

CLINTON UTILITIES BOARD



STANDARD SPECIFICATIONS FOR CONSTRUCTION OF WATER AND SEWER UTILITIES

WPN 25.0680
Clinton Utilities Board Sewer Standard Specifications
APPROVED

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 BY THE COMMISSIONER

December 2, 2025

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

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APPROVED WATER SPECIFICATIONS

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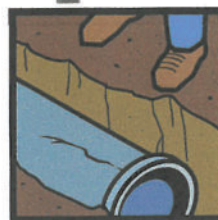
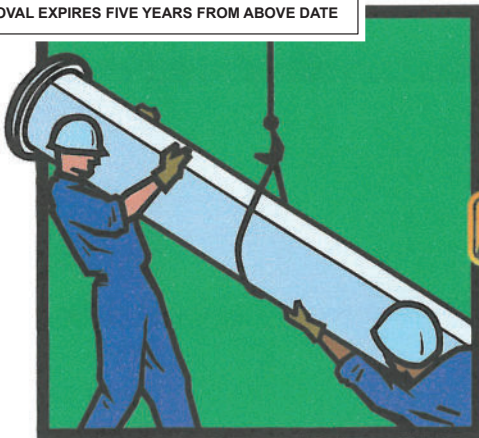
DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR USE IN CONSTRUCTION BY THE COMMISSIONER

12/02/2025

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REVISED NOVEMBER 2025



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SECTION 01000

DESIGN, PLANS AND SPECIFICATIONS FOR WATER DISTRIBUTION SYSTEM IMPROVEMENTS

PART 1. GENERAL

Staying abreast of the continuously changing governmental mandates and technological advances, CUB's Water & Sewer Department's utility plan review is primarily to ensure conformance to acceptable engineering practices and system compatibility. CUB's Water Distribution systems' design and operations are based on the latest standards of the American Water Works Association (AWWA) and requirements of the Tennessee Department of Environment and Conservation (TDEC) Division of Water Supply. CUB's plans review process is also geared toward compliance with the latest edition of CUB's *Standard Specifications for the Construction of Water and Sewer Utilities*, the Safe Drinking Water Act and other applicable Federal, State and local regulatory requirements. A checklist of what CUB will be looking for in reviewing and approving plans for extensions or improvements to the public water distribution system is included in this Section 01000.

All construction on or to be connected to the Clinton Utilities Board (CUB)'s public water distribution system that is not performed by CUB's Water & Sewer Department in-house personnel shall be performed by a person, firm or corporation licensed to engage in contracting as set forth in the Tennessee Contractors Licensing Act of 1976 (TCA 62-601) and who has been approved in advance by CUB's Water & Sewer Department Director. This requirement shall apply to all such construction regardless of the amount of work involved. These requirements apply also to subcontractors who may be engaged by a contractor to conduct any part or all of the project work.

Any and all extensions of the Public Water Distribution System by Developers shall be designed and constructed consistent with CUB's master plans for the service area in which the extension is to be made. Property Owners or Developers seeking to make such extensions shall pay all costs associated with extending the public water and/or sewer facilities to serve the developer's project including, but not limited to: engineering, review and approvals, construction, easements, inspection services and testing, and other associated expenses. Extensions of the public water distribution system will require the Owner/Developer to execute CUB's *Water Extension Agreement*, and extensions of both water and sewer systems will require the owner/developer to execute CUB's *Water and Wastewater Extension Agreement*.

PART 2. PRE-DESIGN CONFERENCE

Before beginning the design of a system extension the Owner, Developer and/or their Design Engineer should first confer with the Clinton Utilities Board (CUB)'s Water and Sewer Department Director to:

- review CUB’s master plans for its water distribution system growth and discuss the growth potential and density that may be expected in the general area of the extension being planned,
- review CUB’s water distribution system maps regarding existing water mains that currently exist in the area to be developed,
- discuss system requirements and CUB’s Standard Specifications, and
- coordinate other issues related to the mains being extended.

PART 3. RESPONSIBLE PARTY

For residential, commercial and industrial developments all costs of materials, equipment, labor, overhead, insurances, land and easement acquisitions, recording, legal, fees, etc. for any and all work associated with the extensions, upgrades or other improvements to CUB’s Public Water Distribution System as may be necessary to serve new developments shall be the sole responsibility of that property’s owner and/or developer.

PART 4. DESIGN ENGINEER

The Engineer developing the design and construction drawings shall be licensed to practice in the State of Tennessee by the Tennessee Department of Commerce and Insurance, Board of Architectural and Engineering Examiners

PART 5. APPROVAL OF DESIGN; CONSTRUCTION PLANS AND SPECIFICATIONS

1. Submittal of construction plans, hydraulic calculations and construction specifications for a proposed water distribution system extension must be submitted as scheduled below:

⇒ Initial submissions:

- i. For proposed Water Distribution System Extension - To CUB’s Director - Water & Sewer Department for approval.
- ii. For all matters regarding fire protection including hydraulic calculations regarding Needed Fire Flows (NFF), hydrant spacing and locations, etc. shall be submitted to the appropriate Fire Department as follows:
 1. Within the city limits of the City of Clinton, submit to Fire Department Chief.
 2. Within the areas served by the Claxton Volunteer Fire Department, submit to their Fire Chief.

⇒ After approval by CUB, to the Tennessee Department of Environment and Conservation Division of Water Supply (TDEC-DWS) for approval.

⇒ For all matters regarding fire flows and fire protection requirements shall be submitted to the State Fire Marshal’s office for approval.

- ⇒ Plans must be submitted to TDEC within 30 days of CUB’s approval.
- ⇒ Approvals shall expire twelve (12) months following TDEC’s approval date.

2. Per TDEC Division of Water Supply’s “*Community Public Water Systems Design Criteria*” no new construction shall be done nor shall any change be made in any public water system until the plans for such new construction or change have been submitted and approved by the Department. Preliminary plans and the “Engineer’s Report” should be submitted for review prior to the preparation of final plans when the project will significantly change the distribution system or alter the treatment plant. No approval for construction will be issued until final, complete, detailed plans and specification have been submitted to the Department and found to be satisfactory. All submittals made to TDEC must first be signed by the Clinton Utilities Board’s Director – Water & Sewer Department or his designee. Documents submitted for formal approval by TDEC shall include but not be limited to those identified in TDEC’s “*Community Public Water Systems Design Criteria*”.
3. Each plan sheet shall bear an appropriate title block showing the name of the project, location, owner (and developer, if applicable), engineer, date, scale in feet, true north where applicable, sheet number, revision date, and other information as may be required.

Each sheet shall contain a note as follows:

This proposed work, as it conforms to CUB’s *Standard Specifications for Construction of Water and Sewer Utilities*, is “Approved for Construction” by:

_____ date _____
 Dan A. Hawkins, P.E., CUB Director - W&S Dept.

and a blank area at least 4-inches by 6-inches near the title block for use of the Tennessee Department of Environment and Conservation (TDEC) when imprinting their official “Approved for Construction” stamp.

4. In addition to, or to compliment the requirements of TDEC’s “*Community Public Water Systems Design Criteria*”, plans for Water Main Extensions and/or improvements or other construction to the public water system submitted to CUB for approval shall include:
 - ✓ A plan sheet showing locations and sizes of all proposed water mains, including reservoirs and booster pumping stations if any, and where these extensions and/or improvements are proposed to connect to the existing public water distribution system,
 - ✓ A vicinity map showing the general location of the proposed project work, and
 - ✓ For multiple-page submittals, a project layout map showing the entire project and numbering of the sheets contained in the submittal.

⇒ Plan Details

- ✓ In General, Plans should have included all requirements of TDEC's Division of Water Supply, have a scale of not more than 100 feet to the inch, and must show at a minimum:
 - i. Locations of streets and existing water mains, size of mains, location and size of service lines, material and type of pipe and all appurtenances, booster pumping stations, etc.
 - ii. All known existing structures both above and below ground which might interfere with the proposed construction, particularly sewer lines, gas mains, storm drains, etc.
 - iii. Easements, lot and right-of-way lines and corners. Provide lot numbers, street names and proposed edges-of-pavement. Do not include pre-existing lot lines, only those for the proposed or part of build out.
 - iv. Stationing of the water line at 100-foot intervals and location of all appurtenances by stationing. Use readily identifiable symbology with a legend defining each.
 - v. Elevations at the beginning, end(s), high point(s), and low points(s) of proposed water lines.
 - vi. The location of maximum and minimum pressure(s). A hydraulic profile may be required.
- ✓ No other utilities shall be shown except for clarification or reference and shall be a reduced line weight and gray scale color from the design utility.
- ✓ Residential split service connections are not acceptable. Service connections should be located at the front of each lot or at a location where it will not interfere with future or proposed driveways, sewer service lines, utility poles or pad-mounted transformers, or any other conflict which can be envisioned.
- ✓ Plans shall include a permanent Bench Mark based on USGS Datum referenced to Tennessee NAD 87 Coordinate System. Additional Bench Marks will be required when the project area exceeds 2,000 feet in length.

PART 6. TYPICAL DESIGN OF WATER DISTRIBUTION SYSTEM PIPING

1. General

- CUB's existing water distribution system current is comprised of approximately 140 miles of water mains and five water storage tanks or reservoirs. Each water storage reservoir has been placed at a strategic point within the distribution

system and located at a certain elevation to provide for system storage and pressures. Owner/Developers and Engineers who propose and/or design water services to new subdivisions shall be required to perform a hydraulic evaluation of how their proposed subdivision will affect and/or be affected by CUB's existing system of water mains, reservoirs and pumping stations.

- Design of extensions or other improvements to the public water system proposed to provide water service to proposed developments, whether these be industrial, commercial or residential, must account for the size of CUB's existing water mains as well as the location of existing reservoirs, booster pumping stations and determine by hydraulic calculations whether CUB's existing water distribution will be adequate to supply both the flows and pressures necessary to meet the engineered demands of the proposed development.

2. Minimum Distributor Pipe Size

- The minimum size pipe shall be 8-inch diameter except for the following instances:
 - i. 6-inch pipe will be permitted when looped in a grid and no leg of such grid exceeds 600 feet in length.
 - ii. Dead-end 6-inch lines may be permitted at lengths of 600 feet and less if approved by CUB.
 - iii. Two-inch pipe may be permitted for serving cul-de-sacs having lengths of 300 feet or less provided CUB has determined that a future need for the extension of this water line is unlikely.
- The size of pipe shall be justified by hydraulic analyses performed by a qualified professional engineer who holds a valid license to practice in the State of Tennessee.
- All assumptions and any flow data used by the design engineer must be clearly documented and submitted with the hydraulic calculations. If actual flow data are not available, theoretical calculations shall be based on CUB's water storage reservoirs that serve the area in question being one-quarter (25%) full, and the appropriate Hazen and Williams friction factor shall be applied for the type pipe being used, but in no case shall such friction factor be greater than 130.
- Distributor pipes should be sized for an instantaneous peak demand of 750 gallons per minute except in cases where 2-inch pipe is used and then only as approved by CUB.

3. Future considerations

- Where water distribution system mains are being extended to serve newly subdivided lots, these mains shall be extended to the point where they can either be connected to the existing public water distribution system (to prevent dead ends) or to the point where they can be further extended to serve later phases of the same development, contiguous properties, or other future development.

CUB will determine if additional future development can be served by future main extensions and therefore CUB will specify the point at which the water main extension will be extended to and terminated by the owner/developer.

4. Fire Protection

- CUB does not guarantee, or by its operation specifically intend to maintain a water supply in its water distribution system, water stored in adequate volumes or pressures as may be required for system-wide fire protection or for industrial, commercial or residential fire-sprinkler systems. However, fire hydrants are connected at strategic locations throughout CUB's water distribution system. As such, it is the responsibility of the Owner/Developer or their Engineer to determine what fire flows and pressures are needed for their proposed development, and to design and construct water system extensions and improvements as may be necessary to supply their required needs, including but not limited to, new booster pumping stations (or upgrades to existing booster pumping stations) and/or new water storage reservoirs.
- When Owner/Developer's plans include fire protection, fire hydrants shall be located at locations designated by the appropriate local fire department's Chief. At minimum, fire hydrants shall be placed along street at a spacing of no greater than 1,000 feet for light residential and 600 feet for congested areas.
- The minimum public water distribution system pipe size to which a fire hydrant may be connected is 6-inch.
- Generally speaking, fire hydrants should only be connected to distributor pipes which are capable of providing a flow of at least 750 gallons per minutes at a residual pressure of 30 psi.
- Private systems containing fire hydrants, such as industrial sites, shall have a double check valve assembly backflow preventer and a compound fire flow meter located between the private system and the public water distribution system main. The backflow preventer and fire flow meter should be located on private property as close to the public main as possible. These devices shall be placed in a structure designed for protection from the elements, i.e. - a meter pit or heated building.
- The minimum standards for privately-owned sprinkler service lines shall be the following:
 - i. Constructed of the same materials specified herein for water mains but subject to applicable prevailing codes and the review and approval of the local fire department and/or the State Fire Marshal's office.
 - ii. An approved check valve or backflow prevention device shall be installed on the service line to isolate the private system from the public water distribution system.
- Fire hydrants installed on water mains that are or will become part of the public water distribution system shall be located within a recorded public right-of-way

or dedicated and recorded easement and at a minimum of 2-feet but no greater than 8-feet from the face of curb to the pumper nozzle cap.

- Although CUB is not the agency that will approve or make recommendations regarding the Design Engineer's calculated fire flows for the particular area or subdivision being considered, Design Engineer shall realize that CUB's public water distribution system is limited by its capacity, and as such may not be able to deliver design engineer's desired fire flows without upgrades to the public water distribution system. Also, Design Engineer should be aware that flows "determined" by the local fire departments are flows taken during certain conditions and are typically only as measured over the time of about one minute. As such, a fire department's recorded hydrant flow conditions may or may not represent sustained fire flows or those flows that would be desired during an extended fire fighting operation. Therefore, when designing improvements to the public distribution system to deliver fire flows to a proposed development or subdivision Design Engineer should not only use the fire department's recorded hydrant flows and pressures but should also take into consideration all factors concerning the public water distribution system's ability to supply fire flows including: public water distribution system piping sizes, distances of the proposed development from the existing water storage reservoirs that serve the area in question, usages along the length of the water main piping between the reservoir and the proposed development, and using the elevations of these reservoirs when they are at or near empty conditions (which may occur during times when the reservoirs must be undergo maintenance).

5. Storage Tanks or Reservoirs

- CUB's public water distribution system is currently comprised of roughly 140 miles of water mains and five water storage tanks or reservoirs. Each water storage reservoir has been located at strategic points within the distribution system and at certain elevations to provide for potable water storage and pressures.
- Owner/Developers and Engineers who propose and/or design water services to new developments and/or subdivisions shall be required to perform a hydraulic evaluation of how their proposed developments and/or subdivisions will affect and/or be affected by CUB's existing system of water mains, reservoirs and booster pumping stations.
- Design of extensions or other improvements to the public water system proposed to provide water service to proposed developments, whether these be industrial, commercial or residential, must account for the size of CUB's existing water mains as well as the location of existing reservoirs, booster pumping stations and determine by hydraulic calculations whether CUB's existing water distribution will be adequate to supply both the flows and pressures necessary to meet the engineered demands of the proposed development.

- The costs of public water distribution system upgrades deemed necessary to supply the flow, volume and pressure requirements of the proposed development shall be at the expense of the Owner/Developer.
- Where water storage tanks or reservoirs are required to meet the water demands of the proposed development and/or subdivision, information shall be submitted to CUB for review and approval including but not limited to:
 - i. Tank or reservoir locations, vicinity maps, proposed connections to the public water distribution system,
 - ii. Site drawings showing configuration and proposed connections to the public water distribution system, electric service connections, fencing, grading, etc.,
 - iii. Survey description of site owned or to be purchased for dedication, by metes and bounds,
 - iv. Plans and profiles of tanks or reservoirs including inlet, outlet and overflow piping, foundation details, wall section (reinforced and post-stressed concrete tanks only), pipe connection details, elevations and other dimensions, etc., shall be included on the Construction Drawings, and
 - v. Name, location, address and telephone number of all parts suppliers.

6. Booster Pumping Stations

- Where booster pumping stations are required to meet the demands of the proposed development and/or subdivision, information shall be submitted to CUB for review and approval including but not limited to:
 - i. Booster pumping station locations, vicinity maps, proposed connections to the public water distribution system,
 - ii. Station site drawings showing configuration and proposed connections to the public water distribution system, electric service connections, fencing, grading, etc.,
 - iii. Survey description of site owned or to be purchased for dedication, by metes and bounds,
 - iv. Pump and motor manufacturer,
 - v. Pump Curves,
 - vi. Details of motors and gearing systems,
 - vii. Details of motor control centers,
 - viii. Pump Station Design details,
 - ix. Construction Drawings showing plan and profile of station including wet well, pumps on/off and alarm levels, concrete details, pipe connection details, etc., and
 - x. Name, location, address and telephone number of all parts suppliers.

- In general, all booster pump stations shall have a minimum of two pumps, each of which is capable of handling the total rated design capacity of the pumping station at build-out of station's service area.
- All electrical equipment must conform to the latest AIEE and NEMA standards and must have UL approvals. The control panel and station operations software shall be similar to other pumping station control units CUB has in service or as otherwise approved by CUB.

7. Dead End Mains

- Dead end mains shall be minimized. Whenever possible, all water main systems shall be designed to provide a complete system loop with all portions of the system having possible feed from at least two directions. However, CUB realizes that this is often not possible in cul-de-sacs.
- Water lines within residential, commercial and industrial developments shall be looped within the development and/or extended to the farthest exterior property line(s) where CUB has determined that there will be a future need for their extension.
- When directed by CUB, water lines within residential, commercial and industrial developments shall be extended and connected to lines within the existing public water distribution system, even though these existing mains may be outside of the proposed development area, if CUB determines doing so is necessary to achieve the system's overall flow requirements.
- Where dead end distribution system mains are allowed to occur by CUB, there shall be provided a fire hydrant on the end of the main, when fire protection is being provided, or otherwise a CUB-approved blow-off assembly for flushing purposes.

8. Gate Valves

- Unless otherwise specified by CUB, gate valves shall be placed at all intersections of distributor pipes. At a minimum:
 - i. Two valves shall be placed at each tee; one installed in the run and one installed in the branch and each installed approximately 3-feet from the tee.
 - ii. Three valves shall be placed at each cross; each installed approximately 3-feet from the cross.
- Valves at no time shall be placed greater than 2,000 linear feet apart unless otherwise specified by CUB.
- Valves shall be placed on fire hydrant leads (or "legs") and approximately 3-feet from fire hydrants, except when tapping sleeve with valves are used and hydrants are to be located farther than 3-feet from the tapping sleeve and valve.

9. Bends

- Bends in 6-inch and greater piping shall be minimized. They should be placed in distributor pipes only as required to make necessary vertical or horizontal changes in pipe direction and only with adequate blocking.
- Two 45° bends are generally more acceptable than one 90° bend.

10. Cross Connections

- There shall be NO physical connection between the public water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating material may be discharged or drawn into the public potable water distribution system.
- There shall be NO physical connection allowed between the public water distribution system and any private ground water source or well, whether that private water source has been determined potable or not.
- Neither stream condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.

11. Water Services and Private Plumbing

- Water services (the sections of water service piping between CUB's meter box and the customer's house or business, i.e. – their private service line and plumbing) shall conform to the standard plumbing codes used by the City of Clinton and its Codes Enforcement Officer, as may be revised from time to time.
- All private water service lines shall have an isolation gate or ball valve installed on the customer's side of the water meter box, i.e. - located between CUB's water meter box and the customer's house or business. These private isolation valves are to be used by the customer when turning the water flow off and on to the customer's house or business.
- In most locations, CUB owns and maintains the water meter box, water meter and associated valving and piping inside the water meter box. CUB does not allow customers to turn the service line water off or on by the valves located inside a CUB-owned water meter box.
- When Customers who do not have a private isolation valve on their water service lines, or whose private isolation valves do not operate properly but need to have their water turned on or off by using the valving located inside CUB's meter box should call CUB's Water Department at 457-9232 during normal working hours (8:00 am – 3:30 pm, Monday through Friday except Holidays) and request such service. During working hours there will be no charge for this service. However, such requests made either before or after CUB's normal working hours (requests to have CUB turn on or off their water service inside the meter box) may be required to pay a service fee.

PART 7. PROJECT COMPLETION AND CLOSE-OUT

1. Prior to CUB's final acceptance of water distribution system extensions, improvements or other new construction, and prior to CUB taking over the improvements for ownership and maintenance:

- Upon completion of the project work, the Design Engineer shall prepare detailed plans to reflect As-Built information. Two copies of correct and accurate As-Built Drawings and plans shall be submitted to CUB as follows:
 - i. one hardcopy on 24-inch by 36-inch reproducible mylar sheets, and
 - ii. one electronic copy on compact disc (CD) or DVD in digital format compatible with CUB’s mapping system software.
- Owner or Developer shall obtain and record all land acquired for the particular project work that CUB has determined is necessary for project components that are to be conveyed to CUB for CUB’s ownership and maintenance.
- Owner or Developer shall obtain and record necessary easements with drawings and submit to CUB copies of all recorded deed, easement and right-of-way documents required and obtained during the construction of the project work.
- Upon completion, start-up and final acceptance of booster pumping stations and other stations with specialized equipment to be conveyed to CUB for CUB’s ownership and maintenance, Owner/Developer or his Design Engineer shall submit to CUB the following:
 - i. Four (4) sets of “Installation Requirements”, “Owner’s Manuals” and “Operating Manuals” for each booster pumping station, pressure-reducing valve station, and specialized equipment station installed,
 - ii. Manufacturer’s Warranty and information,
 - iii. Complete Parts listing with exploded parts diagram(s),
 - iv. Specifics on paint systems used,
 - v. Wiring diagrams and other pertinent information, and
 - vi. All PLC details including Ladder Logic in written form and included on a CD or DVD.

END OF SECTION

SECTION 01100

DESIGN, PLANS AND SPECIFICATIONS FOR WASTEWATER COLLECTION SYSTEM IMPROVEMENTS

PART 1. GENERAL

Staying abreast of the continuously changing governmental mandates and technological advances, CUB's Water & Sewer Department's utility plan review is primarily to ensure conformance to acceptable engineering practices and system compatibility. CUB's Wastewater Collection systems' design and operations are based on the latest standards of the Wastewater Environment Federation (WEF) and Tennessee Department of Environment and Conservation's (TDEC) Division of Water Resources. CUB's plans review process is also geared toward compliance with the latest edition of CUB's *Standard Specifications for the Construction of Water and Sewer Utilities*, the Water Resources Act, Industrial Pretreatment Regulations and other applicable Federal, State and local regulatory requirements. A checklist of what CUB will be looking for in reviewing and approving plans for extensions or improvements to the public wastewater collection system is included in this Section 01100.

All construction on or to be connected to the Clinton Utilities Board (CUB) public wastewater collection system that is not performed by CUB's Water & Sewer Department in-house personnel shall be executed by a person, firm or corporation licensed to engage in contracting as set forth in the Tennessee Contractors Licensing Act of 1976 (TCA 62-601). This requirement shall apply to all construction regardless of the amount of work involved. These requirements apply also to subcontractors who may be engaged by a contractor to conduct any part or all of the project work.

Any and all extensions of the Public Wastewater Collection System by developers shall be designed and constructed consistent with CUB's master plans for the service area in which the extension is to be made. Property Owners or Developers seeking to make such extensions shall pay all costs associated with extending, performing construction on or otherwise improving the public wastewater collection system facilities to serve the developer's project including, but not limited to: engineering, review and approvals, construction, easements, inspection services and testing, and other associated expenses. Extensions of the public wastewater collection system will require the owner/developer to execute CUB's *Wastewater Extension Agreement* and extensions of both water and sewer systems will require the owner/developer to execute CUB's *Water and Wastewater Extension Agreement*.

PART 2. PRE-DESIGN CONFERENCE

Before beginning a system extension design, the design engineer should first confer with the Clinton Utilities Board (CUB)'s Water and Sewer Department Director to:

- review CUB’s master plans for its wastewater collection system service area and discuss the growth potential and density that may be expected in the general area of the extension being planned,
- review CUB’s wastewater collection system maps regarding existing wastewater mains and pumping stations that currently exist in the area to be developed,
- discuss system requirements and CUB’s Standard Specifications, and
- coordinate other issues related to the mains being extended.

PART 3. RESPONSIBLE PARTY

For residential, commercial and industrial developments all costs of materials, equipment, labor, overhead, insurances, land and easement acquisitions, recording, legal, fees, etc. for any and all work associated with the extensions, upgrades or other improvements to CUB’s Public Wastewater (Sanitary Sewer) Collection System’s piping, pumping stations, manholes, etc. as may be necessary for wastewater service connections to serve new developments shall be solely the responsibility of that property’s Owner and/or Developer.

PART 4. DESIGN ENGINEER

Plan and profile drawings shall be prepared and sealed by a registered Professional Engineer licensed to practice in the State of Tennessee by the Tennessee Department of Commerce and Insurance, Board of Architectural and Engineering Examiners

PART 5. APPROVAL OF DESIGN; CONSTRUCTION PLANS AND SPECIFICATIONS

1. Submittal of construction plans, hydraulic (flow) calculations and construction specifications for a proposed system extension shall be submitted as scheduled below:
 - ⇒ Hydraulic calculations shall be submitted for all receiving lines and pumping stations as provided for in the latest edition of the TDEC Division of Water Resources *Design Criteria for Sewage Works*.
 - ⇒ Initial submissions:
For proposed Wastewater (Sanitary Sewer) Collection System Extensions: to CUB’s Director - Water & Sewer Department for approval.
 - ⇒ After approval by CUB, plans may also need to be submitted to the Tennessee Department of Environment and Conservation Division of Water Resources (TDEC-WPC) for approval.
 - ⇒ Plans must be submitted to TDEC-WPC within 30 days of CUB’s approval, and

⇒ Approvals shall expire twelve (12) months from the date of the TDEC-WPC approval date.

