run switch, and high level (redundant) pump starting control. The visual alarm lamp shall be inside a red fluted lens mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. For duplex units, in addition to the above, two high level indicator lights shall be mounted behind the access cover.

C. When liquid level in the sewage wet well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.

D. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.

E. Visual alarm remains illuminated until the sewage level in the wet well drops below the “off” setting of the alarm pressure switch.

F. The control panel shall be equipped with an outside quick disconnect to facilitate usage of a generator during a power outage.

2.11 The grinder pump core unit shall be furnished with a polypropylene lifting harness connected to the pump body to facilitate easy removal when necessary. All mechanical and electrical connections must provide easy disconnect accessibility for core unit removal and installation. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.12 The grinder pump station shall be free from objectionable noise, odor or health hazards in its capability to perform as specified in either individual or low pressure sewer system applications.

PART 3 - EXECUTION

3.01 All factory tests shall include submerging of each grinder pump and a minimum of 5 minutes operation. Included in this procedure will be the testing of all ancillary components such as the anti-siphon valve, check valve, level sensors and each unit's dedicated controls. Certified test results shall be available upon request showing the operation of each grinder pump at two different points on its curve, with the maximum discharge pressure no less than 60 psi. The Engineer reserves the right to inspect such testing procedures with Owner representatives at the grinder pump manufacturer’s facility.

3.02 Installation

A. The Contractor shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.

B. The grinder pump station shall not be set into the excavation until the installation procedures and excavation have been approved by the Owner.

C. Remove packing material. User instructions must be provided to Engineer. Hardware supplied with the unit, if required, will be used at installation. The basin will be supplied with a standard 4" inlet grommet (4.50" OD) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason. Installation shall be accomplished so that 1" to 4" of accessway, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor. A 6-inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than

1/8" or more than 3/4" shall be used as bedding material under each unit. A concrete anti-flotation collar, as detailed on the Drawings, and sized according to the manufacturer's instructions, shall be required and shall be pre-cast to the grinder pump or poured in place. Each grinder pump station with its pre-cast anti-flotation collar shall have a minimum of three lifting eyes for loading and unloading purposes. If the concrete is poured in place, the unit shall be leveled and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured. The Contractor will provide and install a 4-foot piece of 4-inch SCH 40 PVC pipe with watertight cap, to stub-out the inlet for the property owners' contractor, as depicted on the Drawings.

D. The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the Contractor. An alarm device is required on every installation; there shall be no exceptions. It will be the responsibility of the Contractor to coordinate with the individual property owner(s) to determine the optimum location for the alarm panel. The Contractor shall mount the alarm device in a conspicuous location, as per national and local codes. The alarm panel will be connected to the grinder pump station by a length of six conductor 12 gauge type TC cable, in conduit where exposed. The power and alarm circuits must be on separate power circuits. The grinder pump station will be provided with a minimum of 32 feet of electrical supply cable (25 feet of useable electrical supply cable outside the station) to connect to the alarm panel. This cable shall be supplied with a factory installed EQD half to connect to the mating EQD half on the core.

E. Minimum electrical wiring requirements:

1. All LPS electrical systems are to be single phase, 240V AC, 30A, four-wire weatherproof disconnect service.
2. The external NEMA 3 electrical disconnect, installed within 5 feet of the present location of the sewer line leaving the house to the septic tank, can be fused, non fused or breaker type.
3. The height of the disconnect shall be a minimum of 4 feet from the grade.
4. The wiring from the main breaker to the disconnect shall be four-wire (two hot, one insulated neutral and one ground wire).
5. The installation of these conductors shall be in conduit where exposed. Prior to installation an electrical permit must be obtained. All work shall be inspected by the State Electrical Inspector.

3.03 Backfill Requirements

A. Proper backfill is essential to the long-term reliability of any underground structure. Several methods of backfill are available to produce favorable results with different native soil conditions. The most highly recommended method of backfilling is to

surround the unit to grade using Class I or Class II backfill material as defined in ASTM 2321. Class 1A and Class 1B are recommended where frost heave is a concern, Class 1B is a better choice when the native soil is sand or if a high, fluctuating water table is expected. Class 1, angular crushed stone offers an added benefit in that it does not need to be compacted. Class II, naturally rounded stone, may require more compactive effort, or tamping, to achieve the proper density.

B. If the native soil condition consists of clean compactible soil, with less than 12 percent fines, free of ice, rocks, roots and organic material, it may be an acceptable backfill. Heavy, non-compactible clays and silts are not suitable backfill for this or any underground structure such as inlet or discharge lines.

C. Flowable fill (i.e., low slump concrete) is acceptable when installing grinder pump stations in augured holes where tight clearances make it difficult to assure proper backfilling and compaction with dry materials. Flowable fill should not be dropped more than 4 feet from the discharge to the bottom of the hole to avoid separation of the constituent materials.

D. Backfill of clean native earth, free of rocks, roots, and foreign objects shall be thoroughly compacted in lifts not exceeding 12" to a final proctor density of not less than 85 percent. Improper backfilling may result in damaged accessways. The grinder pump station shall be installed at a minimum depth of 30 inches below finished grade to the top of the 1-1/4" discharge line to assure frost protection. The finish grade line shall be 1" to 4" below the bottom of the lid; final grade shall slope away from the grinder pump station.

E. All restoration shall be the responsibility of the Contractor. The properties shall be restored to their original condition in all respects, including, but not limited to, curb and sidewalk replacement, landscaping, loaming and seeding, and restoration of the traveled ways, as directed by the Engineer.

END OF SECTION

Return to Table of Contents

APPENDIX A

OPENING DIRECTION OF SEWER VALVES, WATER VALVES AND FIRE HYDRANTS