2. Engineering Reports, Design and Construction Drawings for extensions of the public wastewater collection system shall be developed in accordance with TDEC Division of Water Resources’s “*Design Criteria for Sewage Works*” and CUB’s “*Standard Specifications for Construction of Water and Sewer Utilities*”. No new construction shall be performed nor shall any change be made to any public wastewater system component until the plans for such new construction or change have been submitted and approved by CUB and TDEC-WPC. Preliminary plans and an “Engineer’s Report”, if required, should be submitted for review prior to the preparation of final plans when the project will significantly change the public wastewater collection system, pumping/lift stations, or wastewater treatment plant. No approval for construction will be issued until final, complete, detailed plans and specifications have been submitted to the CUB and, in most cases, also to TDEC’s Division of Water Resources. All submittals made to TDEC-WPC must first be signed by the Clinton Utilities Board’s Director – Water & Sewer Department or his designee. Documents submitted for formal approval by TDEC shall include but not be limited to those identified in TDEC’s “*Design Criteria for Sewage Works*”.
3. Each plan sheet shall bear an appropriate title block showing the name of the project, location, owner (and developer, if applicable), engineer, date, scale in feet, true north where applicable, sheet number, revision date, and other information as may be required.

Each sheet shall contain a note as follows:

This proposed work, as it conforms to CUB’s *Standard Specifications for Construction of Water and Sewer Utilities*, is “Approved for Construction” by:

_____ date _____
Dan A. Hawkins, P.E., CUB Director - W&S Dept.

and a blank area at least 4-inches by 6-inches near the title block for use of the Tennessee Department of Environment and Conservation (TDEC) when imprinting their official “Approved for Construction” stamp.

4. In addition to, or to compliment the requirements of TDEC-WPC’s “*Design Criteria for Sewage Works*”, plans for Wastewater Main Extensions and/or improvements or other construction to the public wastewater collection system submitted for CUB approval shall include:
 - ✓ A plan and profile sheet showing existing and proposed wastewater mains for projects extensions or other improvements to the existing wastewater (sanitary sewer) collection system, including pumping stations,
 - ✓ The locations and sizes of all proposed wastewater mains and pumping stations,

- ✓ A vicinity map of proposed project work, and
- ✓ A project layout map showing the entire project.

5. Plan Details

- ✓ In general, Plans should have included all requirements of TDEC's Division of Water Resources
- ✓ Plans and profiles are required for all wastewater lines.
- ✓ Profiles should have a horizontal scale of not more than 50 feet to the inch. The vertical scale of profiles shall not be more than 10 feet to the inch. The plan view and profile views shall be drawn to a corresponding horizontal scale.
- ✓ Plans and profiles shall be drawn on the same sheet and show:
 - i. Locations of streets and existing wastewater mains; existing line and grade of ground surface; size, slope, material and class of pipe for the main and service lines; length between manholes; location and size of service lines and taps; and grade of sewer between each two adjacent manholes.
 - ii. Match line when profile covers more than one page.
 - iii. Locations and site details of existing and proposed pumping stations and force mains with details of each station - including sizes of pumps, configuration, station drawings and details, etc.
 - iv. Locations of special features such as concrete encasements, drop manholes, elevated sewers, inverted siphons, etc.
 - v. All known existing structures both above and below ground which might interfere with the proposed construction, such as water lines, gas mains, storm drains, etc.
 - vi. Easements, lot and right-of-way lines and corners. Provide lot numbers, street names and proposed edges-of-pavement. Do not include pre-existing lot lines, only those for the proposed or part of build out.
 - vii. Stationing of the wastewater line at 100-foot intervals and location of all appurtenances by stationing. Use readily identifiable symbology with a legend defining each.
 - viii. Elevations of all proposed manhole inverts, both in and out, as well as finish grades for tops of frames and covers.
 - ix. Proposed finished floor elevations, if known.
 - x. The location of proposed connections to existing wastewater mains.
- ✓ No other utilities shall be drawn except for clarification or reference and shall be a reduced line weight and gray scale color from the design utility.

- ✓ Residential split service connections are not acceptable. Service connections should be located at the front near the middle of each lot or at a location where it will not interfere with future or proposed driveways, water service lines, utility poles or pad-mounted transformers, or any other conflict which can be envisioned.
- ✓ Plans shall include a permanent Bench Mark based on USGS Datum referenced to Tennessee NAD 87 Coordinate System. Additional Bench Marks will be required when the project area exceeds 2,000 feet in length.

PART 6. TYPICAL DESIGN ELEMENTS OF WASTEWATER COLLECTION SYSTEM PIPING

1. Design Basis

- ⇒ Generally the sewer should be designed to carry, when running full, not less than the following minimum peak design flows of wastewater, exclusive of wastewater from industrial plants:
 - i. Laterals and sub-main sewer: 400% of average design flow
 - ii. Main, Trunk and Interceptor Sewers: 250% of average design flow.
- ⇒ In general, wastewater collection system extensions shall be designed for the estimated ultimate tributary population.

2. Design Factors

- ⇒ In determining the required capacities of sanitary sewer systems, the following factors must be considered:
 - i. Maximum hourly quantity of wastewater,
 - ii. Line capacities,
 - iii. Pumping Station capacities,
 - iv. Additional maximum wastewater from industrial plants, and
 - v. Ground water infiltration and inflow.
- ⇒ Typical design flows to be used for the design and calculations of flows from various facilities can be found in Chapter 2 of TDEC Division of Water Resources’s “*Design Criteria for Sewage Works*”, “*Design Basis for New Sewage Works*”. The flows shown in TDEC-WPC *Criteria* are assumed to include nominal infiltration, but an additional allowance should be made where conditions are unfavorable. However, typical or categorical flows may be used when they can be considered representative of the proposed development, such as when wastewater collection system improvements are being designed to serve industrial and commercial developments that have similar plants in operation in other locations.

3. Minimum size

- ⇒ The minimum wastewater collection system main pipe size shall be 8-inch diameter except for the following instances:

- i. 6-inch pipe may be allowed by CUB for certain applications and then only when it serves no more than three single-family residential houses and where such pipe length does not exceed 200 feet in length.
- ii. The use of 4-inch pipe is generally prohibited from use as a public wastewater collection system main. But, a 4-inch main may be allowed by CUB for certain specific applications when an 8-inch or a 6-inch size main, for whatever reason, is not logical and then only when it serves one single-family house and where such pipe length does not exceed 100 feet in length, and provided CUB has determined that a future need for its upgrade or extension is very unlikely.

⇒ The size and configuration of collection system piping and pumping facilities shall be as determined by projected flow analyses performed by an Engineer who is currently licensed to practice in the State of Tennessee by the Tennessee Department of Commerce and Insurance, Board of Architectural and Engineering Examiners.

4. Depth

- In general, public wastewater collection system mains shall be deep enough to accept gravity flows of sanitary sewage from basements and therefore designs should take into consideration the required slope for the service line times the distance from the building to be served to the sewer main to determine minimum depth of the flow line. Where practical in most streets a minimum depth of five (5) feet of cover should be maintained.
- In special circumstances and only with CUB's prior approval:
 - i. In roadways and other traffic-bearing areas the minimum cover in roadways may be reduced to 48 inches for PVC pipe and 36 inches for ductile iron pipe.
 - ii. In non-traffic areas the minimum cover may be reduced to 30 inches for either PVC or ductile iron pipe.

⇒ Maximum depth for standard SDR 35 PVC pipe is 10 feet. However, if the pipe has been installed with a fully compacted gravel envelope to 6-inches above the top of the pipe, the maximum depth allowed is 12 feet. Depths greater than 12 feet will generally require PROTECTO401-lined ductile iron pipe and shall only be as approved by CUB.

5. Slope

⇒ All sewers shall be so designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second. The minimum recommended slopes for 8-inch through 12-inch sewer mains are shown below. However, slopes greater than these are desirable and therefore these minimum slopes should be used only when required and then only as approved by CUB. All sewers shall be laid with uniform slope between manholes.

SEWER SIZE	RECOMMENDED MINIMUM SLOPE
6-inch	0.60 feet per 100 feet
8-inch	0.40 feet per 100 feet
10-inch	0.30 feet per 100 feet
12-inch	0.25 feet per 100 feet

⇒ Maximum slope allowed for any sanitary sewer pipe is 16%. However CUB may allow the slope of a sewer line to be constructed in excess of 16% if the line is constructed of CUB-approved mechanical joint, lined Ductile Iron Pipe with concrete anchors at each joint or as otherwise specified by CUB.

6. Alignment

⇒ Sewers shall be designed with straight alignment between manholes. No deflection at joints, even those “allowed” by pipe manufacturers, will be permitted.

7. Increasing Sizes

⇒ When a smaller sewer pipe joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient through the connection.

8. High Velocity Protection

⇒ When special circumstances may required, and only if approved by CUB, lined Ductile Iron Pipe may be used whenever slopes are greater than the following:

SEWER SIZE	MAXIMUM SLOPE
8-inch	16%
10-inch	13%
12-inch	9%

⇒ Sewers larger than 12-inches in diameter shall be designed in compliance with latest TDEC-WPC standards.

- i. Where the slope of a sewer line is in excess of 10%, ‘trench check dams’ shall be constructed at 100 linear foot intervals, or more frequently if required by CUB, to prevent water from following the ditch line of the sewer line and causing washout. Such dams shall be constructed of Bentonite clay materials, unreinforced concrete, flowable fill, or other impervious material as shown on Standard

Detail Drawing. They shall be keyed into the sides of the ditch line during construction to prevent water traveling around the dam. Dams of clay shall be a minimum of 18 inches in thickness. Forms shall be used in the construction of concrete or flowable fill dams. Concrete or flowable fill check dams shall be a minimum of 8 inches but no more than 12 inches in thickness, and shall be formed and supported from the bottom of the trench so as not to impart any weight on the sanitary sewer pipe.

9. Bedding, encasements, other requirements for protection of pipe:

- ⇒ All sewers shall be designed to prevent damage from superimposed loads. Proper allowances for loads on the sewer shall be made because of the width and depth of the trench.
- ⇒ As a general rule, ductile iron pipe and/or concrete encasement shall be used in roadways where cover is less than 4 feet, or in open areas where cover is less than two and one-half feet.
- ⇒ Ductile iron pipe shall be required when sewer installation occurs in areas of non-virgin soil, such as areas of fill. Piers shall be provided when necessary for support, and only as allowed by CUB. For structural reasons, ductile iron pipe, concrete encasement, or relocation shall be required when culverts or other conduits are laid such that the top of the sewer pipe is less than 18 inches below the bottom of the culvert or other conduit.
- ⇒ Ductile iron pipe shall be used beneath waterways which have a continuous flow of water. Concrete encasement shall be provided when joints on the ductile iron pipe are located beneath waterways, or as directed by CUB.

10. Joints and Infiltration

- ⇒ Sewer joints should be designed and constructed to prevent infiltration and the entrance of roots.

PART 7. TYPICAL DESIGN ELEMENTS OF WASTEWATER COLLECTION MANHOLES

The work to be performed shall consist of the installation of wastewater lines according to this edition of CUB's *Standard Specifications for the Construction of Water and Sewer Utilities* and Detail Drawings contained therein or later edition which may be in place at the time of bidding or construction.

1. Location:

- ⇒ The maximum spacing between manholes shall be 300 feet.
- Manhole shall be installed at the upper end of each collection sewer line, at all changes in grade, at points of changes in size, at all pipe intersections, and at distances not greater than 300 feet.

2. Drop Manholes:

- A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert.
- Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, but greater than 3 inches, the invert should be u-shaped to prevent deposition of solids.

3. Diameter:

- The minimum inside diameter of manholes shall be 48 inches.
- The entrance tube shall be at least 24 inches in diameter (inside dimension).

4. Invert flow angle:

- The minimum angle of a pipe invert with flow coming into the manhole shall be 90-degrees from the outlet pipe invert. When it is impossible to obtain this angle, the inlet pipe must be a drop, splash or constructed invert above the flow channel installed in a manner that does not inhibit normal flow through the manhole.

PART 8. TYPICAL DESIGN ELEMENTS OF WASTEWATER LIFT/PUMPING STATIONS

1. IN GENERAL

- Subdivisions and commercial/industrial development sites shall be laid out so that all wastewater collection system mains will be gravity flow wherever possible. If the use of a wastewater pumping station is approved by CUB, the station shall be connected to CUB's SCADA system (see Part 8, Item 2. SCADA below).
- Typically CUB accepts only lift stations or pump stations with all equipment accessible for maintenance above ground, either by lifting pumps and motors out of the wet well (submersible) or pad mounted stations (suction lift) with approved housing. In special circumstances, CUB may consider other designs.
- Wet wells shall be constructed from precast reinforced concrete, with precast reinforced concrete tops and monolithic bases. Wet wells shall be designed and installed to be watertight. Concrete ballast shall be designed and installed to prevent the wet well from floatation when it is void of any water or equipment. Double-door aluminum access hatches, with lockable and spring-assisted doors, shall be installed in the wet well top and valve vault top. All metal components to be installed in the wet wells shall be stainless steel, Grade 304 or better.
- Acceptable submersible designs must be of a non-clog type and be able to pass a 3-inch solid. Grinder type pumps are typically only allowed for individual users connecting to a low pressure sewer system, but may be considered in special circumstances and then only on a case-by-case basis.
- Unless specifically exempted, the design and construction of all lift and pump stations (other than individual grinder pump installations) shall

include a paved driveway, minimum 8-foot high chain-link fence enclosing the site with a minimum 12-wide twin-leaf gate and a permanent potable water supply.

- Station site piping shall include a “bypass connection”, located outside the pump/control equipment housing and on the station’s discharge (force main), which includes: a check valve, header piping terminating with male OPW-type quick-connect fittings which will match CUB’s bypass pump’s hose fittings all in a pre-cast concrete box with a lockable and water-tight cover that will provide CUB with easy access to operate the check valve and connect/disconnect CUB’s bypass pump hose to the header piping.
- All lift and pump stations shall have a minimum of two pumps, each of which are capable of handling the total rated design capacity of the pumping station at build-out of station’s service area.
- All electrical equipment must conform to the latest AIEE and NEMA standards and must have UL approvals. The control panel and station operations software shall be similar to other pumping station control units CUB has in service or as otherwise approved by CUB.

2. SCADA

- SCADA equipment, manufactured by TELOG, Model #3314 with “data logger” and telephone-ready modem, shall be furnished and installed at each new pumping station. SCADA equipment shall have, at a minimum, inputs/outputs for wet well level, pump run times, pump high temperature alarms, high and low wet well alarms and loss of power and the ability to call out over a telephone line to a CUB pager to report specific alarms. SCADA equipment shall be installed complete and ready to operate and communicate via a telephone line. Contractor is not responsible for obtaining telephone service to the station or to the SCADA equipment.
- Where pumping stations are required, information shall be submitted to CUB for review and approval including but not limited to:
 - i. Vicinity maps showing pumping station location
 - ii. Station site drawings showing configuration and proposed connections to the public wastewater collection system, electric service connections, potable water service, fencing, grading, etc.
 - iii. Survey description of site owned or to be purchased for dedication, by metes and bounds
 - iv. Pump and motor manufacturer,
 - v. Pump Curves,
 - vi. Details of motors and gearing systems,
 - vii. Details of motor control centers,
 - viii. Pump Station Design details,

- ix. Construction Drawings showing plan and profile of station including wet well, pumps on/off and alarm levels, concrete details, pipe connection details, etc. and
- x. Name, location, address and telephone number of parts supplier

3. FORCE MAIN PIPING

- The minimum wastewater main size pipe shall be as necessary to provide to maintain a minimum “flushing” velocity of 3 feet per second
- The size of pipe shall be determined by pumping station design flows, and these flows shall be determined by a qualified Engineer who holds a valid license to practice in the State of Tennessee.
- All assumptions and any flow data used by the design engineer must be clearly documented and submitted with the pumping station submittal. Pumping station design shall take into consideration the initial low flows during construction up through build-out, and shall have means of maintaining “flushing” velocities of 3 feet per second throughout the entire development schedule, including initial construction periods.
- Shall be designed to minimize the need for air vacuum and air release valves but, when such valves are necessary, to provide an adequate number and locations of air vacuum and air release valves to ensure best and most efficient operation and performance of the pumping station and force main piping.

PART 9. PROTECTION OF WATER SUPPLIES

- ⇒ There shall be NO physical connection between a potable water supply line and a sewer or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply.
- ⇒ Horizontal separation: Sewer should be installed at least 10 feet from any existing or proposed water pipe. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer to the water main if
 - i. It is installed in a separate trench, and
 - ii. The elevation of the top of the sewer pipe is at least 18 inches below the bottom of the water pipe.
- ⇒ Vertical separation: Whenever a sewer must cross under a water main, the sewer shall be installed at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot meet the above requirement, the water main shall be relocated to provide the separation or reconstructed with ductile iron pipe for a minimum distance of 10 feet on each side of the crossing sewer pipe. At least one full length of water main should be centered over the sewer so that both joints shall be as far from the sewer as possible.

- i. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water and sewer mains shall be constructed to water pipe standards (see Section 01000 and 03000 of these Standards) and shall be pressure-tested to assure water-tightness.

PART 10. PROJECT COMPLETION AND CLOSE-OUT

1. Prior to CUB's final acceptance of wastewater collection system extensions, improvements or other new construction, and prior to CUB taking over the improvements for ownership and maintenance:

- Upon completion of the project work, the Design Engineer shall prepare detailed plans to reflect As-Built information. Two copies of correct and accurate As-Built Drawings and Plans shall be submitted to CUB as follows:
 - i. One hardcopy on 24-inch by 36-inch reproducible mylar sheets, and
 - ii. One electronic copy on compact disc (CD) or DVD in digital format compatible with CUB's mapping system software.
- Owner or Developer shall obtain and record all easements, rights-of-way and land acquired for the particular project work that CUB has determined is necessary for project components that are to be conveyed to CUB for CUB's ownership and maintenance. Owner or Developer shall submit to CUB copies of all recorded deed, easement and right-of-way documents that have been required and obtained during the construction of the project work.
- Upon completion, start-up and final acceptance of pumping stations and other stations with specialized equipment to be conveyed to CUB for CUB's ownership and maintenance, Owner/Developer or his Design Engineer shall submit to CUB the following:
 - i. Four (4) sets of "Installation Requirements", "Owner's Manual" and "Operating Manual" for each booster pumping station, pressure-reducing valve station, and specialized equipment station installed.
 - ii. Manufacturer's Warranty and information
 - iii. Complete Parts listing with exploded parts diagram(s)
 - iv. Specifics on paint systems used
 - v. Wiring diagrams and other pertinent information
 - vi. All PLC details including Ladder Logic in written form and included on a CD or DVD

END OF SECTION

SECTION 01200

FIELD ENGINEERING

PART 1. GENERAL

The CONTRACTOR (or OWNER/DEVELOPER) shall provide all field engineering services and establish grades, lines, and levels, by use of recognized engineering survey practices. CONTRACTOR will be responsible for all staking including benchmarks for survey reference, and for resetting all staking as may be required due to damage from construction activities or vandalism.

PART 2. PRODUCTS - not used

PART 3. EXECUTION

3.1 INSPECTION

If survey control points are provided by CUB, the CONTRACTOR shall verify the locations of survey control points prior to starting work and promptly notify CUB of any discrepancies discovered. Otherwise, CONTRACTOR will be responsible for setting survey control points prior to starting work.

3.2 SURVEY REFERENCE POINTS

- A. The CONTRACTOR shall protect any existing survey control points prior to starting site work and preserve permanent reference points during construction, and will make no changes without prior written notice to CUB.
- B. The CONTRACTOR shall promptly report to CUB the loss or destruction of any reference point or relocation required because of changes in grades or other reasons. CUB will determine who will be responsible for the replacement of such dislocated survey control points based on original survey control.
- C. The CONTRACTOR shall preserve all USGS, TVA, State of Tennessee, TDOT, and private markers; do not remove or disturb any such markers without prior approval from CUB. Any removal and replacement of such markers shall be at the expense of the CONTRACTOR. The re-establishment of these markers shall be performed by a surveyor licensed to practice surveying in the State of Tennessee, with a letter indicating the completion of work sent directly to CUB's Director-Water and Sewer.

3.3 STAKING

The CONTRACTOR shall be responsible for staking the project and preparing cut sheets as needed for construction.

END OF SECTION

SECTION 01300

TESTING LABORATORY SERVICES

PART 1. GENERAL

1.1 SELECTION AND PAYMENT

- A. CONTRACTOR shall employ and pay for services of an independent testing laboratory, which has been approved in advance by CUB, to perform specified inspection and testing. Such testing shall be subject to the approval of CUB.
- B. Employment of testing laboratory shall in no way relieve CONTRACTOR of obligation to perform work in accordance with requirements of Contract Documents.
- C. If CUB requires a retest because of non-conformance to specified requirements, the tests shall be performed by the same independent firm based on instructions by CUB. Payment for such retesting will be charged to the CONTRACTOR by deducting inspection or testing charges from the Contract Sum or Unit Price Bid.

1.2 CONTRACTOR'S RESPONSIBILITIES

- A. CONTRACTOR shall submit proposed concrete mix design to CUB for approval prior to construction.
- B. CONTRACTOR shall deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing.
- C. CONTRACTOR shall cooperate with laboratory personnel, and provide access to the WORK and IMPROVEMENTS and to manufacturer's facilities as may be necessary.
- D. CONTRACTOR shall provide incidental labor and facilities to allow access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, and to facilitate tests and inspections, storage and curing of test samples.
- E. CONTRACTOR shall notify CUB and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

PART 2. PRODUCTS – Not used

PART 3. EXECUTION – Not Used

END OF SECTION

SECTION 01400

EROSION CONTROL

PART 1. GENERAL

Federal, state and local governments have passed laws and regulations to address the problem of polluted runoff. Phase I EPA storm water regulations initiated a national storm water permitting program in 1990 that applied to industrial activities, to construction sites of five acres or more and to urban runoff from larger cities. Phase II regulations in 1999 address additional urbanized areas, certain cities with population over 10,000, and construction activities of one to five acres.

The Tennessee Department of Environment and Conservation, Division of Water Resources implements the EPA Phase I and Phase II regulations in Tennessee.

Unless otherwise specified, Owner/Developer or CONTRACTOR shall be responsible for erosion control and slope stabilization relative to the construction of water and/or wastewater system improvements in accordance with the requirements of the Tennessee Department of Environment and Conservation, Division of Water Resources and the EPA Phase I and Phase II regulations. As such, Owner/Developer or CONTRACTOR shall be responsible for installation and maintenance of all necessary temporary and permanent control measures during the life of the Contract to address and control erosion and pollution created by run-off from the project work site(s). Such measures may include, but not be limited to: berms, dikes, dams, sediment basins, fiber matts, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.

1.1 DESCRIPTION

- A. This work shall consist of erosion control on all cut and fill operations, excavation, backfill, or other construction activities within the limits of the construction site, within any temporary or permanent easements, and within any borrow site used during the period of construction. The protection of these sites shall continue throughout the construction period. During flood seasons, protect the sites by sandbagging, pumping water, and any other means appropriate to restrain flooding of sites, materials and equipment. During dry weather, sprinkle the sites with water and/or other means as necessary to provide dust control. In case of abnormally cold weather, any construction such as excavation work may need to be delayed until warmer weather or covered to prevent freezing. Such delay shall be approved in advance and in writing by CUB prior to CONTRACTOR's receiving permission to delay the WORK and IMPROVEMENTS so affected.
- B. Temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features and to ensure economical, effective, and continuous erosion control throughout the construction and post-construction period.

- C. Agencies may require a written plan to ensure that PL 100-4, Section 319, TCA 69-3-101, et. seg., Subsection 69-3-108 and Subsection 69-3-114, and, if applicable, Division of Construction Grants and Loans General Permit for Utility Line Crossings, Chapter 400-4-7.09 are met. Since Owner/Developer or CONTRACTOR is responsible for the construction means and methods which in turn are responsible for ensuring that construction does not harm the Waters of Tennessee, CONTRACTOR is solely responsible for ensuring that the above-mentioned laws and regulations are met.

PART 2. PRODUCTS

2.1 TEMPORARY BERMS

These berms are used temporarily at the top or base of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

2.2 TEMPORARY SLOPE DRAINS

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

2.3 SEDIMENT STRUCTURES

Sediment basins, ponds, and traps shall be designed and constructed to operate as effective areas to trap and store sediment from erodible areas and to protect properties and stream channels below the construction areas from siltation.

2.4 CHECK DAMS

Check dams are shall be designed and constructed barriers composed of large stones, sand bags, or other non-corrodible materials placed across or partially crossing a natural or constructed drainway.

2.5 TEMPORARY SEEDING AND MULCHING

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

2.6 BALED HAY OR STRAW CHECKS

- A. Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing 5 cubic feet or more of material and must be securely installed in place.

- B. Baled hay and/or straw checks shall be used where the existing ground slopes toward or away from the embankment along the toe of slopes, in ditches, or other areas where siltation erosion or water runoff is a problem.

2.7 TEMPORARY SILT FENCES

Silt fences are temporary sediment barriers consisting of a filter fabric stretched across and attached to supporting posts and entrenched. The silt fence shall be constructed of synthetic filter fabric, posts, and depending upon the strength of the fabric used, wire fence for support. The filter barrier is constructed of stakes and burlap or synthetic filter fabric. These fences are to be designed with adequate size and height to prevent overtopping of silt-laden water and securely installed in place.

PART 3. EXECUTION

3.1 PROJECT REVIEW

It is the responsibility of the Owner/Developer or CONTRACTOR (hereinafter simply referred to as “CONTRACTOR”) prior to any construction activities, to develop an erosion control plan acceptable to all applicable regulatory agencies. If at any time such regulatory agency(s) (or CUB) determines it to be necessary to do so, the CONTRACTOR shall provide additional erosion devices. The site shall be provided with maximum protection from erosion at all times.

3.2 CONSTRUCTION REQUIREMENTS

- A. In the event of conflict between these requirements and pollution control laws, rules or regulations, or other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.
- B. In streets and other paved areas, CONTRACTOR shall remove excavated material from the site as construction progresses to prevent any erosion of this material. In other areas, CONTRACTOR shall place the excavated material so as not to block any drainage area.
- C. CONTRACTOR shall replace excavated material in the trench immediately after work has been completed and after work has been approved by CUB.
- D. CONTRACTOR shall protect and retain natural vegetation whenever feasible.
- E. CONTRACTOR shall restore and cover exposed areas subject to erosion as quickly as possible by means of seeding and mulching, and shall use diversion ditches or other methods as appropriate to prevent storm water from running over the exposed area until seeding is established as specified. Fiber matting may be necessary as required by CUB.
- F. CONTRACTOR shall take particular care along streams and drainage ditches so that fallen trees, debris, and excavated material will not adversely affect the

stream flow, and shall exercise care to minimize the destruction of stream banks. Wherever the stream banks are affected by construction, CONTRACTOR shall reduce the slope of the stream banks to provide a suitable condition for vegetative protection and minimize land exposure in terms of area and time.

- G. CONTRACTOR shall take particular care during the placing of concrete, hauling of materials, etc., to keep vehicles from creating an erosion problem and from tracking mud out onto public streets and rights-of-way. Proper scheduling of operations and prompt repair of ruts created during this operation is necessary.
- H. CONTRACTOR shall pave or otherwise stabilize roadways and driveways as soon as feasible.

3.3 CONSTRUCTION OF STRUCTURES

A. Design and Construction of Temporary Berms

1. The maximum allowable drainage area per affected site is 5 acres.
2. The minimum allowable height measured from the upslope side of a dike is 18 inches.
3. Side slopes shall be 1.5:1 or flatter. (Minimum base width = 4.5 feet).
4. The channel behind the dike shall have a positive grade to a stabilized outlet. If the channel slope is less than or equal to 2 percent, the channel shall be stabilized.

B. Design and Construction of Temporary Slope Drains

1. Temporary slope drains shall consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water accumulating in the cuts and on the fills down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.
2. Fiber matting and plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.
3. All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain. Energy dissipaters, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipater would be dumped rock or a small sediment basin, which would slow the water as well as pick up some sediment. All temporary slope drains

shall be removed when no longer necessary and the site restored to match the surroundings.

C. Design and Construction of Sediment Structures

1. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. To facilitate cleanout, the pool area should be cleared.
2. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 8-inch layers by traversing with construction equipment.
3. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
4. The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.
5. All cut and fill slopes shall be 2:1 or flatter.

D. Design and Construction of Check Dams

1. Check dams shall be utilized to retard stream flow or restrict stream flow within the channel. Check dams can be constructed of either stones or logs.
2. All check dams shall be keyed into the sides and bottom of the channel. A formal design is not needed for check dams; however, the following criteria should be adhered to when specifying check dams.
 - a. The maximum height of the check dam shall be as shown on the Standard Detail Drawings or as otherwise approved by CUB. The center of the dam must be at least 6 inches lower than the outer edges.
 - b. Stone check dams should be constructed of 2 to 3-inch stone.
 - c. Log check dams should be constructed of 4 to 6-inch logs. The logs should be embedded into the soil at least 18 inches.

E. Temporary Seeding and Mulching

Seeding and mulching shall be performed in accordance with Section 07100, Seeding.

F. Baled Hay, or Straw Erosion Checks

Hay or straw bales for erosion checks shall be embedded in the ground 4 to 6 inches to prevent water from flowing under them. The bales shall also be anchored securely to the ground by at least two wooden stakes driven through each bale into the ground. Bales can remain in place until they rot,

or be removed after they have served their purpose, as determined by CUB. The CONTRACTOR shall keep the check in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris cleanout will be considered Contractor's required routine maintenance.

G. Design and Construction of Temporary Silt Fences

1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem and designed to keep most silt from leaving the site.
2. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier.
3. Burlap shall be 10-ounce per square yard fabric.
4. Posts for silt fences shall be either 4-inch diameter wood or 1.33 pounds per linear foot steel with a length of 5 feet. Steel posts shall have projections for fastening wire to them.
5. Stakes for filter barriers shall be 11 feet x 2 inch square wood (preferred) or equivalent metal with minimum length of 3 feet.
6. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14-gauge and shall have a maximum mesh spacing of 6 inches.
7. The height of a filter barrier shall be a minimum of 15 inches and shall not exceed 18 inches.
8. The stakes shall be spaced a maximum of 3 feet apart at the barrier location and driven securely in to the ground (minimum of 8 inches).
9. A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of stakes and upslope from the barrier.
10. The filter material shall be stapled to the wooden stakes, and 8 inches of the fabric shall be extended into the trench. Heavy duty wire staples at least 1/2-inch long shall be used. Filter material shall not be stapled to existing trees.
11. The trench shall be backfilled and the soil compacted over the filter material.
12. The CONTRACTOR shall be required to maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by CUB. In some cases, silt accumulation at the fence may be left in place and seeded, removed, etc., as directed by CUB. The silt fence becomes the property of the CONTRACTOR whenever the fence is removed.

3.4 MAINTENANCE

The temporary erosion control features installed by the CONTRACTOR shall be maintained by the CONTRACTOR until no longer needed or permanent erosion control methods are installed. When the areas disturbed by CONTRACTOR's activities have been reseeded, paved, etc. to the point where erosion is no longer a treat, the temporary erosion control materials shall be removed by CONTRACTOR and become the property of the CONTRACTOR.

3.5 EROSION CONTROL OUTSIDE PROJECT AREA

Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow, pit operations, haul roads, and equipment storage sites.

3.6 PAYMENT

Unless otherwise noted and included in the Bid Form, all costs associated with installing, maintaining and removal of erosion control devices in accordance with these documents and the requirements of the State of Tennessee's TDEC-WPC, the EPA and/or local agencies shall be incidental to the cost of performing the WORK and IMPROVEMENTS of this contract and shall not be an considered an additional expense to CUB.

END OF SECTION

SECTION 01500

CONTROL BLASTING

PART 1. GENERAL

This section covers the method, responsibilities, and required protection techniques for blasting. Control blasting operations of CUB project sites may be allowed when other methods of rock removal are determined to be ineffective and then only if approved by CUB prior to CONTRACTOR performing any such operation.

In order to perform control blasting on CUB projects, CONTRACTOR, and/or his subcontractor who will be performing the control blasting, must have a valid and current "Explosive Blaster License", issued by the State Of Tennessee, Department of Commerce & Insurance, Division of Fire Prevention, Administrative Services Section, Permits and Licenses Unit, 500 James Robertson Parkway, Third Floor, Nashville, TN 37243-1159, Phone (615) 741-1322.

PART 2. PRODUCTS – not used

PART 3. EXECUTION

3.1 PRE-BLAST SURVEY AND BLAST MONITORING

- A. The CONTRACTOR shall conduct a pre-blast survey of the surrounding structures within 300 feet of any blasting operation and document their condition before any blasting begins. The documentation shall include written descriptions, photographs of all structures, pavements, other rigid improvements that could possibly be affected by control blasting operations, and measures of obvious signs of structural distress such as cracks.
- B. Gauge marks will be located over existing cracks at selected locations to be measured before and after blasting to determine if widening or displacement has taken place.
- C. Before carrying out the inspection, the CONTRACTOR shall notify the owners of the buildings or structures to be inspected and request permission to carry out the inspection. Should any building owner refuse permission to carry out this inspection, the CONTRACTOR shall notify CUB in writing, giving CUB the owner's reason for refusal.
- D. CUB reserves the right to require the CONTRACTOR to monitor all blasts by an approved method and/or by a subcontractor at the CONTRACTOR'S expense. Vibration monitoring may be required in certain areas, as directed by CUB.

3.2 SAFETY

- A. Blasting shall be conducted in conformance with all local and state safety codes. The CONTRACTOR shall secure at his own expense all required blasting permits and additional hazard insurance.
- B. The CONTRACTOR shall cover the blasting area with enough excavation material and/or matting to prevent danger to lives and property.
- C. It is the sole responsibility of the CONTRACTOR to properly handle, use, and store explosives. Any damages to persons or property as a result of blasting operations are the responsibility of the CONTRACTOR.

3.3 RECORD-KEEPING

- A. The CONTRACTOR shall provide an itemized blasting log to CUB on a daily basis.
- B. A CUB representative shall be present during all blasting operations.

3.4 BLASTING LIMITS

- A. The CONTRACTOR shall avoid shattering rock beyond the required limits of the trench or excavation.
- B. Charge holes shall be properly located and drilled to the correct depth for the charges used.
- C. Charges shall be limited in size to permit reasonable removal of material by excavating equipment. "Over-break" effects shall be corrected by removing the broken rock and replacing it with approved material.

3.5 PAYMENT

Unless otherwise noted or included in the Bid Form, all costs associated with BLASTING shall be incidental to the installation of the WORK and IMPROVEMENTS included in this contract and shall not be an additional expense to CUB.

END OF SECTION

SECTION 01600

UNCLASSIFIED EXCAVATION AND BACKFILLING

PART 1. GENERAL

The work called for by this section shall consist of clearing and grubbing, loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction purposes; furnishing, placing, and maintaining all sheeting, shoring, bracing and timbering necessary for the proper protection and safety of the work, the workmen, the public and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe beds; the backfilling and tamping of trenches, foundations and other structures; the preparation of fills and embankments; the removal of unsuitable material from outside the normal limits of excavation and, where ordered by CUB, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the work. This work shall be performed as specified below.

PART 2. PRODUCTS – not used

PART 3. EXECUTION

3.1 UNSUITABLE MATERIALS

Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, pipe bedding, or backfilling is encountered the material shall be removed and excavation (“over-excavation”) continued until suitable material is encountered. The material removed shall be disposed of in the manner described below. Areas excavated for this reason shall then be refilled with crushed stone up to the level of the lines, grades, and/or cross sections shown on the construction drawings. This refill shall be No. 67 (TDOT) crushed stone (also known as 3/4-inch clean stone) for bedding, as specified later in these specifications. This work shall be considered incidental to the project, and no additional payment shall be allowed.

3.2 ROCKS AND BOULDERS

- A. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling and/or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements, and/or similar material shall be considered as unclassified excavation, and no separate payment will be made.
- B. Should rock be encountered in the excavation, it shall be removed by blasting or otherwise. The CONTRACTOR shall secure, at his own expense, all permits required by law for blasting operations and the additional hazard

insurance required. The CONTRACTOR shall observe all applicable laws and ordinances pertaining to blasting operations and perform work in accordance with Section 01500 – Control Blasting of these Standards.

- C. Rock shall be excavated over the horizontal limits of excavation and to a depth of not less than 6 inches below the outside bottom of pipe. The space shall then be backfilled with No. 67 (TDOT) crushed stone (3/4-inch clean stone) or other CUB-approved material, tamped and brought up to the proper grade and made ready for construction.
- D. This work shall be considered incidental to the project, and no additional payment shall be allowed.

3.3 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 construction drawings or directed by CUB shall be used for these purposes. Any materials not so used shall be considered waste materials and disposed of by the CONTRACTOR as specified below.
- B. Once any part of the work is completed, the CONTRACTOR shall properly dispose of all surplus or unused materials (including, waste materials) left within the construction limits of that work. The CONTRACTOR is solely responsible for the removal, hauling, and disposal of waste materials. The CONTRACTOR is responsible for locating disposal sites and for obtaining all related permits from the site property owner and any agency having jurisdiction. CUB shall not be liable for improper disposal of waste materials. The CONTRACTOR shall leave the surface of the work in a neat and workmanlike condition.
- C. The disposal of waste materials shall be considered an integral part of the excavation work and one for which no separate payment shall be allowed.

3.4 EXCAVATION FOR TRENCHES, PITS, MANHOLES AND OTHER STRUCTURES

- A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of water, sewer, and other pipes and their appurtenances (including manholes, inlets, outlets, headwalls, collars, concrete saddles, and pipe protection) that are called for by the construction drawings. Unclassified excavation shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these Standard Specifications.
- B. CONTRACTOR may, if he chooses, use a motor powered trenching machine. CONTRACTOR shall be fully responsible for the preservation or repair of any damages to existing utility lines and/or service connections caused by his work or the work of his subcontractors or suppliers.

- C. Unless the construction of lines by tunneling, jacking, directional drilling or boring is called for by the construction drawings or specifically authorized by CUB, excavation for pipelines shall be made by open cut and true to the lines and grades shown on the construction drawings or established by CUB on the ground. The banks of trenches shall be cut between vertical parallel planes equidistant from the pipe centerline. The horizontal distance between the vertical planes (or, if sheeting is used, between the inside faces of that sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance determined by the following formula: $4/3d + 15$ inches, where "d" represents the internal diameter of the pipe in inches. When approved in writing by CUB, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to non-vertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline in accordance with the formula given above. Any cut made in excess of the formula $4/3d + 15$ inches shall be at the expense of the CONTRACTOR and may be cause for CUB to require that stronger pipe and/or a higher class of bedding be used, and all at no additional cost to CUB.
- D. Excavation for manholes and other structures may be performed with non-vertical banks except beneath pavements or adjoining existing improvements. Excavation for manholes and other incidental structures shall not be greater in horizontal area than that required to allow a 2-foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the construction drawings. No earth backfilling will be permitted under manholes, or other such structures. Should the CONTRACTOR excavate below the elevations shown or specified, he shall, at his own expense, fill the void to grade with either concrete or granular material as approved by CUB.
- E. Pipe trenches shall not be excavated more than 200 feet ahead of the pipe laying and work shall be performed so as to cause the least possible inconvenience to the public. Temporary bridges or crossings shall be constructed when and where CUB deems necessary to maintain vehicular or pedestrian traffic.
- F. In all cases where materials are deposited along open trenches, the material shall be placed in accordance with OSHA requirements and so that in the event of rain no damage will result to the work and/or to adjacent property.

3.5 EXCAVATION, TRENCHING AND TUNNELING NEAR TREES

- A. CONTRACTOR shall take special care to avoid damage wherever excavation, trenching and/or tunneling is being performed near trees or large bushes. Where excavation by machinery would endanger trees, bushes, service lines, utilities mains or structures which otherwise might be saved by the use of hand excavation, the pipe trench shall be excavated by hand.

- B. Were underground utility work will be conducted near trees, the practices listed below and as described in “Trenching and Tunneling Near Trees: A Field Guide for Qualified Utility Workers” by Dr. James R. Fazio shall (should) be followed. A copy of this field guide may be obtained from CUB.
1. Techniques that maximize the protection of tree roots will be utilized.
 2. When space allows, utility trenching will be routed outside the dripline of existing trees.
 3. When a root two inches in diameter or larger is accidentally or unavoidably cut, it will be sawed flush with the tree side of the trench.
 4. Whenever possible, soil from a trench will be piled on the side of the trench farthest from the tree. Soil that must be piled within a tree’s dripline and on the side of the trench closest to the tree will be placed on plywood or a 4-inch bed of organic mulch such as wood chips.
 5. Trenches will be refilled as quickly as possible and compacted to no more than their original firmness. Backfill will be kept free of oil cans, wood scraps, chemicals and other waste or debris.
 6. Backfilled soil will be watered as soon as the backfilling operation is completed.
 7. Trenching will be avoided (by tunneling or re-routing) within the dripline of any tree six inches DBH (diameter at breast height or 4.5 feet above ground) or smaller.
 8. For trees over six inches DBH, tunneling will replace trenching as described in aforementioned field guide by Dr. Fazio.

3.6 SHEETING, SHORING, AND BRACING

- A. CONTRACTOR shall take special care to avoid damage wherever excavation is being done, and shall sufficiently sheet, shore, and brace the sides of all excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage. Separate payment will not be made for sheeting, shoring, and bracing, which are considered an incidental part of the excavation work.
- B. Wherever employees may be exposed to moving ground or cave-ins, CONTRACTOR shall shore and lay back exposed earth excavation surfaces more than 5 feet high to a stable slope, or else provide some equivalent means of protection. CONTRACTOR shall effectively protect trenches less than 5 feet deep when examination of the ground indicates hazardous ground movement may be expected, and shall guard the walls and faces of all excavations in which employees are exposed to danger from moving ground by a shoring system, sloping of the ground, or some equivalent protection.

- C. CONTRACTOR shall comply with all OSHA and TOSHA standards in determining where and in what manner sheeting, shoring, and bracing are to be designed and constructed.
- D. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, CONTRACTOR shall take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. Wherever considered necessary, and with the approval of CUB, CONTRACTOR shall underpin adjacent structures.
- E. Sheeting, shoring, or bracing materials shall not be left in place unless this is called for by the construction drawings, ordered by CUB, or deemed necessary or advisable for the safety or protection of the new or existing work or features. CONTRACTOR shall remove these materials in such a manner that the new structure or any existing structures or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.
- F. All holes and voids left in the work by the removal of sheeting, shoring, or bracing shall be filled and compacted as specified herein.
- G. A trench box may be used, provided it is a prefabricated movable trench shield which has been designed and constructed to provide protection equal to or greater than that of any other OSHA-approved trench shoring system.

3.7 THE DEWATERING OF EXCAVATION

CONTRACTOR shall provide and keep in operation enough suitable pumping equipment whenever necessary to keep the trench or excavation dewatered, or whenever directed to do so by CUB. CONTRACTOR shall give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift.

3.8 BORROW EXCAVATION

- A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations, or whenever the backfill material from such excavations is unsuitable, then CONTRACTOR shall obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, CONTRACTOR shall make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material. Before a borrow pit is opened, the quality and suitability of its material shall be approved by CUB. All state and local regulations concerning borrow pits, drainage and erosion control shall be strictly followed.
- B. Borrow pits shall be excavated in such a way that the remaining surfaces and slopes are reasonably smooth and that adequate drainage is provided over the

entire area. Drainage ditches shall be constructed wherever necessary to provide outlets for water to the nearest natural channel, thus preventing the formation of pools in the pit area, and in accordance with Section 01400 – Erosion Control of these Standards. The sides of borrow pits shall be left at a maximum slope of 2:1 unless otherwise directed by CUB.

- C. Properly clear and grub borrow pits, and remove all objectionable matter from the borrow pit material before placing it in the backfill.
- D. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work, and no separate payment shall be made.

3.9 PIPE BEDDING

- A. Bedding for PVC pipe shall consist of a 6-inch envelope of No. 67 (TDOT) crushed stone (3/4-inch clean stone) on all sides of the pipe being installed on this project. Pipe bedding shall be thoroughly and completely tamped before placing any further backfilling materials. The crushed stone envelope shall not be required on 2-inch PVC water line installations, except where unsuitable materials or rock are encountered and as determined by CUB.
- B. Bedding for rigid pipe used on sewer installations shall consist of a 6-inch bedding of No. 67 (TDOT) crushed stone (3/4-inch clean stone) beneath the pipe and up to the center line of the pipe. Pipe bedding shall be thoroughly and completely tamped before placing any further backfilling.
- C. In general, crushed stone bedding will not be required for rigid pipe used on water line installations. However, where unsuitable materials or any rock are encountered within six-inches of the bottom or either side of the pipe crushed stone bedding shall be as required for rigid pipe on sewer installations.
- D. The bedding material shall be shaped for bell and spigot pipe at proper intervals to provide uniform bearing under the entire length of the pipe.

3.10 GENERAL BACKFILLING METHODS

- A. Backfilling operations shall be performed so as not to disturb or injure any pipe and/or structure against which the backfill is being placed. If any pipe or structure is damaged and/or displaced during backfilling, the CONTRACTOR shall open up the backfill and make whatever repairs are necessary. This work shall be done at no cost to CUB.
- B. Backfilling and clean-up operations shall closely follow pipe laying. Failure to comply with this provision will result in CUB's requiring that the CONTRACTOR's other activities be suspended until backfilling and clean-up operations follow pipe laying more closely. In this event, extension of contract completion date will not be warranted.

- C. Backfilling operations around manholes and other structures shall be conducted in the same manner as specified above for pipelines except that even greater care is necessary to prevent damage to the utility structures.
- D. Consolidating by flooding will not be permitted under or adjacent to paved or unpaved traffic areas. If tests for in-place density consistently fail to meet the requirements, CUB may require the CONTRACTOR to change his method of compaction.
- E. No trash including bags, boxes, waste pipe or fitting materials, food wastes, paper, cans, etc. shall be allowed to be placed in any excavation or in any backfill material used on this project. CONTRACTOR shall collect and properly dispose of all waste materials and trash generated by or resulting from his or his employee's activities or the activities of his subcontractors, suppliers, etc.

3.11 BACKFILLING UNDER PAVEMENT

- A. Location: Edge of ditch line is located under roadways or other paved areas, or within 2 feet of the edge of pavement, or in any location where the excavating could result in a sloughing of the bank and subsequent failure of a paved area, sidewalk or curb/gutter.
- B. Limits of Backfill: From the top of the bedding envelope to the pavement subsurface. If the backfill is not directly under pavement, the top one-foot of backfill shall be restored to equal or better condition.
- C. The minimum requirements for backfill material shall be crushed stone, Class A Aggregate Grading D, as specified in the latest edition of Section 903 of the Tennessee Department of Highways, Standard Specifications for Road and Bridge Construction, (pug mix), placed in 8-inch lifts and compacted to 100% of the Standard Proctor Density at 2% less than the optimum moisture content as determined by AASHTO T99-81. However, backfilling must be conducted to the satisfaction of the agency having primary jurisdiction of the street or roadway in question. In locations where the paved area is maintained and/or controlled by more than one governing entity or agency (city, county, state, federal) the more stringent regulation(s) shall apply.

D. FLOWABLE FILL

1. In certain situations and conditions, where time is of the essence such as when it is paramount that the roadway be reopened to vehicular traffic as soon as possible, CUB may allow the use of "flowable fill" for backfill under asphalt pavement areas.
2. Flowable fill is a controlled, low-strength material to be used primarily as backfill and having a compressive strength of 150 psi or less. Flowable fill mixtures are usually comprised of a combination of cement, water, fine aggregate and fly ash or slag. They are generally

available, with sufficient advance notice or request, from Oak Ridge and/or Knoxville area ready-mix concrete producers/suppliers and delivered to the job site in standard ready-mix concrete trucks.

3. Flowable fill mixtures shall be carefully controlled by the ready-mix concrete supplier to ensure that under the particular conditions of the site to be backfilled the specific flowable fill mixture is designed and produced to harden within 3 to 5 hours of application and with an expected subsidence of 1/8 inch per foot of depth.
4. The agency with primary jurisdiction over the excavated/affected roadway will ultimately determine if flowable fill can be used for backfill, what the design specifications are to be for the flowable fill, the depth and manner in which the flowable fill is to be installed, when and how the final asphalt topping materials are to be installed, and when traffic can be allowed to travel over this backfilled and patched area.

3.12 BACKFILLING OUTSIDE OF PAVED AREAS

- A. Location: Edge of ditch line is located more than 2 feet from the edge of paved areas or in areas where sloughing of the bank is very unlikely and subsequent failure of a paved area, sidewalk or curb/gutter is not expected.
- B. Limits of Backfill: From the top of the bedding envelope to within one foot of the finished ground elevation. Within easement areas in yards, the top one-foot of backfill must be good topsoil, suitable for seeding. If not used as lawn, restore to equal “pre-construction” or better condition.
- C. Backfill material shall consist of either fine, loose earth like sandy soil or loam, or of granular material that is free from clods, vegetable matter, debris, stone, and/or other objectionable materials, and that has a size of no more than four inches. Backfill material shall be placed in maximum 12-inch lifts and compacted to 90% of its maximum density at $\pm 2\%$ of optimum moisture content as determined by the Laboratory Standard Proctor Test (ASTM D698 - latest revision). A tolerance of minus two percent (-2.0%) shall be allowed in the compaction effort.

3.13 MAINTENANCE

- A. CONTRACTOR shall maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by CUB or the lead agency in responsible charge of the area in question.
- B. CONTRACTOR shall maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by CUB or the lead agency in responsible charge of the area in question. CONTRACTOR shall continue such maintenance, including reseeded for an acceptable coverage of grass,

until final acceptance of the project or until CUB or the lead agency in responsible charge of the area in question issues a written release.

3.14 SLOPES

All open cut slopes shall be neatly trimmed and finished to conform either with the slope lines shown on the construction drawings or the directions of CUB. Leave the finished surfaces of bottom and sides in reasonably smooth and uniform planes like those normally obtainable with hand tools, though the CONTRACTOR will not be required to use hand methods if he is able to obtain the required degree of evenness with mechanical equipment. CONTRACTOR shall conduct grading operations so that material is not removed or loosened beyond the required slope.

END OF SECTION

SECTION 01700

TRAFFIC CONTROL AND REGULATION

PART 1. GENERAL

This section covers requirements for Traffic Control Plans and the proper and adequate placement of highway/roadway signs, signals, pavement markings, channelization devices, and other traffic control devices to ensure safe work zones.

PART 2. PRODUCTS – not used

PART 3. EXECUTION

3.1 SIGNS, SIGNALS, AND DEVICES

The following shall be fabricated and installed in accordance with the latest edition of the U. S. Department of Transportation Federal Highway Administration’s “*Manual of Uniform Traffic Control Devices (MUTCD)*”, particularly “Part VI – Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility, and Incident Management Operations”, subject to approval of the City of Clinton’s Department of Public Works, the Anderson County Highway Department and/or the State of Tennessee Department of Transportation as may be applicable depending upon location of work and agency jurisdiction:

- ⇒ Post Mounted and Wall Mounted Traffic Control Informational Signs
- ⇒ Traffic Control Signals
- ⇒ Traffic Cones and Drums
- ⇒ Traffic Control Flags

3.2 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, City of Clinton’s Public Works Department operations, County and/or State operations where applicable, and CUB’s operations.
- B. Monitor parking of construction personnel’s vehicles. Maintain vehicular access to and through parking areas. CONTRACTOR shall obtain individual property owner’s written permission to park on private property.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.3 TRAFFIC CONTROL PERSONNEL

CONTRACTOR shall provide trained and equipped traffic control personnel and furnish all appropriate warning signage, paddles, cones, barricades, lighting, etc. to

control/regulate traffic when construction operations or traffic encroach on public traffic lanes or within street rights-of-way as may be required by the appropriate agency with jurisdiction and in responsible charge of the affected streets and/or rights-of-way.

3.4 FLARES AND LIGHTS

CONTRACTOR shall use flares and/or lights during hours of low visibility or after dark as necessary to delineate traffic lanes and to safely guide traffic through the construction area(s) as may be required by the appropriate agency with jurisdiction and in responsible charge of the affected streets and/or rights-of-way.

3.5 TRAFFIC CONTROL

The CONTRACTOR shall:

- A. Provide the stated protection subject to the codes, regulation, and approval of the agency having jurisdiction and CUB's Project Representative.
- B. Obtain any and all required traffic control plans.
 - For projects located within the City of Clinton, CONTRACTOR shall develop and submit a Traffic Control Plan to the City of Clinton for approval by the City's Director of Public Works.
 - For projects located outside of the City limits, Traffic Control Plans if required shall be submitted to and approved by the Anderson County Highway Department and/or Tennessee Department of Transportation.
 - For projects located within the City limits and on roadways also within the jurisdiction of, or controlled and/or maintained by the Anderson County Highway Department and/or Tennessee Department of Transportation, CONTRACTOR may be required to develop and submit Traffic Control Plans to multiple agencies for their approval.
 - Such Traffic Control Plans shall be submitted to the appropriate agency or agencies and their approval of the Plan obtained prior to CONTRACTOR beginning any WORK or IMPROVEMENTS within that public right(s)-of-way.
- C. Obtain any and all necessary permits, in coordination with the appropriate agencies required to perform the work, prior to beginning work.
- D. Provide and maintain adequate barricades, signs, and/or traffic control personnel to protect the public from traffic hazards 24-hours per day, seven days per week, until which time CONTRACTOR has completed the WORK and IMPROVEMENTS within the public right-of-way and returned the traffic lanes to normal operating status as determined by the appropriate agency or agencies.

3.6 TRAFFIC SIGNS AND SIGNALS

- A. At approaches to site and on site, the CONTRACTOR shall install traffic signs and signals at crossroads, detours, parking areas, and elsewhere as needed to safely direct construction and affected public traffic.
- B. Signs and signals shall be relocated as work progresses, to maintain effective traffic control.
- C. CONTRACTOR shall temporarily cover signs when not applicable.

3.7 REMOVAL

- A. CONTRACTOR shall remove equipment and devices when no longer required.
- B. CONTRACTOR shall repair any and all damages caused by such installation.

3.8 PAYMENT

Unless otherwise noted or included in the Bid Form, all costs associated with TRAFFIC CONTROL shall be incidental to the installation of the WORK and IMPROVEMENTS included in this contract and shall not be an additional expense to CUB.

END OF SECTION

SECTION 02000

MATERIALS AND EQUIPMENT

PART 1. GENERAL

This section covers the transportation, handling, storage, and substitution of materials and equipment.

PART 2. PRODUCTS

- A. CUB has pre-approved certain materials and products for use on CUB projects. Included with these Standard Specifications, under “APPENDIX A”, are “STANDARD AND APPROVED PRODUCTS LISTS”. CONTRACTOR shall furnish only materials and products from these lists of approved items. Should CONTRACTOR want to use an item not listed, but one they consider to be equal to or superior to a CUB pre-approved item, CONTRACTOR shall submit a written request for CUB to consider allowing CONTRACTOR to substitute that particular item or items for use on that project. For CUB’s consideration, CONTRACTOR shall submit as much information as possible concerning such materials or products. CUB’s review and comments, or approval, will be expedited. However, CONTRACTOR will need to submit their request for CUB’s consideration at least 10 working days prior to CONTRACTOR’s need for CUB’s comments or approval of a specific item not already included on CUB’s standard and approved listings (see Paragraph 3.4 SUBSTITUTIONS below).
- B. Only new materials, machinery, components, equipment, fixtures, and systems shall be used in performing the WORK and IMPROVEMENTS. This does not include machinery and equipment used for preparation, fabrication, conveying, construction and erection of the WORK and IMPROVEMENTS. Products may also include existing material or components required for reuse. CONTRACTOR shall not use materials and equipment removed from existing premises, except as may be specifically permitted in advance by CUB.

PART 3. EXECUTION

3.1 TRANSPORTATION AND HANDLING

CONTRACTOR shall:

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

3.2 STORAGE AND PROTECTION

CONTRACTOR shall:

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible.
- B. Store electronic, electrical, and other sensitive equipment, products and materials in weather-tight and climate-controlled buildings or enclosures.
- C. For exterior storage of fabricated products, place products above ground on supports that are sloped for drainage.
- D. Provide off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement or damage.
- H. Arrange storage of products to permit access for CUB's periodic inspection to assure products are undamaged and are maintained under specified conditions.

3.3 PRODUCT OPTIONS

- A. Products listed must be by manufacturers named in "APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS" and meeting all specifications, no options or substitutions allowed.
- B. Products for which CONTRACTOR has submitted a written request for consideration of and has received CUB's approval for use of on a particular project (see Part 2, Subparagraph A above and Section 3.4 Substitutions below).

3.4 SUBSTITUTIONS

- A. CUB will consider CONTRACTOR's requests for Substitutions for only a maximum of 15 calendar days after date of Agreement between CUB and the CONTRACTOR.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the CONTRACTOR.

- C. CONTRACTOR shall document each request with complete data substantiating compliance of proposed substitution with Contract Documents and these Standard Specifications.
- D. A request constitutes a representation that the Bidder/CONTRACTOR:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to CUB.
 - 4. Waives claims for additional costs or time extension, which may subsequently become apparent.
 - 5. Will reimburse CUB for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitutions Submittal Procedure
 - 1. Submit to CUB three copies of request for Substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit to CUB shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 - 3. CUB will notify CONTRACTOR, in writing, of decision to accept or reject request.

END OF SECTION

SECTION 03000

WATER DISTRIBUTION SYSTEM

PART 1. GENERAL

- 1.1 Plan and construction drawings, specifications, and calculations including hydraulic flows must be prepared and sealed by a Professional Engineer licensed to practice in the State of Tennessee. Design shall be in conformance with the requirements of the State of Tennessee Department of Environment and Conservation, Division of Water Supply (TDEC-DWS) and CUB's most current edition of *Standard Specifications for Construction of Water and Sewer Utilities*. TDEC-DWS's requirements for Review and Approval for Public Water Systems, quoted from their web site www.state.tn.us/environment/permits, states:

“Persons who construct or modify a public water system are required to obtain an approval from the Tennessee Division of Water Supply at least 30 days before construction or modification is to begin. Applicants are required to submit all engineering and construction plans, a completed Plans Review Fee Worksheet Form and the proper fee to the Division of Water Supply. All plan documents must be presented in conformance with accepted engineering practices and the “Community Public Water Systems Design Criteria” manual published by the Division of Water Supply.”

- 1.2 Engineering and construction plans and specifications shall be approved and signed by CUB's Water & Sewer Department Director before they are sent to the Tennessee Department of Environment and Conservation, Division of Water Supply for their review. Immediately following TDEC-DWS's approval, the letter from TDEC-DWS with their approval to construct shall be submitted to CUB's Water & Sewer Department Director.
- 1.3 Plans, specifications and calculations regarding fire protection should also be submitted to the local fire department and the State Fire Marshal's office as may be required by the State Fire Marshal.
- 1.4 The installation of all pipes and appurtenances that are to become the property of CUB and/or will become the responsibility of CUB for ownership and maintenance shall be inspected and approved by CUB during construction. No backfilling of trenches or excavations will be allowed until the pipe, service line, blow-off, air-release valve, etc. in place has been visually inspected and approved by CUB. At least three working days prior to the time the work is scheduled to begin the CONTRACTOR and/or Engineer shall notify CUB's Water & Sewer Department Director of his intent to construct system improvements and the specific location of where the work will be performed. CUB will then schedule to have a CUB representative on site to inspect CONTRACTOR's work prior to any backfilling operations. CUB's representative may not be able to remain on site during the entire work day or work period, but CUB's representative will visit the site on a

periodic basis during the work day to inspect work performed and, as CUB's approvals are earned, CONTRACTOR will be allowed to backfill open trenches and excavations as his work progresses.

- 1.5 The work to be performed shall consist of the installation of water lines according to this edition of CUB's *Standard Specifications for the Construction of Water and Sewer Utilities* and Detail Drawings contained therein or later edition which may be in place at the time of bidding or construction.
- 1.6 A stamped copy of the TDEC Division of Water Supply's approved Plans and Specifications must be kept on the job site at all times during the construction of the project work.
- 1.7 The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project and approved by CUB.

PART 2. PRODUCTS

2.1 GENERAL

- A. For CUB's pre-approved water mains and service piping products, materials and fittings, refer to APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS located near the back of these Standard Specifications.
- B. Packing and jointing materials used in the joints of pipe shall meet the Standards of the American Water Works Association (AWWA). Either mechanical joints or slip-on joints with rubber gaskets are required for pipe connections.
- C. All products shall be NSF and AWWA approved for use in potable water systems.
- D. Unless previously approved all materials used in the construction must be new materials manufactured no earlier than one year prior to the current year. When project material is stored long term prior to use, it must be done to manufacturer's requirements, in a way to prevent contamination and is subject to rejection due to mishandling and improper storage.
- E. All materials shall be manufactured or assembled in the United States of America or under USA standards as provided but not limited to the agencies listed in the reference index of these specifications. Supplier and manufacturers must show or disclose adherence to the same on their material submittal sheets.
- F. Restrained joint fittings may be required in certain applications and/or installation conditions.

2.2 WATER MAIN PIPE

All materials will be visually inspected by CUB at the site for conformance to the specifications. At CUB'S discretion, the CONTRACTOR may be required to

supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications.

- A. Ductile Iron Pipe (6 inches to 16 inches in diameter) shall be made of good quality ductile iron in conformance with the latest revision of ANSI/AWWA Standard C151/A21.51 and shall conform to the requirements of the Materials Specifications herein. The pipe shall be push-on joint with a minimum pressure class of 350 psi, cement lined according to ANSI/AWWA C-104/A21.4, AWWA Standard C-110 and NFPA 13 for fire protection and coated outside with an asphaltic coating. These Standards are included in these contract documents by reference here. Copies of the Standards can be obtained by contacting AWWA, 6666 West Quincy Avenue, Denver, Colorado 80235 or by calling AWWA at 303-794-7711 or by Internet access at “www.awwa.org”.
- B. PVC pipe (2 inches to 8 inches in diameter) and fittings shall be NSF-Approved SDR-17 Class 250. The pipe shall be manufactured from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined by ASTM D1784, and in accordance with ASTM D2241 and the Materials Specifications herein. Gaskets and lubricants intended for use with PVC pipe, as supplied by the pipe manufacturer, shall be made from materials that are compatible with the plastic material and with each other when used together will not support the growth of bacteria, and will not adversely affect the potable qualities of the water that is to be transported. Gaskets shall be the elastomeric type and shall be manufactured to conform to the requirements of ASTM F-477. Solvent cemented joints in the field are not permitted. Pipe lengths shall be no greater than 20 feet.
- C. HDPE pipe (3-inch to 6-inches in diameter) and fittings shall be NSF-approved SDR-11 high-density polyethylene meeting the requirements of ASTM D3035, ASTM D2239, ASTM D2737, ASTM F714, AWWA C906. HDPE pipe used for potable water shall be listed to ANSI/NSF 14/61. The pipe shall be manufactured from premium PE4710 resin material that conforms to ASTM D3350 with the cell classification of 345464C/E and is listed with the Plastic Pipe Institute’s TR4. Pipe is to be formulated with carbon black and /or ultraviolet stabilizer for maximum protection against UV rays. Except for special installation, piping and fittings shall be joined together using socket, heat or saddle fusion procedures and/or compression fittings designed specifically for use on HDPE pipe, and approved by CUB and installed by acceptable directional drilling methods.
- D. Copper pipe (2-inch diameter) shall be Type-K copper, annealed, and meeting ASTM B88, latest revision. Furnished in 20-foot straight laying lengths and in conformance with the Materials Specifications herein. Copper Pipe may be used for water service lines only.

2.3 TEES, CROSSES AND BENDS

All materials will be visually inspected by CUB at the site for conformance to the specifications. At CUB'S discretion, the CONTRACTOR may be required to

supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications.

- A. Iron tees, crosses and bends for use with ductile iron and PVC pipe shall be cement mortar lined, mechanical joint (with accessories) or plain end water main fittings. 3-inch through 16-inch sizes shall either be pressure rated cast iron meeting the latest requirements of AWWA Standard C-110 or be manufactured from Ductile Iron in accordance with, and meet all applicable terms and provisions of, ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.11 (current revisions) and rated for 350 PSI working pressure, as determined by CUB. Mechanical joint and plain end tees, crosses and bends shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- B. All coated fittings shall meet requirements of NSF-61. Fittings shall be cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4. Fittings may be double cement-lined or epoxy coated if determined necessary and specified by Engineer and if approved by CUB.
- C. PVC bends for use with 2-inch PVC pipe shall be bell-type, factory welded and shall meet the requirement for bells of pipe as set forth in ASTM Standard D-2241 for 2-inch through 12-inch pipe designated SDR-17 Class 250.

2.4 REDUCERS

- A. Iron reducers for use with ductile iron and PVC pipe shall be cement-mortar lined mechanical joint and shall be either 250 psi rated cast iron meeting the latest requirements of AWWA Standard C-110, or 350 psi pressure rating ductile iron meeting the latest requirements of AWWA C-153, as determined by CUB.
- B. Mechanical joint and plain end reducers shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- C. Reducers for transition from 6-inch or larger pipe to 2-inch PVC pipe shall be accomplished by use of a mechanical joint plug which has been provided with a 2-inch tap. A 2-inch bell and 2-inch NPT PVC transition fitting meeting the requirements as set forth in ASTM Standard D-2241 for 2-inch through 12-inch pipe designated SDR-17 Class 250 connected to the tapped plug will effect an approved reduction.

2.5 CAPS AND PLUGS

- A. Caps and plugs for use with ductile iron and PVC pipe shall be mechanical joint except for slip-on type plugs which shall be restrained type, with cast lugs and furnished with a minimum of four restraining cap screws, and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

- B. Mechanical joint caps and plugs shall be either 250 psi pressure rated cast iron meeting the latest requirements of AWWA Standard C-110, or 350 psi rated ductile iron meeting the latest requirements of AWWA C-153, as determined by CUB.
- C. Caps for 2-inch PVC pipe may be fabricated by using a 2-inch brass NPT cap and a 2-inch PVC plain end and 2-inch NPT transition fitting meeting the requirements as set forth in ASTM Standard D-2241 for 2-inch through 12-inch pipe designated SDR-17 Class 250.

2.6 IN-LINE AND ISOLATION VALVES

- A. Gate valves shall be mechanical joint, resilient-seat type, iron body, non-rising stem, “O”-ring, stem seal type, 2-inch square operating nut, open counterclockwise.
- B. Gate valves shall meet the latest requirements of AWWA Standard C-509 or C-515 as determined by CUB.
- C. Gate valve pressure ratings shall be 250 psig or greater.
- D. Gate valves meeting the latest requirement of AWWA Standard C-509 and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST Rubber-seated butterfly valves meeting the latest requirement of AWWA Standard C-504 will be acceptable for use on 8-inch or greater pipe sizes. Rubber-seated butterfly valves shall be open counterclockwise, furnished with a 2-inch operating nut, mechanical joint type, class 250-B.
- E. Shop drawings of butterfly valves must be submitted to CUB for CUB’s approval.

2.7 VALVE BOXES

- A. Valve boxes shall be the two-piece “Buffalo” screw type, 5-1/4-inch diameter shaft, capable of extending from valve alignment device to ground surface, constructed of cast iron.
- B. Valve box lids shall be provided with the word “WATER” embossed in the lid surface. Lids shall be compatible with the box lid receptacle. Where valve boxes are installed in public street and/or roadways having a classification of major collector or greater, lids shall have a skirt or at least 2½ inches and weigh no less than 15 pounds. Lids installed outside of paved areas shall include a skirt of at least 1½ inches and weigh no less than 12 pounds.
- C. The assembled valve box weight (including lid with 1½ inch skirt) shall be no less than 60 pounds for 12-inch to 24-inch extension; 80 pounds for 24-inch to 36-inch extension; and 90 pounds for 36-inch to 48-inch extension.
- D. Shop drawings of valve boxes shall be submitted to CUB for approval.
- E. Valve boxes installed in grassed or otherwise landscaped areas shall be set in a 4-inch thick pad of precast, reinforced concrete, approximately 15-inch by

15-inch in size, with top flush with concrete and constructed where drainage is away from lids.

2.8 BLOW-OFF ASSEMBLIES

- A. Blow-off Assemblies for dead-end pipe less than 6-inches in diameter shall be assembled by installing a 2-inch size flushing assembly constructed as shown in the Standard Detail Drawings and in accordance with the STANDARD AND APPROVED PRODUCTS LIST. Blow-off Assembly piping shall be a minimum of 30 inches bury. Shop drawings of proposed flushing assembly installations shall be submitted to CUB for approval.
- B. A 2-inch gate valve meeting the requirements set forth under Section 03100 of these Standards shall be installed for each Assembly.
- C. Locations and installation requirements may vary depending upon specific site conditions and shall be subject to CUB's approval.
- D. Typically blow-offs for dead-end 6-inch and greater sized distribution main pipes shall be by way of a 3-way fire hydrant installed at the end of the line and meeting the requirements of Section 03100 and the Standard Detail Drawings of these Standards. In particular situations, and only where approved in advance by CUB and TDEC, where fire hydrants are not a part of the new construction a 2-inch Blow-Off Assembly may be used to blow-off such larger water distribution mains.

2.9 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves shall be of cast iron or stainless steel construction with mechanical joint ends rated for 250 psi working pressure. Tapping sleeves shall be appropriately sized for use on O.D. pipe to be tapped. Tapping sleeves should be provided with tapped bosses for testing purposes. Side flange bolts and pipe shall be of corrosive resistant material. Tapping sleeve shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. Stainless steel tapping sleeves may be used with prior approval of CUB's Director - Water & Sewer Department. Use of stainless steel tapping sleeves, if approved by CUB, will require that the installed sleeve withstand a sustained 300 psi pressure test prior to CONTRACTOR being allowed to make the tap into the main.
- B. Tapping valves shall meet all requirements for gate valves under Section 03100 of these Standards except flanged valve inlets and mechanical joint outlets shall be provided. Tapping valves shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

2.10 REPAIR CLAMPS or SLEEVES

- A. Repair clamps, or sleeves, shall be furnished in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

- B. Repair sleeve gaskets shall be lubricated before use with lubricant supplied or recommended by sleeve manufacturer.
- C. Full circumference stainless steel band-type sleeves shall only be used as a temporary measure to stop leakage from a pipe until which time more permanent repairs can be made. These band-type clamps shall have appropriate pipe diameter range and are typically allowed only for repairing circumferential (ring) breaks in cast iron pipe. Stainless steel band-type repair couplings must be capable of withstanding test pressures of 300 psi at a torque of 70 foot pounds for 5/8-inch bolts and 90 foot pounds for 3/4-inch bolts; equipped with malleable iron lugs meeting ASTM A-47, Grade 32510, or ductile iron per ASTM A-536, Grade 60-40-18; with supporting side fingers, furnished with Grade 30 specially compounded rubber of new materials with ingredients to produce superior storage characteristics, performance and resistance to set after installation; bolts of high strength steel with heavy hexagon nuts meeting the latest requirement of AWWA Standard C-111.

PART 3. EXECUTION

Unless otherwise specified, the Contractor and his subcontractors shall be directly responsible for his and his personnel's knowledge of and adherence to the rules, regulations and requirements of the following agencies:

- ✓ Occupational Safety and Health Act;
- ✓ Tennessee Occupational Safety and Health Act;
- ✓ Tennessee Department of Transportation;
- ✓ Anderson County Highway Department;
- ✓ City of Clinton Police, Fire and Public Works Departments;
- ✓ Clinton Utilities Board;
- ✓ Environmental Protection Administration;
- ✓ Tennessee Department of Environment and Conservation;
- ✓ Anderson County Health Department;
- ✓ Federal, State and local Erosion Control agencies; and
- ✓ Other such department or agency that has jurisdiction or authority over the different activities of the Contractor and/or Owner/Developer as they perform and construct the various types of improvements for CUB in the performance of the project work.

The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project and approved by CUB.

3.1 REQUIRED PRE-CONSTRUCTION ACTIVITIES

- A. Prior to commencement of work:
 - 1. Contractor shall supply two (2) complete sets of approved construction drawings, and copies of all easements, applicable permits and licenses, to CUB's Water & Sewer Department Director.

2. Contractor shall attend a mandatory pre-construction meeting with CUB staff. Responsible representatives for the contractor, subcontractors (if any) and Owner/Developer must attend. Attendance of the Engineer is optional unless required by CUB.
3. Contractor shall supply material submittal sheets on all materials to be installed. Submittal sheets must contain manufacturer, required standards to be met, and marks or highlights to indicate model, size, type and material of material proposed for the project. All submittals must be approved by CUB prior to start of construction.
4. Contractor of Engineer shall submit the Construction Start Notification to the Tennessee Department of Environment & Conservation – Division of Water Supply and shall supply a copy of this Notification to CUB.
5. At least three (3) working days prior to beginning any excavation, Contractor shall be responsible to mark all areas to delineate where excavations are necessary and then call the Tennessee One Call System notifying them of an intent to dig and requesting utility locates for all areas to be excavated.
6. Contractor shall keep “locates” current with Tennessee One Call System throughout the schedule of activities of the project work.
7. The Contractor or Owner/Developer may be required to provide a cash deposit, bond, certified check, or other acceptable form of security for the amount of the work to be completed or a portion thereof pursuant to the approved construction plans. The amount of the security shall be determined by and at the discretion of CUB. Should the work not be performed according to these Standards and/or other applicable requirements, CUB may execute the security for the purpose of remediation of any deficiencies and/or for the completion of the project. Within sixty (60) days of the completion and acceptance of all provisions of the approved plans, cash deposits or other legal arrangements, or unexpended or unobligated funds thereof, shall be refunded or terminated.

3.2 PREPARATION

A. Precautions and permit to excavate:

1. Contractor shall abide by each utility company’s requirements when excavating in the vicinity of, repairing, replacing and/or disturbing their existing mains, services, or other facilities.
2. For all work to be performed within the city limits of the City of Clinton, and prior to any excavation being performed within any public right-of-way, including public alleys and easements, Contractor shall contract the Director of the City of Clinton Public Works Department to determine what requirements are for the excavation and repairs to the disturbed areas and obtain a written permit if required.

3.3 EASEMENTS, RIGHTS-OF-WAY

- A. For work to be performed or constructed across private property by Owner/Developer to extend public mains, or otherwise make improvements to the public water and/or wastewater systems within CUB's service area, which will be turned over to CUB for ownership and maintenance, and prior to beginning any such work, such Owner/Developer shall:
1. Determine what easements and or rights-of-way will be required for CUB to own, maintain and/or replace these improvements once they have been constructed, approved by CUB and turned over to CUB for ownership and maintenance,
 - i. Perform any surveying necessary to formally determine and describe the easements and/or rights-of-way
 - ii. Develop written descriptions of the easements and/or rights-of-way,
 - iii. Complete CUB's standard Easement and Right-of-Way Acquisition form or similar form acceptable to CUB,
 - iv. Obtain all necessary easements and/or rights-of-way from affected private property owners,
 - v. Record all signed and notarized easements and rights-of-way at the Anderson County Courthouse,
 - vi. Provide CUB with copies of recorded plats of any and all public easements and/or rights-of-way for the proposed construction of public utilities, and these shall be recorded as dedicated exclusively to CUB (for CUB to construct, maintain, and/or replace the various water and sanitary sewer improvements to be constructed by Owner/Developer).
- B. Permanent easements are required for all public water system components not located within the public street right-of-way. The normal easement width is 20 feet. Easements wider than that may be required when conditions warrant. Where the water main is located near structures the easement must provide 10 feet lateral clearance between the main and the structures. If that clearance cannot be obtained, the water main must be installed in a CUB-approved encasement pipe. An easement for a public main located along a private roadway should include the width of the roadway plus the area between the main and the roadway plus an additional 10 feet on the side of the main opposite the roadway. Blanket easements are not acceptable. Easements granted for public mains should be specifically described with dimensions and angles sufficient to allow the easement to be accurately located. The dedication of any easement shall prohibit the location of permanent structures on , under or over the easement and shall allow CUB access to the easement for construction, reconstruction, replacement, repair, operation, and maintenance purposes; and shall hold CUB harmless for the cost of replacement or damage to any improvement or vegetation within the easement. Other appropriate or necessary requirements may also be included. Earth embankments, added subsequent to main construction, which increase

that cover shall not be permitted without specific written approval by and from CUB.

- C. It shall be the responsibility of the Engineer/Owner/Developer and/or Contractor to ensure that the utilities are placed within these recorded easements and/or rights-of-way and the water and/or sewer lines are installed within two (2) feet either side of the center line of the recorded easement and/or right-of-way. Utilities installed more than two feet from the centerline of the recorded easements and/or rights-of-way will require that the Owner/Developer and/or Contractor either relocate the utilities in question to a location within two feet either side of the center line of the recorded 20-foot wide easement or obtain additional easements and/or rights-of-way as necessary to provide CUB with an easement width of 10 feet either side of the centerline of the newly installed utility line or lines. All costs associated with the development, acquisition and recording of the necessary easements shall be the sole expense of the Owner/Developer.

3.4 FIELD STAKING

The Design Engineer or Owner/Developer's Surveyor shall stake in the field the alignment of the water line and the location of all fire hydrants, valves, bends, crosses and other appurtenances identified on the plans. All survey points shall be protected.

3.5 INSPECTION

The installation of all pipes and appurtenances that are to become the property of CUB and/or will become the responsibility of CUB for ownership and maintenance shall be inspected and approved by CUB during construction. No backfilling of trenches or excavations will be allowed until the pipes, service lines, air-release/vacuum valves, etc. in place have been visually inspected and approved by CUB. At least three (3) working days prior to the time the work is scheduled to begin Contractor and/or Engineer shall notify CUB's Water & Sewer Department Director of his intent to construct system improvements and the specific location of where the work will be performed. CUB will then schedule to have its representative on site to inspect Contractor's work prior to any backfilling operations. CUB's representative may not be able to remain on site during the entire work day or work period, but CUB's representative will visit the site on a periodic basis during the work day to inspect work performed and, as CUB's approvals are earned, Contractor will be allowed to backfill open trenches and excavations as his work progresses.

3.6 TRENCH EXCAVATION

- A. Perform work in such a manner as to form a suitable trench in which to safely install the work of the project and so as to cause the least inconvenience to the public.
- B. Cut pavements along neat, straight lines with a pavement saw.

- C. Trench depth shall be sufficient to provide a minimum cover in accordance with these Standards for the respective utility.
- D. Align trench as shown on the plans.
- E. Shape the bottom of the trench to provide uniform bearing of the pipe on undisturbed earth throughout its entire length. Dig bell holes to aid in securing uniform support of the pipe.
- F. The trench width at the ground surface may vary with the trench depth, the nature of soils encountered, existence of any pavement, and the proximity of adjacent structures. The minimum clear width of an unsupported or supported trench measured at the centerline of the pipe shall be at least 18 inches or the pipe outside diameter plus 12 inches, whichever is greater. Where embedment compaction is required, the trench shall be wide enough to accommodate the compaction equipment. Whenever possible, the clear width of the trench at the top of the pipe should not exceed the pipe outside diameter plus 24 inches unless the pipe is designed to carry the prism load as determined by the Engineer and acceptable to CUB.
- G. The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. When unstable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline and backfill to the proper grade with #57 or #67 stone.
- H. Ledge rock, boulders, cobbles and large stones encountered in the trench excavation shall be removed to provide a depth of at least 6 inches of embedment cushion on each side of and below the bottom of the pipe barrel and appurtenances. The excavation shall be sufficiently wide to enable proper placement of the embedment specified herein.
- I. If the trench passes over a previous excavation, the trench bottom shall be compacted to provide support equal to that of the undisturbed native soil.
- J. When an unstable subgrade condition exists that, in CUB's opinion, cannot support the pipe, an alternative foundation shall be provided. At CUB's discretion, an additional depth shall be excavated and refilled to pipe foundation grade with embedment material as directed by CUB.
- K. Where running or standing water occurs in the trench bottom, or where the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps. The trench shall be kept free from water during installation operations by suitable means, until the pipe has been installed and backfill placed and compacted to a sufficient height to prevent pipe flotation.

3.7 INSTALLATION OF WATER LINES

- A. All water lines greater than 2 inches in diameter shall be Class 350 Ductile Iron Pipe, or Class 250 PVC, or SDR 11 HDPE as determined and specified by CUB. Water lines 2 inches in diameter shall be HDPE, PVC or Type-K Copper in unpaved areas and shall be either HDPE or copper pipe under roadway pavement, or in bores and tunnels as may be approved by CUB.

- B. The installation standards listed as follows are hereby included by reference as a part of these Contract Documents. Copies of these Standards can be obtained by contacting AWWA or ASTM.
- ⇒ **Ductile Iron (DI)** Water Mains and appurtenances shall be installed in general accordance with the latest revision of AWWA Standard C600 – *Installation of Ductile Iron Water Mains and Their Appurtenances*.
 - ⇒ **Polyvinyl Chloride (PVC)** Water Mains and appurtenances shall be installed in general accordance with the latest revision of AWWA Standard C605 – *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fitting for Water*.
 - ⇒ **High-Density Polyethylene (HDPE)** Water Mains and appurtenances shall be installed in general accordance with the latest revision of ASTM D2774 - *Standard Practice for Underground Installation of Thermoplastic Pressure Piping*.
- C. All PVC and HDPE pipe shall be installed with a continuous 12-gauge (minimum size) copper wire for location, which shall be tied into metallic mains and valve boxes. The ends of the wire shall terminate in a valve box or other acceptable location – having an access length of at least two (2) feet – whereby detection equipment may be attached. CONTRACTOR shall furnish and install this wire incidental to the installation of the water main and shall not be an additional expense to CUB.
- D. Water lines shall be installed as shown on the approved construction drawings. All fittings, valves, and hydrants shall be at the required locations, the spigots centered in the bells, and all valves and hydrant stems plumb.
- E. Hydrant locations shall be as approved by CUB and either the City of Clinton Fire Department or the Claxton Volunteer Fire Department, depending upon the location of the hydrant.
- F. Timing and procedures of pipe installations, valve closings, temporary services, and interruption of services shall be approved by and coordinated with CUB. CUB may require that the work be performed during non-business hours if necessary to maintain services.
- G. Unless otherwise indicated by the construction drawings, all water lines shall have at least 30 inches of cover. Exceptions, if any are allowed, MUST be approved by CUB in writing.
- H. The maximum trench width for water line installations shall be 24” for 6” and 8” diameter lines, 30” for 10” and 12” diameter lines, 36” for 16” and 24” diameter lines. Trench widths for larger sizes shall only be as approved by CUB.
- I. The CONTRACTOR shall provide and use tools and facilities that are satisfactory to CUB and that will allow the work to be performed in a safe and convenient manner. All pipe, fittings, valves, and hydrants are to be unloaded from the trucks using suitable tools and equipment. A derrick,

ropes, or other suitable tools or equipment shall be used to lower all pipe, fittings, valves, and hydrants into the trench one piece at a time. Each piece shall be lowered carefully so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances shall water line materials be dropped or dumped.

- J. Before placing pipe in the trench, CONTRACTOR shall field inspect for cracks or other defects and remove defective pipe from the construction site.
- K. Any pipes strung out along the route of the proposed lines before the actual installation of those lines is due to take place shall not be lowered into the trench until they have been swabbed to clean and remove any mud, debris, etc., that may have accumulated within them.
- L. PVC pipe shall be strung out a maximum of one day ahead of pipe laying. Lay all pipe in a straight line on a uniform grade and in accordance with these Standards.
- M. All HDPE pipe shall be received, inspected and handled in accordance with www.plasticpipe.org/publications/material_handling_guide.html.
- N. Reel trailers should be used when stringing out coiled pipe for direct burial, plow-in or pull-in. Pipe should be strung out on the ground upon arrival at the job site to allow time for the coil set to relax and simplify handling and emplacement. Always inspect the pipe as it is being uncoiled and during installation to make sure no damage to the pipe has occurred during shipment and subsequent handling at the job site.
- O. All unnecessary material shall be removed from the bell and spigot ends of each section of DI and PVC pipe. As may be necessary, hone the pipe with suitable tools or equipment. Before any pipe is laid, the outside of its spigot end and the inside of its bell shall be cleaned and left dry and oil-free.
- P. Every precaution shall be taken to keep foreign material from getting into the pipe while it is being installed. No debris, tools, clothing, or other materials shall be placed in the pipe during laying operations. Clean the interior of pipe and the gasket to remove all dirt and other undesirable material prior to hubbing it up in the trench (or, if HDPE, socket or heat fusion at surface). If dirt or other foreign material that has gotten into a pipe will not, in the opinion of CUB, be removed by flushing, the interior of the pipe shall be cleaned and swabbed with a disinfecting solution of 5% hypochlorite.
- Q. For both push-on and mechanical joint DI and PVC assemblies, apply lubricant as supplied by the pipe manufacturer to the gasket and plain end of the pipe in accordance with the pipe manufacturer's recommendations. Once lubricant has been applied, extreme care should be taken to keep the plain end or gasket from contacting the ground.
- R. After a length of pipe has been placed in the trench, the plain end shall be centered in the bell of the adjacent pipe, and then inserted to the depth specified by the manufacturer.

- S. Pipe shall be installed with the bell ends facing in the direction of laying unless otherwise directed by CUB.
- T. As a minimum, the manufacturer's instructions for laying and joining pipe shall be followed. Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, the bottom of the trench shall be carefully graded so that each pipe barrel will rest on a solid foundation for its entire length.
- U. Whenever pipe laying is not in progress, the open ends of the pipe shall be closed either with a watertight plug or by other means approved by CUB.
- V. Where necessary, pipe shall be cut so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. The manufacturer's recommendations shall be followed concerning how to cut and bevel or otherwise machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis. For cast iron pipe, hydraulic cutters or a carborundum saw shall be used. A carborundum saw shall be used for ductile iron pipe. A cut-off saw or handsaw may be used for PVC pipe. Pipe cutters designed for cutting plastic pipe shall be used to cut HDPE pipe. CUB may consider other methods for 12-inch diameter and larger pipes. Cuts on ductile iron pipe shall not be made within two feet of the bell unless it can be proven by field measurement that the outside diameter is within tolerances of the pipe manufacturer.
- W. Wherever DI or PVC pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions, or plumb stems, or wherever long radius curves are permitted, the amount of deflection shall not exceed that allowed by ANSI/AWWA C600 or C605, nor that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be as approved by CUB. Bend fittings shall only be used when the pipe deflections are inadequate, according to manufacturer's recommendations, or as directed by CUB. Make any approved deflections only after the joint has been fully assembled.
- X. THRUST BLOCKS
 - 1. Thrust blocks shall be installed wherever the water main changes direction (at bends), at tees, at dead ends, at hydrants, where changes in pipe size occur at reducers, and at any other point recommended by the manufacturer or required by CUB. Acceptable restraint measures include concrete thrust blocks, thrust restraints, restrained joints and tie rods.
 - 2. Thrust blocks shall be considered an integral part of the water line work and no additional compensation shall be due CONTRACTOR.
 - 3. Where thrust blocking is considered to be inadequate or inappropriate, and only as approved by CUB, thrust blocking may be eliminated in this particular location. However, restrained joints shall be required by CUB for a certain number of joints (usually two or three) either side of the location where the thrust blocking should have been or was originally intended to be located. Tie rods may also be required to be installed as

directed by CUB. Again, unless CUB approves otherwise, concrete thrust blocks shall be used at points described in Item 1. above.

4. The detail and dimensional data for concrete thrust blocks for up to 200 psi working pressure and soil bearings at 1,000 pounds per square foot or more are given in the Standard Drawings. For greater water pressures or less soil bearing capacity, especially when the soil is wet or mushy, the quantities required should be calculated in accordance with DIPRA “thrust Restraint Design for Ductile Iron Pipe”. When using thrust restraints, installation must be conducted to manufacturer’s specifications. When iron and /or carbon steel tie rods are being used, all parts of such tie rods exposed to soil or weather shall be given a final coating of asphalt for protection. Asphalt coating will not be required for stainless steel materials. Tie rods shall not be less than nominal ¾-inch in diameter. A minimum number must be calculated based on working pressure plus one (1) additional rod. When using concrete with mechanical thrust restraint(s), the mechanical restraint(s) and fittings must be wrapped sufficiently enough in plastic to permit future removal of the concrete without damaging the pipe.
- Y. No pipe shall be installed in water or when it is CUB’s opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project and no additional compensation shall be due CONTRACTOR.
- Z. In general, locate all lines in relation to other piped utilities in accordance with Tennessee Department of Environment and Conservation requirements and these Standards. Water lines shall be designed with a 10-foot horizontal separation from any existing or proposed sewer main. If this is not practical, the water main may be placed closer than 10 feet from a sewer main provided it is laid in a separate trench and that the elevation of the top of the sewer is at least 18 inches below the bottom of the water main. If the elevation of the lines cannot be adjusted to meet the 18-inch separation, then the water main shall be constructed with ductile iron pipe for a distance of 10 feet on either side of the sewer, with a full pipe section centered over the sewer, or as directed by CUB. Any variance of the requirements of this paragraph must first be approved by CUB and the Tennessee Department of Environment and Conservation
- AA. All pipes shall be jointed in the exact manner specified by the manufacturers of the pipe and jointing materials.
- BB. All fire hydrants shall be installed to stand plumb with the pumper nozzle facing the street or in a direction as may otherwise be directed by CUB.
- CC. CONTRACTOR shall provide for drainage at the base of the hydrant by placing coarse gravel or #57 or #67 clean crushed stone from the bottom of the trench to at least 6 inches above the weep holes in the hydrant to a distance of 18 inches below the bottom of the elbow. Do not connect such drainage system to a sanitary sewer line. Proper drainage of fire hydrant barrels shall be provided during hydrant installation in accordance with

hydrant manufacturer's specifications, as shown on Standard Detail Drawing or as otherwise directed by CUB.

- DD. All water distribution mains shall be flushed prior to inspection as specified in Section 3.9 below to assure complete removal of all debris and foreign material.
- EE. On water lines to be abandoned, all water lines, fittings and appurtenances shall be removed to a minimum depth of 6 inches below the proposed grade and backfilled in accordance with Section 01600 – Unclassified Excavation and Backfilling.
- FF. The repair of pipes and/or fittings shall include the repair or replacement of detection wire, or the addition of detection wire if none exists at the location of the repair.
- GG. Unless specifically exempted and approved, all tapping and modification to the existing in-service public water distribution and/or wastewater collection system pipes shall be conducted by CUB.
- HH. All valve operations must be conducted under the presence and direct supervision of authorized CUB personnel.

3.8 LEAKAGE TEST

- A. In general, no new construction shall be connected to existing in-service public mains or services until which time new construction has been fully tested and accepted by CUB. Acceptance by CUB of such new construction shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified in the flowing table, repairs or replacements shall be accomplished in accordance with the specifications.
- B. All newly installed and backfilled pipe or any valved section thereof shall be subjected to a leakage test, conducted in the presence of CUB. Pressure tests shall be performed in accordance with current AWWA Standard C600 and/or manufacturer's installation procedures.
- C. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
- D. If for some special reason CUB might allow new construction to be connected to existing mains prior to leakage testing, and if such testing is against a previously existing valve and the valve leaks through during such testing, CUB shall be responsible for repairing the valve. However, CUB shall not be liable for costs or lost time incurred by the CONTRACTOR when attempting to test a line against a faulty valve.
- E. Each completed section of pipe installed shall, with the prior notice to and approval of CUB and prior to connection of the new piping to existing mains or services, be slowly filled with water and a test pressure shall be applied equal to 1.5 times the normal working pressure or 200 psi, whichever is greater. Test pressure shall be based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge.

A pump shall be connected to the pipe in a manner satisfactory to CUB. The CONTRACTOR shall furnish the labor and equipment, including the pump, pipe, connections, gauges, and all necessary apparatus to perform all testing of the pipe.

- F. Before applying the specified test pressure, all air shall be removed from the pipe. If hydrants or blowoffs are not available at high places, and as allowed by CUB, these taps shall be made by the CONTRACTOR at the points of highest elevation before testing, and CUB-approved plugs shall be inserted by the CONTRACTOR after the test has been completed.
- G. The leakage test shall be conducted by measuring, through an accurate calibrated meter, the amount of water which enters the test section under 200 psi or 1.5 times the normal working pressures, whichever is greater, for a period of at least 2 hours. No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{SD \sqrt{P}}{133,200}$$

L = allowable leakage, in gallons per hour
 S = length of pipeline tested, in feet
 D = nominal diameter at the pipe, in inches
 P = average test pressure during the leakage test, in psig

The following table has been developed for the commonly used sizes of ductile iron pipe under an average test pressure of 200 psi. The leakage formula above may be used when conditions differ from those stated parameters.

<u>Pipe Diameter</u> (Inches)	<u>Allowable Leakage per 1,000 feet</u> (Gallons per hour)
2	0.21
4	0.42
6	0.64
8	0.85
10	1.06
12	1.27

Any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this leakage test shall be replaced with sound material in the manner specified at no cost to CUB. The test shall be repeated until the results are satisfactory to CUB.

3.9 DISINFECTION

- A. In general, no new construction shall be connected to existing in-service public mains or services until which time new construction has been disinfected and accepted by CUB.
- B. This section presents procedures for disinfecting new and repaired water mains. All new water mains shall be properly disinfected before they are placed into service. All water mains taken out of service for inspection, repair, or other activities (see paragraph 3.5 below) that lose sufficient pressure or otherwise might allow contamination of their water contents shall be disinfected before they are returned to service. In general, methods and procedures for disinfection, flushing, and bacteriological testing shall be in accordance with the latest revision of ANSI/AWWA C651. ANSI/AWWA C651 is included in these Standards and CUB project Contract Documents by reference here. Copies can be obtained by contacting AWWA, 6666 West Quincy Avenue, Denver, Colorado 80235 or by calling AWWA at 303-794-7711 or by Internet access at “www.awwa.org”.
- C. If dirt or other foreign material that has gotten into a pipe will not, in the opinion of CUB, be removed by flushing, the interior of the pipe shall be cleaned and swabbed with a disinfecting solution of 5% hypochlorite.
- D. Water shall be flowed into the new pipe in a manner approved by CUB. Chlorine additives shall be so proportioned that the chlorine concentration is kept at a minimum of 50 mg/l available chlorine for the necessary amount of time.
- E. Table I shows how much chlorine is needed for each 100 feet of line for pipes of various diameters. A 1% chlorine solution may be prepared either with 1 pound of calcium hypochlorite or sodium hypochlorite for each 8.5 gallons of water.

TABLE I
CHLORINE REQUIRED TO PRODUCE A 50 MG/L CONCENTRATION
IN 100 FEET OF PIPE, BY DIAMETER

<u>Pipe Size (inches)</u>	<u>100% Chlorine (Pounds)</u>	<u>1% Chlorine Solutions (Gallons)</u>
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
14	0.328	3.96
16	0.428	5.12

- F. While the chlorine is being applied, the CONTRACTOR shall manipulate valves under the direction of CUB so that the treatment dosage will not flow back into the public water distribution system’s line that is supplying the water. CUB shall continue the application of chlorine until the entire line being treated is filled with the chlorine solution. Then the CONTRACTOR

shall retain the chlorinated water in the line for at least 24 hours, during which time all valves and hydrants in the isolated section of line being treated shall be operated so that appurtenances can also be disinfected. After 24 hours, the treated water shall be tested by CUB to ensure it still has a chlorine concentration of at least 25 mg/l throughout the line.

- G. After the applicable retention period, the CONTRACTOR shall flush the heavily chlorinated water from the line until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the public water distribution system (generally between 1 and 2 mg/l). The CONTRACTOR shall perform such flushing only at sites where there is adequate drainage, where the discharge of the chlorinated water will not harm vegetation, and as approved by CUB. CONTRACTOR may be required to dechlorinate the water to acceptable levels prior to such discharge.
- H. The velocity of the water used to flush a line shall be at least 2.5 feet per second. The flow rates required to produce this velocity in various sizes of pipe are shown in the following Table II.

TABLE II
REQUIRED OPENINGS TO FLUSH PIPELINES
[at 40 psi residual (during flushing) pressure]

Pipe Size (Inches)	Flow Required To Produce 2.5 fps Velocity (gpm)	Hydrant Orifice Size (Inches)	Hydrant Outlet Number	Nozzle Size (Inches)
4	100	15/16	1	2-1/2
6	220	1 – 3/8	1	2-1/2
8	390	1 – 7/8	1	2-1/2
10	610	2 – 5/16	1	2-1/2
12	880	2 – 13/16	1	2-1/2
14	1,200	3 – 1/4	2	2-1/2
16	1,565	3 – 5/8	2	2-1/2

- I. Once a line has been flushed, CUB shall test to make certain that the residual chlorine in the water is within acceptable limits.
- J. It must be noted that flushing is no substitute for taking preventive measures before and during the laying of water lines. Certain contaminants, especially those in caked deposits, are difficult or even impossible to remove by flushing, no matter how high the velocity. The cleanliness of the pipe is critical to its being accepted by CUB for ownership and maintenance. The CONTRACTOR will be responsible for the cleanliness of the pipe.

3.10 BACTERIOLOGICAL TESTS

- A. After a water line has undergone final flushing, but before it is placed into service, CUB shall collect a sample for bacteriological testing from every

1,200 linear feet of the new water main, plus one set from the end of the line. In the case of lines shorter than 1,200 feet, only one set shall be taken from the end of the line. Two consecutive sets of acceptable samples, taken at least 24 hours apart may be collected.

- B. Samples will be collected in sterile bottles containing sodium thiosulfate. A hose or fire hydrant shall not be used when collecting samples.
- C. The samples will be collected by CUB and tested for bacteriological quality by a state-certified laboratory in order to determine if they contain any coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfection will be repeated by the CONTRACTOR, at no cost to CUB, until the required number of satisfactory samples is obtained.
- D. When the samples tested are found to be satisfactory, CUB will advise the CONTRACTOR regarding placing the water line in service.

3.11 SERVICE LINE CONNECTIONS

- A. After water lines have been installed, after construction has been inspected and approved by CUB, typically after pressure testing and disinfection procedures are completed and after bacteriological testing analyses determines the piping to be clear and safe, CUB will advise the CONTRACTOR that water service line connections can be made.
- B. Corporation stops installed on Ductile Iron Pipe may be installed either before or after pipe installation. Generally, corporation stops are located at ten o'clock or two o'clock on the circumference of the pipe. Corporation stops installed on Ductile Iron pipe 4 inches in diameter and smaller shall be installed with the use of a service clamp or saddle specifically designed for use on the Ductile Iron pipe to be tapped. Corporation stops installed on Ductile Iron Pipe 6 inches in diameter and larger may be screwed directly into the tapped and threaded main without any additional appurtenances.
- C. Corporation stops installed on PVC pipe shall be installed with the use of a service clamp or saddle specifically designed for use on the PVC pipe to be tapped. Generally, corporation stops are located at ten o'clock or two o'clock on the circumference of the pipe. The maximum outlet size recommended with service clamps or saddles is 2 inches. Tapping sleeves and valves are to be used for making taps larger than 2 inches on PVC pipe.
- D. In some cases, with prior approval of CUB, and only on new sections of water mains that have not been connected to the public water distribution system or to any existing and active service line, service connections will be allowed to be constructed to the curb stop prior to CONTRACTOR's pressure testing and disinfection procedures. Then, after pressure testing and disinfection procedures are completed for the mains and the service lines, and after bacteriological testing analyses determines the piping to be clear and safe, CUB will advise the CONTRACTOR that water service line connections can be connected to existing customer service lines.

- E. No temporary water or sanitary sewer service will be allowed the Owner, Developer or Contractor for their use before, during or after the construction activities without their first having an account for that specific service established with CUB. In other words, no connection can be made to any CUB-owned public water or wastewater pipe for service use without CUB having a record of an application and receipt of all fees and deposits being paid, and a billing account in place for the use of the public utility.

3.12 DISINFECTION PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING LINES

- A. The procedures outlined in Subsection 3.9 above apply primarily to cases in which the lines have been wholly or partially dewatered. However, leaks or breaks that are repaired with clamping devices while the lines remain full of water under pressure present little danger of contamination and require no disinfection. All disinfection shall be in accordance with the latest revision of ANSI/AWWA C651. ANSI/AWWA C651 is included in these contract documents by reference here. Copies can be obtained by contacting AWWA, 6666 West Quincy Avenue, Denver, Colorado 80235 or by calling AWWA at 303-794-7711 or by Internet access at “www.awwa.org”.
- B. When an existing water line is opened, whether by accident or design, the excavated area could be wet and contaminated because of the presence of contaminants nearby. The danger of contamination can be lessened if liberal quantities of hypochlorite are applied to the open trenches. It is better to use tablets for disinfection in such cases because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation site.
- C. Where practical, in addition to the procedures previously described, the section of the main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described herein. The dose may be increased to as much as 300 mg/L and the “contact time” reduced to as little as 15 minutes. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the chlorine concentration in the water exiting the main is no higher than the prevailing water in the distribution system or that which is acceptable for domestic use (less than 2 ppm). Disinfection of lines by the slug method shall be in accordance with AWWA C601.
- D. The following disinfection procedure is considered the minimum that may be used for disinfection when existing lines are repaired:
 - 1. Swab the interior of all pipes and fittings (particularly couplings and tapping sleeves) that are to be used in repairing an existing line with a solution of 5% hypochlorite before installing them.
 - 2. The most practical means of removing contamination introduced into a line during repairs is to give the line a thorough flushing. If the locations of valves and hydrants make it possible, flushing in both directions is recommended. Start flushing as soon as repairs are

completed, and continue until all discolored water and air are eliminated.

E. Bacteriological Samples

- i. Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of the flow is unknown, then samples shall be taken on each side of the main break. If positive bacteriological samples are recorded, then the situation shall be evaluated to determine corrective action. Daily sampling shall be continued until two consecutive negative samples are recorded.

3.13 CLEANUP

After completing each section of water line, all debris and construction materials shall be removed from the work site. Then the surface shall be graded and smoothed on both sides of the line. The entire area shall be left clean and in a condition satisfactory to CUB. The CONTRACTOR shall keep cleanup operations as close to active pipe laying as practical, generally following by less than 300 feet, or as approved by CUB.

3.14 WARRANTY PERIOD

- A. Twelve (12) months following acceptance of the water and/or wastewater system improvements, extensions, etc. a follow-up inspection will be made by CUB to determine if any failures/deficiencies have occurred as a direct result of the contractor's work and/or materials. Present at this inspection will be a representative of CUB, the Owner and/or Developer and/or the Contractor.
- B. The Owner, Developer and/or Contractor will be responsible for correction of any and all failures and/or deficiencies that have occurred during the first year of service as determined by CUB and at no expense to CUB.

END OF SECTION

SECTION 03100

VALVES, BLOWOFFS, AND HYDRANTS

PART 1. GENERAL

- 1.1 This section covers valves, hydrants, and blowoffs for water lines specified under Section 03000 - Water Distribution System.
- 1.2 Valves in water mains shall, where possible, be located within the street rights-of-way or accessible dedicated easements, unless otherwise directed by CUB.
- 1.3 The direction of opening for all valves in CUB's water distribution system shall be counter-clockwise as viewed from the top.
- 1.4 The operating nut shall be between 30 and 36 inches below the finished grade. However, where such is not possible and the depth of the line is over 4 feet below the finished grade, CUB-approved valve extensions shall be furnished and installed by CONTRACTOR.
- 1.5 In general, line valves, or isolation valves, shall be installed at no more than 500 linear feet apart. At least two valves shall be installed at each tee fitting, and at least three valves shall be installed at each cross fitting, unless otherwise directed by CUB.
- 1.6 All valves, blowoffs, and hydrants removed from the system during approved construction operations shall be disposed of at the direction and discretion of CUB.

PART 2. PRODUCTS

For CUB's pre-approved water mains and service piping products, materials and fittings, refer to APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS located near the back of these Standard Specifications. Materials shall be in accordance with the materials specifications contained herein.

PART 3. EXECUTION

3.1 GATE VALVES

- A. Gate valves shall be installed on all fire lines and on all distribution lines 10 inches and smaller in diameter. Valves shall be installed at all intersections of water mains and at each tee and cross as directed by CUB, but at no time greater than 500 feet apart. Gate valves shall have a 2-inch square operating nut, open counter-clockwise.
- B. Gate valves larger than 2 inches shall be mechanical joint, resilient seat, iron body, non-rising stem, "O"-ring, stem seal type, manufactured to meet or exceed the requirements of AWWA C509 or AWWA C515 as determined by

CUB, and in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

- C. Gate valves shall have a pressure rating of at least 250 psi.
- D. Gate valves 2 inches or smaller shall be wedge-type brass gate valves in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- E. Gate valves shall be installed in valve boxes as shown on the Standard Detail Drawing.

3.2 BUTTERFLY VALVES

- A. Butterfly valves shall be installed on lines whose diameters are 12 inches or larger, or as otherwise may be directed by CUB.
- B. Rubber-seated butterfly valves shall meet or exceed the requirements of AWWA C504 or latest revision.
- C. Butterfly valves shall be furnished with a 2-inch operating nut, mechanical joint type, and open counter-clockwise.
- D. Shop drawings of butterfly valves must be submitted to CUB for CUB's approval prior to ordering or use.
- E. Butterfly valves shall be installed with valve boxes as shown on the Standard Detail Drawing and as described in these standard specifications.

3.3 TAPPING VALVES

- A. Tapping valves 12 inches and smaller shall conform to the latest revision of AWWA C509 or AWWA C515, as determined by CUB, and in accordance with the STANDARD AND APPROVED PRODUCTS LIST covering gate and tapping valves, except as may be approved by CUB for modification for passage and clearance of tapping machine cutters.
- B. Tapping valves larger than 12 inches shall conform to AWWA C500 or latest revision and the STANDARD AND APPROVED PRODUCTS LIST covering gate and tapping valves except as approved by CUB for modification for passage and clearance of tapping machine cutters.
- C. Prior to the existing line being tapped, tapping sleeves and valves shall be subjected to a pressure test while in place on the existing water line as follows:
 - i. The tapping sleeve and valve shall be subjected to a hydrostatic pressure equal to 1.5 times the normal working pressure (but not less than 200 psi) for a period of 15 minutes.
 - ii. The connection being tested shall maintain 100 percent of the test pressure throughout the test period.

- iii. The CONTRACTOR shall supply all necessary equipment for testing sleeves. Other details of the test shall be as directed by CUB.
- D. Taps on new pipe construction shall generally be made under pressure (wet) as directed by CUB. But, in some circumstances, if allowed in advance by CUB, may be made dry. Taps to existing piping which has already been placed into service in the public water distribution system shall be made under pressure (wet).

3.4 AIR RELEASE VALVES

- A. Air release valves for water lines shall meet the latest requirements of AWWA Standard C-512. The air release valve shall be of the float-operated, direct lever or compound lever design and capable of automatically releasing accumulated air from a pressurized fluid system while it is in operation. Air release valves shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and as shown on the Standard Detail Drawings.
- B. Air release valves are typically installed at high points in pipelines and at regular intervals of approximately 2,000 feet along uniform grade line, and uniform increasing grade line, pipe or as directed by CUB.
- C. Air release valves shall be 3/4-inch size on pipelines 6 inches in diameter and smaller and 1-inch size on pipelines 8 inches to 12 inches in diameter. For pipes larger than 12 inches in diameter, the air release valves shall be 2-inch size.
- D. Air release valves shall be mounted in the vertical position on top of the pipeline with an isolation valve installed between the main and the air release valve (to be used in the event service of the air release valve is required).
- E. Air release valves shall be installed in meter boxes, pre-cast concrete vaults or manholes as shown on the Standard Detail Drawings and as directed by CUB.
- F. Air release valves may be installed during new construction using a tee or a tapping saddle. For installation of air release valves on existing pipes, a CUB-approved tapping saddle shall be used.

3.5 ALTITUDE VALVES

- A. Altitude valves shall meet the latest requirements of ASTM Standard A536 and ANSI B16.42. This valve shall control the high water level in reservoirs without the need for floats or other devices. It shall be a double-acting, non-throttling type valve and remain fully open until the “shut-off” point (high level in the reservoir) is reached, and then fully open to let water out of the reservoir when the system pressure drops below a certain set point.

- B. The altitude valve and piping assembly shall be entirely housed in a pre-cast concrete vault with traffic-bearing top, access hatch, adequate venting and drainage as approved by CUB.
- C. Shop drawings of altitude valves shall be submitted to CUB for CUB's approval prior to ordering or use.

3.6 PRESSURE REDUCING VALVES (PRV)

- A. Pressure reducing valves shall meet the latest requirements of ASTM Standard A536 and ANSI B16.42 and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST for such valves. The pressure reducing valve shall be designed to automatically reduce a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rates. Pressure reducing valves 4-inch and larger shall have a low flow by-pass line which will have its own pressure reducing valve.
- B. Valves for use on fire service mains shall be UL listed, and shall have pressure gauges installed both upstream and downstream of the Pressure Reducing Valve, and a relief valve of not less than ½ inch in size shall be installed on the down stream side of the pressure control valve. Adequate drainage for the relief valve discharge shall be provided.
- C. Pressure reducing valves installed in traffic areas shall be entirely housed in a pre-cast concrete vault with traffic-bearing top, access hatch, adequate venting and drainage per CUB's requirements and approval.

3.7 BLOW-OFF ASSEMBLIES

- A. Wherever a dead-end occurs, a fire hydrant or blow-off assembly shall be installed as directed by CUB. On mains smaller than 6 inches in diameter, where fire flows are not available, or in other instances where fire hydrants will not be furnished or installed, 2-inch blow-offs or blow-off assemblies shall be installed.
- B. Blow-offs shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and as shown on Standard Detail Drawing. A shop drawing of the proposed blow-off assembly installation should be submitted to CUB for approval.
- C. Blow-off valves shall be at least 2 inches in size and capable of flushing in velocities of 2 feet per second or greater in accordance with the requirements of the TDEC - Division of Water Supply.
- D. Blow-offs shall be installed with valves and in in-ground boxes or as otherwise directed by CUB. Blow-off pipes shall be threaded at the ends with an exterior sleeve to protect the threads.
- E. Blow-off assemblies for dead-end pipe less than 6-inches in diameter shall be assembled by installing a 2-inch size flushing-type fire hydrant, 2-inch post-type flushing hydrant, or 2-inch flush-style flushing hydrant equipped with

one 2 ½ inch hose nozzle having National Standard Hose Coupling threads. Hydrant bury shall be a minimum of 36 inches; CUB's standard is 42-inch bury. Hydrants should have 2-inch NPT screwed in connection, minimum 200 psi or 1.5 times working pressure, and an open counterclockwise operating nut. The operating nut and 2 ½ inch hose nozzle shall be installed either above-ground or in an approved ground-level enclosure.

- F. Blow-offs shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- G. A 2-inch gate valve meeting the requirements set forth under Gate Valves of these Standards shall be installed in the 2-inch pipe approximately three feet from, and upstream of, the blow-off hydrant.

3.8 VALVE BOXES

- A. Valve boxes shall be the two-piece Buffalo screw type, 5-1/4-inch diameter shaft, capable of extending from valve stuffing box to ground surface and constructed of cast iron. Valve boxes shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and as shown on the Standard Detail Drawings herein.
- B. A valve box alignment device shall be installed over the valve operating nut of all valves, located on, at or below the bottom of the operating nut on the valve, to facilitate valve boxes being installed plumb from valve nut to surface. Valve box alignment devices shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- C. Valve box lids shall be provided with the word "WATER" embossed in the lid surface. Lids shall be compatible with the box lid receptacle. Lids shall include a skirt of at least 1½ inches and weigh no less than 12 pounds. Where valve boxes are installed in public street and/or roadways having a classification of major collector or greater, lids shall have a skirt or at least 2½ inches and weigh no less than 15 pounds.
- D. The assembled valve box weight (including lid with 1½ inch skirt) shall be no less than 60 pounds for 12-inch to 24-inch extension; 80 pounds for 24-inch to 36-inch extension; and 90 pounds for 36-inch to 48-inch extension.
- E. Shop drawings of valve boxes shall be submitted to CUB for approval.
- F. For valve boxes installed in grassed or landscaped areas, at grade shall be a 4-inch thick pad of concrete, approximately 15-inch by 15-inch in size, around the top of the valve box. Valve boxes shall be installed with the opening centered over the valve operating nut. A valve box alignment device shall be installed over the valve operating nut of all valves, located at or below the bottom of the operating nut on the valve, to facilitate valve boxes being installed plumb from valve nut to surface. Such alignment shall be maintained during all backfilling operations.

- G. Each and every valve box will be inspected by CUB to ensure proper alignment prior to final acceptance and payment (contain no rocks, dirt or debris).

3.9 HYDRANTS

- A. Hydrants shall conform to the latest requirements of AWWA C-502.
- B. Hydrants shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. Hydrants furnished shall be 3-way, 42" bury (from ground line to bottom of pipe), in accordance with AWWA C502, and as shown on the Standard Detail Drawing.
- C. All hydrants shall be equipped with two 2½ inch hose outlet nozzles and one 5¼ inch pumper outlet nozzle. Nozzle threads shall conform to NFPA No. 194 for National Standard Fire Hose Coupling Screw Threads.
- D. Hydrants shall be installed on a 6-inch ductile iron "leg" with a 6-inch gate valve to isolate the hydrant from the water distribution system. The valve shall be located approximately three (3) feet from the hydrant. Size of hydrant main valve inlet shall be 5 ¼ inch nominal diameter. Size of hydrant inlet shall be 6-inch, mechanical joint (MJ), and provided with one set of MJ accessories. When installed, the center of the pumper nozzle and hose outlets shall be a minimum of 18 inches above the final grade (ground line).
- E. The operating nut shall be pentagonal in shape, and operating nut shall open counter-clockwise. The nut shall not be less than one-inch in height, measuring 1 ½ inches from point to flat at the base of the nut and 1 7/16 inches at the top.
- F. The finish paint shall be an oil base. The color of the finish paint above the ground shall be in accordance with the requirements of TDEC and CUB and based upon actual hydrant flow operations and residual pressures as determined by the area fire department, and as further described below in Paragraph P. - Classification and Marking of Fire Hydrants of this Section.
- G. Hydrants shall be equipped with harnessing lugs.
- H. Hydrants shall be aligned vertically and at the height satisfactory to CUB. Hydrants shall be located a minimum of 2 feet and no greater than 10 feet from the face of existing curb or edge of pavement, or at a location as directed by CUB. When curbing does not exist the distance should be a minimum of four (4) feet and no great than fourteen (14) feet from the edge of pavement.
- I. Hydrant shoes shall have two (2) positive-acting non-corrodible drain "valves" that drain the hydrant completely by opening as soon as the main valve is closed. The drain valve shall consistently close tightly when the main valve is open. Drain valves operated by springs or gravity will not be acceptable.
- J. CONTRACTOR shall provide for drainage at the base of the hydrant by placing coarse gravel or clean crushed stone from the bottom of the trench to

at least 6 inches above the waste openings in the hydrant to a distance of 18 inches below the elbow. Such drainage system shall not be connected to a sanitary sewer line.

- K. Should CUB determine necessary, CUB may direct CONTRACTOR to rod gate valves to the tee on the main and to the hydrant shoe. Tie rods shall be required on all fire hydrant installations and shall be fully coated with a bituminous black paint as approved by CUB.
- L. Hydrant extensions shall be used when required to place the hydrant nozzles at the proper elevation as determined by CUB. Extensions shall be compatible with the fire hydrant being adjusted and shall have one set of shear bolts in the top flange and machine bolts in the bottom flange.
- M. Hydrants shall be set to the established grade, with the lowest nozzle at least 12 inches above the ground or as required by CUB. The lowest nozzle shall be installed away from the curb line at a sufficient distance to avoid damage from or to vehicles. Traffic-model hydrants shall be installed so that the breakaway flange is not less than 2 inches or more than 6 inches above established or known finished grade. In the case of such hydrants, that are intended to fail at the ground-line joint on vehicle impact, specific care must be taken to provide adequate soil resistance to avoid transmitting shock moment to the lower barrel and inlet connection. In loose or poor load-bearing soil, this may be accomplished by pouring a reinforced concrete collar approximately 6 inches thick to a diameter of 2 feet at or near the ground line around the hydrant barrel as directed by CUB.
- N. When a dry-barrel hydrant is set in soil that is impervious, which is typical in the Clinton area, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least 6 inches above the drain port opening in the hydrant and to a distance of one foot around the elbow.
- O. Classification and Marking of Fire Hydrants
 - i. Classification of Hydrants
 - 1. Hydrants shall be classified in accordance with their rated capacities at 20 psi residual pressure, per NFPA 291-5.1 as follows:
 - a. Class AA – Rated capacity of 1,500 GPM or greater
 - b. Class A – Rated capacity of 1,000 to 1,499 GPM
 - c. Class B – Rated capacity of 500 to 999 GPM
 - d. Class C – Rated capacity of less than 500 GPM

- ii. Marking of Hydrants

1. The tops and discharge caps of all hydrants shall be painted with the following capacity indication color scheme, per NFPA 291-5.2.1.2 & 5.2.1.4, as follows:
 - a. Class AA – Light Blue
 - b. Class A – Green
 - c. Class B – Orange
 - d. Class C – Red
 - e. Hydrants rated at less than 20 psi residual pressure shall have the rated pressure stenciled in Black on the hydrant top.
- iii. Fire Department pumper trucks, or any other pumping apparatus, shall not be allowed to connect directly to any force hydrant with a flow of less than 500 GPM at 20 psi residual pressure (Class C hydrant).
- iv. Class C hydrants may be used to fill booster tanks, tanker apparatus or portable dump tanks provided that a sufficient air gap is maintained to prevent backflow and contamination of the public water distribution system.

END OF SECTION

SECTION 03200

WATER SERVICE ASSEMBLIES

PART 1. GENERAL

The work to be performed herein shall consist of the installation of water service assemblies, which may include a tapping saddle (service clamp), corporation stop, service pipe, curb stop, copper setter with integral stop and check valve, possibly a re-setter, meter, meter box and lid as required by project plans and specifications and according to the pertinent Standard Detail Drawing(s) located in APPENDIX B herein.

PART 2. PRODUCTS

For CUB's pre-approved water mains and service piping materials and fittings, refer to APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS located near the back of these Standard Specifications. Materials shall be in accordance with the materials specifications contained herein.

2.1 CORPORATION STOP:

- A. The corporation stop shall meet the latest requirement of AWWA C-800.
- B. For tapping directly into 6 inch diameter and larger ductile iron pipes, Corporation Stops shall be furnished with AWWA tapered thread inlets and compression connections for Type-K copper service pipe outlets. Taps onto PVC mains and Ductile Iron mains 4 inches in diameter and smaller shall utilize a Corporation Stop installed with a CUB-standard full-pipe brass tapping saddle.
- C. Corporation stops shall be limited to size ¾-inch and 1-inch.
- D. Corporation stops shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

2.2 SERVICE PIPE: Service pipe 2 inches in diameter and smaller shall be Type-K copper meeting ASTM B88. Service pipe larger than 2 inches in diameter shall be Class 250 PVC. Service pipe shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

2.3 COPPER SETTERS: Copper setters shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and shall conform to Standard Detail Drawing contained in APPENDIX B of these Standard Specifications.

2.4 WATER METERS:

- A. All water meters installed within the public water distribution system shall meet the latest requirements of AWWA Standard C-700, shall match CUB's standard meter specifications and shall be approved by CUB prior to any such installation.
- B. All water meters shall be the frost-proof type with cast iron bottom plates.

- C. Casting shall be of copper alloy containing not less than 75 percent copper.
- D. Register shall be the hermetically sealed magnetic type, straight reading, U.S. Gallons with test hand.
- E. All 5/8-inch through 1-inch meters allowed within CUB's public water system shall be positive displacement measuring chamber design, roll-sealed register, bronze main case meters which meet or exceed the latest revision of AWWA C700.
- F. All 5/8-inch by 3/4-inch and 1-inch water meters shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- G. All 1 1/2-inch through 6-inch water meters will be as approved by CUB on a case-by-case basis and will depend upon flow, pressure and installation specifics.
- H. Shop drawings and performance data for water meters greater than 2-inch size shall be submitted to CUB's Director – Water & Sewer Department for approval. Flow demand, head loss, and range of user's expected flows will be considered by CUB in making evaluation of such meters. All meters greater than 2-inch shall be of the compound design and shall be installed with an external bypass and lockable isolation valve. CUB shall determine what specific meter and configuration shall be allowed or required in each installation.
- I. All water meters must meet or exceed requirements of the latest revision of AWWA C700 and shall conform to the Materials Specifications and Standard Detail Drawing. (AWWA Standard C700 is hereby included in these contract documents by reference here. Copies can be obtained by contacting AWWA, 6666 West Quincy Avenue, Denver, Colorado 80235 or by calling AWWA at 303-794-7711 or by Internet access at "www.awwa.org".)

2.5 METER BOXES:

- A. Meter boxes for 5/8-inch x 3/4-inch assemblies shall be:
 - i. Typically pre-cast concrete or reinforced ABS plastic boxes are to be used in non-traffic areas. These boxes shall be 15 inches in diameter with a minimum depth of 18 inches and a maximum depth of 30 inches, and as approved by CUB. The cover shall be a flat, one-piece cast iron cover or CUB-approved equal, with a 15 inch opening.
 - ii. Traffic-rated iron or steel boxes and covers shall be required for installation within roadways, paved areas or any other location where vehicular traffic would likely drive over a meter box. Such traffic-rated meter boxes and lids shall be of a type and construction as approved by CUB on a site-specific basis. These boxes shall be minimum of 15 inches in diameter with a minimum depth of 18 inches and a maximum depth of 30 inches, and as approved by CUB. The cover shall be a flat, one-piece cast iron designed to be used in traffic areas and capable of withstanding that area's projected traffic loading, and designed to fit on the meter box in such a manner that it will not slide or flip off the meter

box under traffic loading conditions but can be relatively easy to open to allow the meter to be read, and as approved by CUB.

- B. Meter boxes for 1-inch to 2-inch assemblies outside of roadways (non-traffic areas) shall be of reinforced plastic material, 21 inches in diameter with a minimum depth of 24 inches and a maximum depth of 36 inches, and as approved by CUB.
- C. Meters larger than 2-inch size shall be installed in vaults designed for such installations. Drawings of the proposed vaults shall be submitted to CUB's Director – Water & Sewer Department for approval. Vaults in general shall be large enough for personnel to enter to remove or work on the meter, 36 inches in depth and constructed of either pre-cast reinforced concrete, poured-in-place reinforced concrete, or have concrete bottoms and sides constructed of mortared block or brick. These vaults shall have factory-type covers made of aluminum for non-traffic areas, or in traffic areas iron or steel designed to withstand traffic loading, with integral access hatches for reading of the meter. Vaults and covers shall be as approved and installed as directed by CUB. All meters greater than 2-inch shall be installed with isolation valves to allow for removal of the meter and a bypass with lockable isolation valve to allow for continued water service during meter testing and/or change out.
- D. Meter box sections shall be designed for receiving covers. Covers and upper meter box sections shall be designed for easy cover removal and such that cover top surface when set will be flush with that of the upper meter box section rim.
- E. All meter boxes shall conform to Standard Detail Drawing and in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

2.6 TAPPING SADDLES:

- A. Saddles shall be used in connecting $\frac{3}{4}$ -inch and 1-inch potable water service taps to PVC pipe, ductile iron pipe 4 inches in diameter and smaller, galvanized or asbestos pipe, as well as for tapping ductile or cast iron pipe for services larger than 1-inch and for all air release valves regardless of tap size.
- B. Saddles for PVC water main pipe shall be single wide strap, two-part type. The upper and lower castings may be hinged together with a silicon bronze pin. The screws connecting the upper and lower castings shall be of silicon bronze. The lower casting shall be tapped to accept the screws. Saddles shall be designed to form a hydraulic seal between the pipe and a rubber gasket.
- C. Saddles for Ductile Iron, Cast Iron, and AC water main pipe shall be double strap, two-part type. The upper and lower castings may be hinged together with a silicon bronze pin. The screws connecting the upper and lower castings shall be of silicon bronze. The lower casting shall be tapped to accept the screws. Saddles shall be designed to form a hydraulic seal between the pipe and a rubber gasket.
- D. Outlets of saddles shall be tapped $\frac{3}{4}$ -inch or 1-inch AWWA thread for installation of a corporation stop.

- E. Saddles shall be designated to be satisfactory for use with water pressures up to 250 psi in accordance with AWWA Standard C-800.
- F. Saddles shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- G. Tapping saddles shall be threaded to accept the corporation stop specified above. Two wraps of 3-mil Teflon tape shall be used on threads of stops. For cast iron water mains 6 inches and larger in diameter, direct taps for up to 1" service line sizes may be permitted. No taps larger than 1-inch shall be directly made into any size pipe without prior approval by CUB.

2.7 SERVICE FITTINGS:

- A. Service fittings for use in 3/4-inch and 1-inch copper service tubing shall meet the latest requirements of AWWA Standard C-800 and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- B. Adapters for use in 3/4-inch and 1-inch copper service tubing may be straight, quarter bend, or eighth bend.
- C. Brass plugs of either 5/8-inch, 3/4-inch or 1-inch size having AWWA threads shall be used to plug taps where corporation stops have been removed from service.

PART 3. EXECUTION

- 3.1 Service assemblies shall be as shown on the Standard Detail Drawing.
- 3.2 Taps shall not be made on dry lines without written approval from CUB.
- 3.3 There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating material may be discharged or drawn into the public potable water distribution system.
- 3.4 All service lines shall have a minimum of 24 inches of cover. No pipe splices shall be allowed between the main and the meter without the approval of CUB. After the line is installed and copper setter installed, flush the service line through the copper setter prior to meter installation. All service lines must be inspected and approved by CUB prior to any backfill operations.
- 3.5 When freezing conditions are occurring, or when weather reports forecast freezing conditions may occur before backfill can be completed, CONTRACTOR shall not make new taps on live water mains or install live service assemblies unless CONTRACTOR is sure CUB approvals and protective backfill can be completed before freezing will occur. CONTRACTOR shall be responsible for any and all damages to mains and/or service lines and/or meter assemblies which may be caused from freezing due to CONTRACTOR exposing live water mains or services.

- 3.6 In general, install the meter box in the street right-of-way and as near to the property line as possible. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter the box from the top. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top of slope, as applicable, or as directed by CUB.
- 3.7 The service line shall not be taut from the corporation stop to the curb stop; leave enough slack to allow for expansion, contraction and backfill stresses.
- 3.8 Set the copper setter perpendicular to, and in line with, the final or proposed grade.
- 3.9 The CONTRACTOR shall furnish temporary potable water or other method to serve existing customers with a dependable and consistent potable water supply, as required and approved by CUB, whenever and wherever WORK or IMPROVEMENTS are being conducted which would interrupt water service to these customers for a period of more than three consecutive hours or when work may necessitate interruption of water service for more than two such events in a 24-hour period.
- 3.10 All services to be abandoned on active mains shall be cut and plugged at the main, as approved by CUB. The disposal of the meter box and service assembly shall be at the sole discretion of CUB.
- 3.11 All services that are called to be totally replaced shall be constructed from the main to the meter, as shown on the plans or as directed by CUB.
- 3.12 All existing water service lines encountered during construction that are to be reconnected to the public main but are not of Type-K copper pipe shall be replaced with Type-K copper piping as directed by CUB. No pipe splices shall be allowed between the main and the meter without the approval of CUB.
- 3.13 Backflow preventers may be required in accordance with TDEC-DWS's *Backflow/Cross-Connection Control Program* and *Backflow/Cross-Connection Control Program* and CUB's *Backflow/Cross-Connection Control Program*, which are located in APPENDIX C of these documents.

END OF SECTION

SECTION 04000

WASTEWATER (SANITARY SEWER) COLLECTION SYSTEM

PART 1. GENERAL

The work to be performed herein shall consist of the installation of wastewater gravity main lines, force mains and lateral (service) connections according to these Standard Specifications and Standard Detail Drawings contained herein.

A stamped copy of the TDEC Division of Water Resources's approved Plans and Specifications must be kept on the job site at all times during the construction of the project work.

The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project and approved by CUB.

Plans and construction drawings, specifications, and calculations including hydraulic flows must be prepared and sealed by a Professional Engineer licensed to practice in the State of Tennessee. Design shall be in conformance with the requirements of the State of Tennessee Department of Environment and Conservation, Division of Water Resources (TDEC-WPC) and CUB's most current edition of *Standard Specifications for Construction of Water and Sewer Utilities*.

TDEC-WPC's REGULATIONS FOR PLANS, SUBMITTAL AND APPROVAL CHAPTER 400-4-2 CONTROL OF CONSTRUCTION; CONTROL OF OPERATION – June 2001, 400-0-2-.05 FINAL PLANS, CONTRACT DRAWINGS AND SPECIFICATIONS, state:

Construction work shall not be commenced on any new construction or major change of existing facilities or for any activity outlined in Section 69-3-108 of the Act until complete and final plans and specifications for such activities have been submitted to and approved in writing by an authorized representative of the Commissioner. No such approval shall be construed as creating the presumption of correct operation or as warranting by the Commissioner or by his representative that the approved facilities will reach the design goals. The final contract drawings and specifications shall conform to the conditions outlined in the guidelines for preparing such plans as published by the Tennessee Department of Public Health. Final plans should be blue line on 24 inch by 36 inch sheets with all sheets the same size. Final plans and specifications must be submitted to a representative of the Commissioner in quadruplicate for review and comment or approval except for projects of sufficiently limited scope for which the Commissioner's representatives shall be allowed to accept final plans and specifications in duplicate. All submittals of final plans and specifications shall be made at least thirty (30) days before action is desired. Upon approval of a submittal in quadruplicate, each complete set of plans and specifications will be stamped with the official stamp of approval; two sets will be retained by the Tennessee Department of Health and Environment and the other two sets will be returned to the person submitting the plans. Upon

approval of a submittal in duplicate each complete set of plans and specifications will be stamped with the official stamp of approval; one set will be retained by the Tennessee Department of Health and Environment and the other set will be returned to the person resubmitting the plans. If construction has not commenced in accordance with approved plans and specifications within one (1) year from the date of approval of said plans and specifications, the approval shall be subject to re-evaluation and may be declared null and void. The final plans and specifications shall be prepared in accordance with generally accepted wastewater engineering practices.

And,

400-5-2-.02 SUPERVISION OVER OPERATION OF PUBLIC SEWERAGE SYSTEMS.

(1) Preliminary Information: Whenever any new construction or any change of an existing system is contemplated, a statement concerning the proposed construction or change together with such preliminary plans, reports, operating cost data, construction cost estimates, and any other necessary data shall be submitted to the Tennessee Department of Public Health. These data will be reviewed by the Department to determine if sufficient information has been provided for review of the project and if the proposed project meets the Department's general design standards or if additional changes will be necessary prior to preparation of the final plans and specifications. The Department's approval should be obtained in writing prior to preparation of the final plans and specifications.

(3) Final Plans. Before work is commenced on any new construction or change of an existing system, final plans and specifications and cost estimates, together with such additional data as may be necessary to determine the suitability of the works, shall be submitted to the Tennessee Department of Public Health, and no part of the work shall be started until the Department has given its written approval. All such plans should be submitted at least 30 days prior to the date upon which action of the Department is desired. After construction has been completed, a set of "As Built" plans shall be submitted to the Department.

(4) Revision of Plans. All changes in the plans and specifications requested by the Department must be made and approved by the Department prior to construction. In case it is necessary or desirable to make any additional changes in the approved plans and specifications, revised plans and specifications, together with a statement of the reasons for the changes, shall be submitted to the Tennessee Department of Public Health for review and no part of the work affected by the change shall be started until the Department has given its approval in writing.

(5) Work in Conformity with Plans and Specifications. A copy of the approved plans and specifications shall be available at the job site at all times during construction. All work on new construction or changes of existing systems shall be done in conformity with the approved plans and specifications. The consulting or design engineer shall provide adequate inspection during construction to ascertain that all work is done in accordance with the approved plans and specifications. The Department's representative shall have access to the project at all times during

construction. If the Department's representative observes work being done in a manner that does not conform to the approved plans and specifications, a request will be made through the engineer's representative or directly to the contractor to cease all work until the nonconformity with the approved plans and specifications has been rectified.

Engineering and construction plans and specifications shall be approved and signed off on by CUB's Water & Sewer Department Director before they are sent to the Tennessee Department of Public Health for their review. Immediately following TDEC-WPC's approval, a copy of the letter from TDEC-WPC with their approval to construct shall be sent to CUB's Water & Sewer Department Director.

PART 2. PRODUCTS

2.1 WASTEWATER COLLECTION PIPE

For CUB's pre-approved wastewater mains and service piping materials, products and fittings, refer to APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS located near the back of these Standard Specifications.

Prior to installation of any materials, all materials must be visually inspected by CUB at the site for conformance to the Standard Specifications. The CONTRACTOR shall contact CUB to establish a mutually agreeable time when a CUB representative can meet at the site with the CONTRACTOR to examine the materials and products to be used. At CUB's discretion, the CONTRACTOR may be required to supply certified mill tests, samples, or other suitable form of verification that the material and/or product meets the required specifications.

- A. Polyvinyl chloride (PVC) sewer pipe and fittings shall meet or exceed the requirements of ASTM D3034, SDR 35 for pipe from 4" to 15" in diameter. For sizes from 18" to 27" in diameter the pipe shall meet or exceed the requirements of ASTM F-679, wall thickness T-1. All PVC pipe shall be manufactured from virgin, NSF-approved resin conforming to the requirements of ASTM Standard D1784 and shall meet the requirements of the Materials Specifications herein. All PVC pipe shall conform to the requirements of either ASTM Standard 3034 and have a Standard Dimension Ratio (SDR) of 35 or, AWWA Standard C900. Use of ASTM 3034/SDR35 PVC pipe shall be limited to depths less than ten (10) feet.
- B. Where depths to the top of the sewer pipe are ten (10) feet or more, AWWA C900 PVC pipe or Ductile Iron Pipe, lined with *Induron Protecto 401 Ceramic Epoxy* in accordance with these Standards for use of ductile iron pipe in wastewater main construction, shall be used. Ductile iron pipe shall be made of good quality ductile iron in conformance with the latest revision of ANSI/AWWA C-151/A21.51 Standard. The pipe shall be push-on joint with a minimum Class 50 thickness and pressure class of 150 psi with either mechanical joints or slip-on joints with rubber gaskets. All ductile iron pipe

and fittings to be installed for the purpose of conveying wastewater shall be lined with *Induron Protecto 401 Ceramic Epoxy* in strict accordance with manufacturer's specifications for such lining. Ductile iron pipe and fittings shall further conform to the requirements of the Materials Specifications contained herein.

- C. Sewer laterals shall include 6-inch tees of the same material as the sewer main, which are able to withstand all test pressures without leakage.

2.2 MANHOLES

- A. Manholes shall be constructed in accordance with Section 04100 of these specifications, as per AASHTO M-199 or ASTM C-478, and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- B. Manhole inside diameters shall be 48 inches for 18-inch and smaller diameter pipe, and 60 inches for 21-inch to 30-inch diameter gravity pipe connections.
- C. Flexible couplings (boots) with water-tight seals shall be cast in the manhole to provide for the required number and size pipes and shall be marked to insure installation at proper locations.
- D. Premolded rubber "O"-ring, as supplied or recommended by the manhole manufacturer and in accordance with the STANDARD AND APPROVED PRODUCTS LIST, shall be used at all joints to form water-tight connections between sections of the manhole.
- E. Unless otherwise approved by CUB, top sections shall be eccentric cones. Use flat top covers if internal height is less than 36 inches, if inside working area is restricted or in other areas where it is deemed appropriate and only if approved by CUB.
- F. The base of the manhole shall be a precast section with openings and flexible connections sized to accept the sewer inlet and outlet pipes.
- G. Preformed or field-formed inverts shall be shaped from Class B concrete to be smooth, accurately shaped, and in accordance with the approved Construction Plans and CUB's Standard Drawings.

2.3 MANHOLE STEPS

Manhole steps shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and Section 04100 of these Standard Specifications.

2.4 MANHOLE RINGS AND COVERS

Manhole rings and covers shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and Section 04100 of these Standard Specifications.

2.5 FLEXIBLE COUPLINGS

- A. Flexible couplings are to be designed and constructed to join sewer pipes of the same or different material or sizes. Flexible couplings shall fit over the end of plain end or spigot pipe to form a positive seal against infiltration and exfiltration in low-pressure (less than 5 psig) and non-pressure applications. Flexible couplings shall be designed and constructed to flex with normal earth movement while maintaining the integrity of the watertight seal.
- B. Flexible couplings shall be manufactured from Elastomeric Polyvinyl Chloride (PVC), be unaffected by soil conditions, and resistant to chemical, ultraviolet rays, and normal sewer gases. The PVC material shall contain bactericide and fungicide to inhibit growth of bacteria and fungus. The PVC material shall be 55 (minimum) to 65 (maximum) Durometer hardness using the “Shore A” scale in accordance with ASTM D2240 00. Couplings shall conform to the applicable parts of ASTM C-443, C-425, C-564, and D-1869.
- C. Flexible couplings shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST and Section 04100 of these Standard Specifications and installed as necessary to provide a watertight seal for the joint.
- D. Pipe to be coupled with flexible couplings must be properly bedded with specified stone as necessary to prevent any settling after the coupling has been installed. Over-excavation and backfill with bedding stone may be required by CUB to ensure proper bedding of pipe at coupling.
- E. Flexible couplings shall be approved and listed by the following code agencies: SBCCI (Southern Building Code Congress International, Inc.), BOCA (Building Officials & Code Administrators International, Inc.), IAPMO (International Association of Plumbing and Mechanical Officials), and CSA (Canadian Standards Association).

2.6 SADDLE TEES

Saddle tees shall consist of a gasketed skirt sized to fit the existing pipe and an integral 6-inch branch connection and securely strapped to the pipe to provide a watertight seal. Saddle tees shall meet the requirements of ASTM 3034 and F477 and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

PART 3. EXECUTION

Unless otherwise specified, the Contractor shall be directly responsible for his and his personnel's knowledge of and adherence to the rules, regulations and requirements of the following agencies:

- ✓ Occupational Safety and Health Act;
- ✓ Tennessee Occupational Safety and Health Act;
- ✓ Tennessee Department of Transportation;
- ✓ Anderson County Highway Department;
- ✓ City of Clinton Police, Fire and Public Works Departments;
- ✓ Clinton Utilities Board;
- ✓ Environmental Protection Administration;
- ✓ Tennessee Department of Environment and Conservation;
- ✓ Anderson County Health Department;
- ✓ Federal, State and local Erosion Control agencies; and
- ✓ Other such department or agency that has jurisdiction or authority over the different activities of the Contractor and/or Owner/Developer as they perform and construct the various types of improvements for CUB in the performance of the project work.

The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project and approved by CUB.

3.1 REQUIRED PRE-CONSTRUCTION ACTIVITIES

A. Prior to commencement of work:

1. Contractor shall supply two (2) complete sets of approved construction drawings, and copies of all easements, applicable permits and licenses, to CUB's Water & Sewer Department Director.
2. Contractor shall attend a mandatory pre-construction meeting with CUB staff. Responsible representatives for the contractor, subcontractors (if any) and Owner/Developer must attend. Attendance of the Engineer is optional unless required by CUB.
3. Contractor shall supply material submittal sheets on all materials to be installed. Submittal sheets must contain manufacturer, required standards to be met, and marks or highlights to indicate model, size, type and material of material proposed for the project. All submittals must be approved by CUB prior to start of construction.
4. Contractor or Engineer shall submit the Construction Start Notification to the Tennessee Department of Environment & Conservation – Division of Water Resources and shall supply a copy of this Notification to CUB.
5. At least three (3) working days prior to beginning any excavation, Contractor shall be responsible to mark all areas to delineate where excavations are necessary and then call the Tennessee One Call System

notifying them of an intent to dig and requesting utility locates for all areas to be excavated.

6. Contractor shall keep “locates” current with Tennessee One Call System throughout the schedule of activities of the project work.
7. The Contractor or Owner/Developer may be required to provide a cash deposit, bond, certified check, or other acceptable form of security for the amount of the work to be completed or a portion thereof pursuant to the approved construction plans. The amount of the security shall be determined by and at the discretion of CUB. Should the work not be performed according to these Standards and/or other applicable requirements, CUB may execute the security for the purpose of remediation of any deficiencies and/or for the completion of the project. Within sixty (60) days of the completion and acceptance of all provisions of the approved plans, cash deposits or other legal arrangements, or unexpended or unobligated funds thereof, shall be refunded or terminated.

3.2 PREPARATION

A. Precautions and permit to excavate:

1. Contractor shall abide by each utility company’s requirements when excavating in the vicinity of, repairing, replacing and/or disturbing their existing mains, services, or other facilities.
2. For all work to be performed with the city limits of the City of Clinton, and prior to any excavation being performed within any public right-of-way, including public alleys and easements, Contractor shall contact the Director of the City of Clinton Public Works Department to determine what requirements are for the excavation and repairs to the disturbed areas and obtain a written permit if required.

3.3 EASEMENTS, RIGHTS-OF-WAY

A. For work to be performed or constructed across private property by Owner/Developer to extend public mains, or otherwise make improvements to the public water and/or wastewater systems within CUB’s service area, which will be turned over to CUB for ownership and maintenance, and prior to beginning any such work, such Owner/Developer shall:

1. Determine what easements and or rights-of-way will be required for CUB to own, maintain and/or replace these improvements once they have been constructed, approved by CUB and turned over to CUB for ownership and maintenance,
2. Perform any surveying necessary to formally determine and describe the easements and/or rights-of-way,
3. Develop written descriptions of the easements and/or rights-of-way,
4. Complete CUB’s standard Easement and Right-of-Way Acquisition form or similar form acceptable to CUB,

5. Obtain all necessary easements and/or rights-of-way from affected private property owners,
 6. Record all signed and notarized easements and rights-of-way at the Anderson County Courthouse,
 7. Provide CUB with copies of recorded plats of any and all public easements and/or rights-of-way for the proposed construction of public utilities, and these shall be recorded as dedicated exclusively to CUB (for CUB to construct, maintain, and/or replace the various water and sanitary sewer improvements to be constructed by Owner/Developer).
- B. Permanent easements are required for all public wastewater mains not located within the public street right-of-way. The typical easement width is 20 feet. Easements wider than that may be required by CUB when conditions warrant. Where the wastewater main is located near structures the easement must provide 15 feet lateral clearance between the main and the structures. If that clearance cannot be obtained, the wastewater main must be installed in a CUB-approved encasement pipe.
 - C. An easement for a public main located along a private roadway should include the width of the roadway plus the area between the main and the roadway plus an additional 10 feet on the side of the main opposite the roadway.
 - D. Blanket easements are not acceptable.
 - E. Easements granted for public mains should be specifically described with dimensions and angles sufficient to allow the easement to be accurately located.
 - F. The dedication of any easement shall prohibit the location of permanent structures on, under or over the easement and shall allow CUB access to the easement for construction, reconstruction, replacement, repair, operation, and maintenance purposes; and shall hold CUB harmless for the cost of replacement or damage to any improvement or vegetation within the easement. Other appropriate or necessary requirements may also be included. Earth embankments, added subsequent to main construction, which increase that cover shall not be permitted without specific written approval by and from CUB.
 - G. It shall be the responsibility of the Engineer/Owner/Developer and/or Contractor to ensure that the utilities are placed within these recorded easements and/or rights-of-way and the water and/or sewer lines are installed within two (2) feet either side of the center line of the recorded easement and/or right-of-way. Utilities installed more than two feet from the centerline of the recorded easements and/or rights-of-way will require that the Owner/Developer and/or Contractor either relocate the utilities in question to a location within two feet either side of the center line of the recorded 20-foot wide easement or obtain additional easements and/or rights-of-way as necessary to provide CUB with an easement width of 10 feet either side of the centerline of the newly installed utility line or lines.

- H. All costs associated with the development, acquisition and recording of the necessary easements shall be the sole expense of the Owner/Developer.

3.4 INSPECTION

- A. The installation of all pipes and appurtenances that are to become the property of CUB and/or will become the responsibility of CUB for ownership and maintenance shall be inspected and approved by CUB during construction. No backfilling of trenches or excavations will be allowed until the pipes, manholes, service lines and metering assemblies, air-release/vacuum valves, etc. in place have been visually inspected and approved by CUB.
- B. At least three (3) working days prior to the time the work is scheduled to begin Contractor and/or engineer shall notify CUB's Water & Sewer Department Director of his intent to construct system improvements and the specific location of where the work will be performed. CUB will then schedule to have a CUB representative on site to inspect Contractor's work prior to any backfilling operations. CUB's representative may not be able to be on site during the entire work day or work period, but CUB's representative will visit the site on a periodic basis during the work day to inspect work performed and, as CUB's approvals are earned, Contractor will be allowed to backfill open trenches and excavations as his work progresses.

3.5 TRENCH EXCAVATION

- A. Perform work in such a manner as to form a suitable trench in which to safely install the work of the project and so as to cause the least inconvenience to the public.
- B. Cut pavements along neat, straight lines with a pavement saw.
- C. Trench depth shall be a minimum of four feet plus the outside diameter of the pipe, or as otherwise necessary to remove any unsuitable bedding materials as directed by CUB and in accordance with these Standards.
- D. Align trench as shown on the plans.
- E. Shape the bottom of the trench to provide uniform bearing of the pipe on undisturbed earth throughout its entire length. Dig bell holes to aid in securing uniform support of the pipe.
- F. When unstable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline and backfill to the proper grade with #57 or #67 stone.
- G. Remove rock encountered in the trench excavation to a depth of 6 inches below the bottom of the pipe barrel, backfill with suitable earth, and compact to uniformly support the pipe.

3.6 PIPE INSTALLATION

- A. The installation of all pipe, manholes, etc. that will become the property of CUB or responsibility of CUB for maintenance must be inspected by CUB during construction and prior to any backfilling operation. CONTRACTOR shall not begin the backfilling of trenches until the pipe in place has been visually inspected and approved by CUB.
- B. Pipe installation shall begin at the lowest elevation, unless otherwise approved by CUB. Before placing sewer pipe in position in the trench, CONTRACTOR shall carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as provided in Section 01600 - Unclassified Excavation and Backfilling or as required by federal or state OSHA, whichever is more stringent, and in accordance with good and safe construction practices.
- C. Lasers shall be used by CONTRACTOR to install sewer lines, and the type and procedures shall be approved by CUB. Reference points for both line and grade shall be set at each manhole. CONTRACTOR shall check the elevation of the beam each 100 feet with an offset point or engineer's level.
- D. CONTRACTOR shall not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Therefore, CONTRACTOR shall not at any time open up more trench than the available pumping facilities are able to dewater.
- E. Trench bottoms that are found to be unsuitable for foundations after pipe laying operations have started shall be corrected by CONTRACTOR bringing them to exact line and grade with bedding materials approved by CUB.
- F. CONTRACTOR shall carefully inspect each piece of pipe and special fitting before it is placed, and shall lay no defective pipe in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. When pipe laying is not in progress, CONTRACTOR shall keep the ends of the pipe tightly closed with an approved temporary plug.
- G. Excavation for bell holes shall be large enough to allow ample room for the pipe joints to be properly made. CONTRACTOR shall excavate out bell holes no more than 2 joints ahead of the pipe laying, and carefully grade the bottom of the trench between bell holes so that each pipe barrel rests on a solid. Install each pipe with a close concentric joint to avoid sudden offsets or inequalities in the flow line.
- H. As the work progresses, CONTRACTOR shall thoroughly clean the interior of the pipe in place. After each line of pipe has been laid, CONTRACTOR shall carefully inspect it, and remove all earth, trash, rags, and other foreign matter from its interior.
- I. CONTRACTOR shall install wye or tee branches in sewer lines to serve each lot adjoining the sewer and at such other locations as may be designated by CUB. If wye or tee branches are not to be used immediately, CONTRACTOR shall seal them with approved plugs that are firmly held in place to prevent infiltration and withstand all test requirements, yet can be removed for later use as may be required.

- J. For all tees that are plugged and laid in rock, CONTRACTOR shall blast a minimum of 6 linear feet of ditch line in the direction and to the approximate grade of the future lateral as directed by CUB, but do not excavate the material. CONTRACTOR shall furnish CUB with a record drawing and log showing the exact location of each tee installed.
- K. If the work consists of constructing a new sewer to replace an existing one, CONTRACTOR shall connect existing laterals to the new line. Laterals which have been disconnected, cut, or abandoned shall be plugged and sealed with a backing block securing the plug, as may be approved by CUB, to form a watertight seal.
- L. New service laterals shall conform to the Standard Drawings. Cleanouts will be required for all laterals and should be located on the property line (as is possible). In cases where the cleanout cannot be located on the property line, or where a service line must cross another property, CUB will determine how the service line and cleanout shall be installed.
- M. For new laterals to be installed on existing sewer lines 6 inches in diameter, or as required by CUB, the existing line shall be cut and a watertight tee section shall be installed. Where flow in the pipe cannot be plugged or otherwise temporarily stopped to the point where it will not spill out of the pipe during installing of the tee, the existing wastewater flow shall be pumped around the work zone from upstream manhole, which will need to be plugged with a temporary plug to prevent water from flow downstream of the manhole, to downstream manhole. The tee section shall consist of a new tee of the same diameter as the existing pipe, with short sections of pipe on either end. The tee section shall be installed with waterproof flexible couplings on each end, as specified in Subsection 2.5 above, to connect the existing pipe to the new tee section with watertight seals.
- N. For new laterals to be installed on existing sewer lines larger than 6 inches in diameter, a sewer saddle as specified in Part 2 above may be used in lieu of a tee section. The saddle shall be installed on a cleanly cut, properly-sized hole on the existing sewer, such that a watertight connection results. The cut in the existing pipe shall be made with a hole saw which will retain the coupon. Sewer saddles shall not be used on vitrified clay pipe, or any other pipe deemed unsuitable by CUB for this tapping method.
- O. New service line connections to existing manholes, as specified in Section 04100 – Manholes, shall be made by boring an opening in the manhole with a concrete coring saw or drill which has been designed to smoothly core drill concrete without compromising the structural integrity of the wall of the manhole. At the new manhole opening, the one made to receive the new service line, a rubber boot shall be installed and the service line shall be placed into that boot to form watertight seals between the boot and the manhole and between the boot and the service pipe. Where service laterals must enter the manhole at bottom of the manhole, CONTRACTOR shall reshape the manhole's invert(s) as necessary to match the invert of the new sewer pipe as directed by CUB.

- P. New wastewater mains constructed to enter existing manholes, as specified in Section 04100 – Manholes, shall be made by boring an opening in the manhole with a concrete coring saw or drill which has been designed to smoothly core drill concrete without compromising the structural integrity of the wall of the manhole. At the new manhole opening made to receive the new wastewater main, a rubber boot shall be installed and the pipe shall be placed into that boot to form watertight seals between the boot and the manhole and between the boot and the service pipe (see Sub-Paragraph 2.9 of Section 04100 – Manholes). Where new wastewater mains enter the manhole at bottom of the manhole, CONTRACTOR shall reshape the manhole’s invert(s) as necessary to match the invert of the new sewer pipe.
- Q. Grouted inverts of inlet and outlet pipes in manholes shall be finished smooth and as a channel so as not to obstruct the flow of liquid through the manhole.
- R. Under each precast manhole base section, provide a sub-base with a minimum of 12 inch depth of Class I granular material, well compacted with mechanical tamping equipment.
- S. CONTRACTOR shall carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structures in the vicinity of the WORK and IMPROVEMENTS at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in compliance with the provisions set forth in other sections of these Specifications, the requirements of the agency with jurisdiction over the affected facilities and roadways. Not only are the affected utilities to be protected from damage for the WORK and IMPROVEMENTS but CONTRACTOR shall also backfill all excavations as necessary to prevent future settlement or ground shifting that could result in future damages to the affected utilities and/or paved areas. Any work by the CONTRACTOR to provide for such protection shall be considered incidental to the construction of sewer mains and service lines and no additional compensation shall be made to CONTRACTOR by CUB for such work.
- T. Existing water mains, service lines or other utility mains or services that are damaged by CONTRACTOR during his installation of wastewater mains and/or services shall be repaired or replaced in accordance with these specifications by the CONTRACTOR at his expense as an incidental part of the work.
- U. Existing wastewater services or house connections to existing sewers that are damaged or removed by CONTRACTOR, but that were intended to remain after CONTRACTOR’s construction activities, shall be repaired or replaced by the CONTRACTOR at his own expense as an incidental part of the work.
- V. Wastewater flow must be contained and maintained in the existing sewers. Whenever pipe laying progresses to a point where this flow must be interrupted, the CONTRACTOR shall plug the sewer upstream of the construction and provide by-pass pumping to the downstream manhole as required to maintain flows. All downstream pipes, manholes and

appurtenances must be tested and acceptable to CUB to receive wastewater flow. Discharging raw wastewater to the surface or natural waterways will not be permitted under any circumstance. The CONTRACTOR shall notify CUB prior to proceeding with by-pass pumping. When working in areas where interruption of wastewater flow may occur, the CONTRACTOR shall have pumps, lines and all other equipment in readiness at the site to provide by-pass pumping as may become necessary to contain all wastewater within CUB's wastewater collection system.

3.7 SEWER SERVICE ASSEMBLIES

- A. It shall be the Owner/Developer or CONTRACTOR's responsibility to ensure all individual sanitary sewer service lines between the public right-of-way (where connection is made to CUB's public wastewater collection system main) and the existing or proposed house to be served with sanitary sewer, meets or exceeds the requirements of the International Plumbing Code or other Code as may be required by the particular Building Codes Official responsible for inspection and approval of private sewer service installations.
- B. It shall be the Owner/Developer or his CONTRACTOR's responsibility to determine the need for, and install the service risers at a sufficient depth to service each house proposed for development, including basements. If the wastewater collection system main is sufficiently deep the service riser shall be installed at a minimum depth of 8 feet at the property line, or deeper if necessary to serve basements.
- C. The standard collector sewer tap shall consist of a tee connected with a full length section 6-inch diameter branch. The tap will consist of fittings made of the same material as that of the line (i.e. – cast iron or ductile iron fittings on a ductile iron or AWWA C900) except that PVC fittings may be used on Vitrified Clay Lines. Ductile iron pipe and either ductile iron fittings or cast iron fittings or concrete encasement shall be used in roadways where cover is less than 4 feet, or in open areas where cover is less than 2 ½ feet, as directed by CUB. Also, ductile iron pipe lined with *Induron Protecto 401 Ceramic Epoxy* shall be used where velocities greater than 15 feet per second can be expected.
- D. All service risers shall be plugged at the end with PVC stoppers capable of withstanding a low-pressure air test. The plugs may be blocked to withstand the air testing but the ends shall not be encased in concrete.
- E. Each and all parcels along the path of the public sanitary sewer main shall receive one tap, service line and riser. Risers having 45 degree angles or less measured from the horizontal may be used when the depth of the sewer collector is greater than 8 feet or when their use will facilitate connection of individual services. All risers having angles of 30 degrees or greater measured from the horizontal shall be placed in a bedding of compacted Size No. 57 or 67 crushed stone. Such bedding shall have a minimum width of 3 times the pipe diameter and, a minimum thickness under the pipe equal to the pipe diameter and an overall thickness of twice the pipe diameter. A

minimum of 6 inches of bedding stone shall be placed above the top of all PVC risers in accordance with the provisions of these Standard Specifications.

- F. Tee Branches not to be used immediately shall be plugged with stoppers of the same material and joints used on the collector lines.
- G. Installation of service pipe and fittings in developments
 - 1. Service pipe and fittings shall be supplied and installed by the Owner/Developer or CONTRACTOR from the wastewater collector mains to the street right-of-way or edges of easements provided. Service pipe and fittings shall meet the conditions of these Standards Specifications.
 - 2. At the ends of service pipe, at the right-of-way or edge of easement, there the Owner/Developer or CONTRACTOR shall install a 6-inch diameter wastewater cleanout in accordance with these Standard Specifications and as shown on CUB's Standard Detail Drawings.
 - 3. The minimum grade on service pipes shall be one percent or 1/8 inch rise per linear foot of run.
 - 4. Locations of service tees and ends of service pipes shall be field located and recorded on the final As-Built Drawings as follows:
 - i. Record the distances measured along the wastewater collector mains from the nearest downstream manhole to points at right angles to each service tee,
 - ii. Record the perpendicular distances measured between the collector lines and the service pipe ends, and
 - iii. Record depth of service pipe end from the ground surface at the clean out.

3.8 TESTING OF GRAVITY SEWERS

It is the intent to specify a “test as you go” procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance. Initial proof testing will be required when the total footage of a contracted project is greater than 4,000 linear feet and when 50% of the project footage has been installed or in the event the run between manholes is greater than 12-feet in depth. Acceptance does not initiate a reduction in retainage for that section of completed work.

- A. Before the wastewater collection main and service lines can be accepted by CUB, and before any houses will be allowed to be connected, all newly installed and backfilled gravity sewer pipes shall be subjected to a final testing procedure. Testing must be coordinated with and conducted in the presence of authorized CUB personnel.

B. Visual Tests

1. Prior to backfilling, CUB shall make a visual inspection of the sewer lines and appurtenances. The visual tests may include a check for proper grade and alignment, sufficient pipe bedding, pipe condition, absence of deformity, absence of damage, and general cleanliness. The CONTRACTOR shall immediately repair all defects found by such inspection.
2. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the floodwater drains off and no remaining puddle of water is deeper than 1/2 inch. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the CONTRACTOR's expense.
3. The CONTRACTOR will be held strictly responsible to ensure that all parts of the work bear the load of the backfill. If cracks 1/100 inch develop in the pipe within one year from the date of final acceptance of the work, the CONTRACTOR will be required to replace, at his expense, all such cracked pipe. To this end, the CONTRACTOR may want to consider purchasing pipe with a guarantee from the manufacturer that ensures proper service of sewer pipe under conditions established by the drawings, specifications, and local conditions at the site of the work.

C. Low-Pressure Air Testing for Sanitary Sewers

1. Low-pressure air testing of all pipes shall be as specified in the latest edition of ASTM C828. This recommended practice defines the proper procedures for acceptance testing of installed gravity sewer pipe using low-pressure air, to provide assurance that the pipe, as installed, is free from significant leaks. Included are requirements for equipment accuracy, safety precautions, line preparation, test method, and minimum holding times. Air test results shall be recorded on the work sheet, which is included in the Appendix to these Specifications.
2. The pressure drop shall be calculated as the number of seconds for the air pressure to drop from a stabilized pressure of 3½ psig to 2½ psig. The actual time recorded for the pressure to drop from 3½ psig to 2½ psig should be greater than or equal to the minimum calculated test time, as shown in the table below. The testing method should take in to consideration the range in groundwater elevations projected and the situation during the test. The height of the groundwater should be measured from the top of the invert. The CONTRACTOR is responsible for providing all labor and equipment for air testing, and shall identify and repair or replace any section of line that fails the low-pressure air test.

MINIMUM TEST TIMES AND ALLOWABLE AIR LOSS
VALUES FOR VARIOUS PIPE SIZES PER 100 FEET
(Based upon ASTM C828-80)

NOMINAL PIPE DIAMETER (inches)	TIME (seconds / 100 ft.)	ALLOWABLE AIR LOSS (cubic feet / minute)
6	42	2.0
8	72	2.0
10	90	2.5
12	108	3.0
15	126	4.0

Sewers larger than 15 inches diameter shall be tested in accordance with the latest TDEC-WPC standards.

3. Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling. During sewer construction, all service laterals, stubs and fittings into the sewer test section shall be properly capped or plugged to prevent air loss that could cause an erroneous air test result. It may be necessary and is always advisable to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps, and tie-rods or wire harnesses over the pipe bells.
4. Unless otherwise specified, the CONTRACTOR shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the CONTRACTOR is responsible for any necessary repair work on sections that do not pass the test. No sealant shall be used in any newly installed sewer without the prior approval of CUB. Using sealant in a sewer is not the equivalent of a sound sewer pipe. Proper structural repair work is much preferred and may be required by CUB.
5. CUB shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized. CUB should inform the CONTRACTOR regarding acceptable methods of repair in the event one or more sections fail to pass the low-pressure air test.
6. It is extremely important and essential that all plugs be installed and braced in such a way that blowouts are prevented. As an example of the hazard, a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psig, and a force of 2,250 pounds is exerted on a 24-inch plug by an internal pressure of 5 psig. It must be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being tested so long as pressure is maintained in the line.

It is further recommended that no internal pressure of more than 9 psig be permitted except for leak location equipment where the plugs are firmly tied together.

Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the CONTRACTOR should internally restrain or brace the plugs to the manhole wall as an added safety precaution throughout the test.

7. All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not at any time exceed 9 psig. (It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)
8. To facilitate test verification by CUB, all air used shall pass through a single above ground control panel. The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi. Two separate hoses shall be used to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

9. After a manhole-to-manhole reach of pipe has been backfilled to final grade and compacted, prepared for testing, and a 24-hour waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

10. Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig. If the groundwater table is

above the sewer being tested, the air pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer, up to a maximum of 9.0 psig. After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

11. When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater back pressure), the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig. At a reading of 3.5 psig, timing shall commence with a stop watch.
12. If the time shown in Table I for the designated pipe size and length elapses before the air pressure drops 0.5 psig, the section undergoing test shall have passed. The test may be discontinued once the prescribed time has elapsed even though the 0.5 psig drop has not occurred. If the pressure drops 0.5 psig before the appropriate time shown in Table I has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.
13. If the section fails to meet these requirements, the CONTRACTOR shall determine at his own expense the source, or sources, of leakage, and he shall repair or replace all defective materials and/or workmanship to the satisfaction of CUB. The extent and type of repair which may be allowed, as well as results, shall be subject to the approval of CUB. The completed pipe installation shall then be retested and required to meet the requirements of this test.

3.9 DEFLECTION TESTING FOR PVC PIPE

The CONTRACTOR is responsible for providing all labor and equipment for deflection testing. Test deflection of the pipe by manually pulling with twine a one-piece 9-arm go/no-go mandrel (sized in accordance with ASTM D3034) through the pipe. Within 24 hours after compaction of the backfill is complete, the line shall be tested using a 5% deflection mandrel. If the line is satisfactory, it shall be retested using a 7.5% deflection mandrel no less than 30 days following the completion of compaction. CUB shall witness all deflection testing.

3.10 CLEANUP

After completing each section of the sewer line, all debris and construction materials shall be removed from the work site. Then the surface shall be graded and smoothed on both sides of the line, seeded and mulched, paved, etc. as is shown on the construction drawings or as required by CUB. The entire area shall be left clean and in a condition satisfactory to CUB and the agency with jurisdiction over the right-of-way and/or roadway(s). The CONTRACTOR shall

keep cleanup operations as close to active pipe laying activities as practical, generally following by less than 300 feet or as approved by CUB.

3.11 WARRANTY PERIOD

- A. Twelve (12) months following acceptance of the water/wastewater system improvements by CUB, extensions, etc. a follow-up inspection will be made by CUB to determine if any failures/deficiencies have occurred as a direct result of the contractor's work and/or materials. Present at this inspection will be a representative of CUB, Owner and/or Developer and/or Contractor.
- B. The Owner, Developer and/or Contractor will be responsible for correction of any and all failures and/or deficiencies that have occurred during the first year of service as determined by CUB and at no expense to CUB.

END OF SECTION

SECTION 04100

MANHOLES

PART 1. GENERAL

Manholes shall be precast or monolithic reinforced concrete meeting the requirements of ASTM Standard C478 except as may be provided otherwise in these Standards. Manholes shall be furnished with eccentric cones unless otherwise approved by CUB. The CONTRACTOR shall furnish and install manholes in accordance with this Section 04100 and Section 04000 - Wastewater Collection System as well as the Standard Detail Drawings and the STANDARD AND APPROVED PRODUCTS LISTS.

PART 2. PRODUCTS

For CUB's pre-approved wastewater collection system mains and service piping materials and fittings, refer to APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS.

- 2.1 CONCRETE MASONRY: Masonry shall be reinforced or plain, meeting the applicable requirements of Section 06500 - Concrete for Utility Lines.
- 2.2 CLAY BRICK, if allowed by CUB for patching existing brick manholes: Brick shall be medium hard or better quality Grade SM sewer brick conforming to the requirements of ASTM C32. Brick shall be solid and not cored.
- 2.3 GRADE RINGS: Precast Concrete Grade rings may be 4 or 6 inches (maximum) in height, in conformance with subsection 2.9 below and the Standard Detail Drawing. Rubber Composite grade rings may be used to adjust frame and cover to final grade, but shall not exceed 3-inches in height. Grade rings shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- 2.4 ADMIXTURES: As directed by CUB concrete admixtures, such as XYPEX, may be added to the concrete mix at the time of batching and during the manufacture of the precast manholes to be used on CUB projects. Such admixtures must be proven effective to seal the concrete against the penetration of water or liquids from any direction, and to protect the concrete from deterioration due to harsh environmental conditions. Such admixtures are formulated to meet certain project and temperature conditions and therefore it is necessary to consult with the admixture's technical representative to determine the most appropriate admixture for the specific project application.
- 2.5 MORTAR: In general, mortar shall be composed of one part Portland cement and two parts sand (volumetric measure) thoroughly mixed in a tight box, with water added gradually and mixed continually until mortar has attained the proper consistency for use in brick masonry; prepared only in such quantities as needed for immediate use; mortar mixed for more than 30 minutes, re-tempered, or previously set will not be allowed. In certain applications CUB may require epoxy additives

for the mortar, or a special mortar as may be necessary to form a watertight seal or coating.

2.6 GRAY IRON CASTINGS, MANHOLE FRAMES AND COVERS:

- A. Manhole cover frames and covers shall be gray cast iron conforming to the Standard Detail Drawing and the requirements of Class 30 ASTM Standard A48, (30,000 psi); made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking, and such that they are in are in contact with frame flanges for the entire perimeter of the contact surfaces. Painting of the cover is not allowed.
- B. The CONTRACTOR shall submit a certificate from the manufacturer of the castings indicating, that they meet all applicable requirements of these specifications. Manhole frames and covers shall be CUB standard, with the cover marked "SANITARY SEWER" and "CUB" with letters approximately two (2) inches in size. Frames and covers are as listed in the STANDARD AND APPROVED PRODUCTS LIST.
- C. Manhole frames and covers shall be round and their combined weight shall be less than 290 pounds.
- D. Manhole frames and covers shall be securely grouted in place using cement mortar.
- E. The wearing surfaces between cast frames and covers shall be machined, fitted together, and match marked to prevent rocking.
- F. All castings shall be free of faults, cracks, blow holes, or other defects.
- G. Manhole frames shall have a minimum clear opening of 24 inches, heights of approximately 7 ½ inches, and overall base diameters of approximately 35 inches. The base shall have four uniformly spaced holes for attachment to the manhole using 5/8-inch diameter bolts or threaded rods. Lids, or covers, shall have a thickness of 1½ inches, a diameter of 26 inches, shall be solid and shall have either one or two concealed pick holes for lifting purposes.

2.7 WATERTIGHT MANHOLE COVERS:

- A. Watertight manhole frames and covers shall be utilized when the manhole is located in flood prone areas or where storm water drains over a manhole, or as otherwise may be directed by CUB.
- B. For temporary infiltration and inflow (I&I) prevention, as may be required during construction of or around manholes and where the threat of such I&I is temporary and where such threat shall be removed during final site restoration and grading, a manhole cover insert may be used.
- C. Watertight manhole frames and covers shall be of the gasketed, bolt-down type. All bolts used shall be stainless steel for ease of removal and installation.

An appropriate neoprene gasket shall be installed for a watertight seal between the cover and the frame.

2.8 BUTYL MASTIC SEALANT:

- A. Butyl mastic sealant shall be used when joining the casted frame to the precast manhole, and for all manhole adjustments, to provide a watertight seal to all components of the structure. Butyl mastic sealant shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- B. The sealing compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space. Use 2 complete ropes at each joint. The sealing compound shall be protected by a suitable removable 2-piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The sealant shall also meet the requirements of the following table:

<u>Composition</u>	<u>Test-Method</u>	<u>Minimum</u>	<u>Maximum</u>
Bitumen (Petroleum Plastic Content)	ASTM D4	50	70
Ash Inert Mineral Matter	AASHO TIII	30	50
Volatile Matter	ASTM D6	-	2.0

<u>Property</u>	<u>Test Method</u>	<u>Minimum</u>	<u>Maximum</u>
Specific Gravity at 77 degrees F	AS TM D71	1.2	1.30
Ductility at 77 degrees F (cm)	ASTM D113	5.0	----
Softening Point	ASTM D36	320 degrees F	----
Penetration 77 degrees F (150 gms) 5 sec.	ASTM D217	50	120

2.9 PRECAST MANHOLES:

- A. All precast manhole components shall be from items listed in APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS (located near the back of these Standard Specifications), Standard Detail Drawings, and meet the requirements of ASTM C478C and ASTM C76 Class 111.
- B. Manhole inside diameters shall be 48 inches for 18-inch and smaller diameter pipe, and 60 inches for 21-inch to 30-inch diameter gravity pipe connections.
- C. Manhole wall thickness shall be a minimum of 5 inches.
- D. The minimum compressive strength of precast manhole risers, bases, cone or top sections and grade rings shall be 4,000 psi.

- E. The access opening in top section shall be a minimum diameter of 24 inches.
- F. The circumferential reinforcement for the manhole sections shall consist of welded wire fabric per ASTM C-478.
- G. The manhole sidewall shall be a height such that a maximum of two six-inch (6 inch) or three four-inch (4 inch) adjustment rings are used to bring the manhole cover to the final required elevation.
- H. Precast sections shall have two (2) lift holes at 180⁰ apart, a minimum of two (2) inches in diameter and sealed when in place with non-shrink grout to the satisfaction of CUB.
- I. Each manhole section joint shall be tongue and groove, male and female ends, so that when the manhole base, rise and top are assembled together they will make a continuous, watertight and uniform manhole. All joints shall be constructed and sealed to form a watertight connection by using a confined, butyl “O” ring gasket (1 piece, 1-inch diameter) in accordance with either ASTM C-443, ASTM C443, ASTM C-361 or AWWA C-302, and one ring of butyl mastic sealant meeting the latest requirements of AASHTO Standard M198-4. Pre-lubricated manhole gaskets may also be used in manhole sections that have been designed and constructed to receive them. After setting riser sections, thoroughly wet and completely fill all joints with non-shrinking grout to provide a smooth and water-tight wall finish, both inside and outside of the manhole.
- J. Openings for pipes shall be either cast in during manufacturer or core-drilled after final curing to provide the required size and location, allowing for lateral and vertical movement, as well as angular adjustments, with a watertight but flexible pipe-to-manhole connector installed in the manhole wall. Openings shall be for the required number and size of pipes and so as to allow for up to 20 degrees axial deflection without compromising with the security or the water-tightness of the connection.
- K. Manhole inverts shall be formed to the pipe sizes, deflections, and elevations as shown on the plans. Manhole inverts may be pre-poured or formed in place; however, no bricks or blocks may be used in the construction of inverts. Inverts shall be sized to accommodate the mandrel for deflection testing. Inverts shall be formed with smooth radius transitions as large as is permitted by the manhole diameter, to provide optimum hydraulic efficiency.
- L. All precast reinforced concrete manhole sections specified herein shall be inspected by CUB. All materials that fail to conform to these specifications shall be rejected. After delivery to the site, any materials that have been damaged in transit or are otherwise unsuitable for use in the WORK shall be rejected and removed from the site by the CONTRACTOR at no cost to CUB.
- M. Poured-in-place reinforced concrete manholes, polyethylene manholes, or fiberglass manholes may ONLY be used with prior written permission of CUB.

2.10 MANHOLE STEPS

- A. If manhole steps are required by CUB, steps shall be as ASTM C-478, constructed of a 1/2-inch minimum diameter Grade 60 steel reinforced rod encapsulated in polypropylene plastic or fabricated from aluminum alloy 6061, T6. The steps shall be installed in a vertical row, on 15 to 16 inch centers over the invert of the downstream pipe. No steps will be installed in the cone section. Manhole cone sections and/or ring and cover openings shall be aligned directly over the steps. Manhole steps shall be corrosion resistant, free from sharp edges, burrs, or other projections which may be a safety hazard and shall be of sufficient strength to support a live load of 300 pounds imposed at any point on the step as installed in the wall of the manhole.
- B. Manhole steps shall be installed at intervals of 15 inches vertically down the wall of the manhole, and aligned to be under the access cover. Manhole sections shall be placed as to align steps cast into the pre-cast manhole walls.
- C. The minimum width of cleat shall be 10 inches. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4" from the wall when the step is securely imbedded in the manhole wall. The top surface of the cleats shall be designed to prevent foot slippage.

2.11 FLEXIBLE PIPE-TO-MANHOLE CONNECTORS, OR "BOOTS":

- A. Manholes shall either be manufactured with integral flexible pipe-to-manhole connectors in place, or manholes shall be core-drilled and flexible connectors shall be installed in the openings of all precast manholes and pump station wet wells (including existing structures) to form a watertight seal between the manhole and the pipe. The connector shall be of the flexible type in accordance with ASTM C-923 shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.
- B. The rubber for the connector shall comply with ASTM C443 and ASTM C923 and consist of EPDM and elastomers designed to be resistant to ozone, weather elements and chemicals including acids, alkalis, animal and vegetable fats, oils and petroleum products from spills.
- C. All stainless steel elements shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel band around the pipe which shall be Series 305 Stainless. The worm screw shall be torqued to 60 inch-lbs.
- D. The connector shall be of a size specifically designed for the pipe material and size being utilized and shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connector manufacturer.

PART 3. EXECUTION

In general, Manholes shall be of precast concrete and furnished and installed as provided in these Standard Specifications. "Depth of manhole" shall be the vertical distance from the lowest invert in the manhole to the top of the manhole cover frame.

- A. Backfill manholes with the same material used for pipelines.
- B. Prepare manhole sub-grade on undisturbed earth. Remove all loose earth prior to placing crushed stone base or concrete slab. Fill all disturbed areas below sub-grade level with compacted bedding stone.
- C. Manholes having a depth of less than 12 feet shall be set on a compacted Size No. 57 or No. 67 crushed limestone base of minimum 6 inches thickness. Manholes having a depth of 12 feet or more shall be set on a 6-inch thick reinforced concrete slab having a minimum diameter 1-foot greater than the outside diameter of the manhole base section. The concrete slab shall be poured on a minimum 6-inch thick compacted crushed stone bedding. Concrete shall meet the conditions of Section 6500 of these Standards.
- D. The crushed limestone base shall be placed on dry consolidated and, when possible, undisturbed soil. If earth beneath the manhole has been over-excavated or otherwise disturbed, it shall be compacted using a CUB-approved mechanical compaction device or under cut to suitable material and back-filled with clean bedding stone.
- E. Manholes shall be set plumb.
- F. Manhole inverts shall be accurately shaped, using concrete, to a smooth surface texture. Invert flow channels shall be shaped having the same radii as those of the pipe for which the channels are being provided. The depth of the channel shall be a minimum of $\frac{1}{2}$ the diameter of the pipes being accommodated. From the edge of the shaped flow channels to the manhole walls, inverts shall be sloped upward at a minimum of 1 to 6.
- G. Inlets and outlets of each manhole shall be finished smooth and flush with the sides of the manhole wall so as not to obstruct the flow of wastewater through the manholes.
- H. When completed, the manhole shall be free from channel obstructions and leakage.
- I. Seal joints between manhole sections with rubber "O-ring" gaskets or flexible butyl sealant. Manufacturer's recommendations for placing gaskets or sealant shall be followed.
- J. All fully penetrated lift eyes or holes provided in precast manhole section shall be filled with concrete or cement mortar to form a watertight plug and seal.
- K. Precast concrete grade rings shall be set using butyl mastic or Portland cement mortar as directed by CUB. Care should be exercised so as not to allow too much water in the cement mortar mix which may cause shrinkage. Manhole cover frames shall be attached to the manhole barrel or grade rings by means of 4, 5/8-inch anchor bolts or threaded rods and shall be set in a bed of butyl

mastic. Joints of precast concrete grade rings and manhole frames shall be completed so as to prevent water from either entering or leaving the manhole.

3.1 DROP MANHOLES:

In general, drop manholes are allowed only when differences in elevation between the inlet pipe and the outlet pipe are greater than 2 feet. Typically drop manholes are of the Outside or External Drop type, and internal drop assemblies will only be considered in the event an external drop configuration is not reasonable or practical, and then must have CUB's prior approval.

- A. Outside or External Drop Assemblies – The drop pipe construction shall be of ductile iron pipe and either ductile iron or cast iron mechanical joint fittings and shall be constructed in accordance with the Standard Detail Drawings. The inlet piping of an outside drop shall be bedded in 6-inches of concrete. The remainder of the outside drop shall be backfilled with compacted #57 or #67 crushed stone. Ductile Iron Pipe and fittings shall be lined and meet the requirements of these Standards.
- B. Typically, external drop assemblies are used at drop manhole. However, if approved in advance by CUB, internal drop assemblies may be used. Shop drawing for manufactured internal drop assemblies shall be submitted for review and approval by CUB's Director - Water & Sewer Department prior to Owner/Developer ordering materials for such installation.
- C. Concrete used in constructing drop pipe assemblies shall meet the conditions of Section 06500 of these Standards.

3.2 MANHOLE FOUNDATIONS:

- A. CONTRACTOR shall be required to de-water excavations sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.
- B. Obtain an adequate foundation for all new manhole structures by removing and replacing unsuitable material with well-graded granular material (#57 or #67 stone), by tightening with coarse rock and/or by such other means as necessary to provide for a level and solid sub-base acceptable by CUB.
- C. Wherever ground water is encountered in the excavation for the manhole, place all cast-in-place bases or monolithic structures on a one-piece waterproof membrane (minimum 40 mils) to prevent any movement of water into the fresh concrete.

3.3 MANHOLES INSTALLED ON EXISTING LINES:

- A. For all lines 12 inches in diameter or less, sections of pipe shall be removed and a complete precast manhole installed. The existing pipes shall then be properly bedded and then joined by flexible couplings (see Section 04000 - Wastewater Collection System) to pipe extensions from the manhole. By-pass pumping shall be conducted in accordance with the requirements of CUB, or

the regulatory agency having jurisdiction (the most stringent requirements shall apply).

- B. Shop drawings for monolithic (poured-in-place) manholes must be submitted for review and approved in advance by CUB.
- C. Where precast manholes are permitted by CUB to be installed on existing lines the material beneath the sewer pipe shall be removed in such a manner that a 6-inch reinforced concrete base (with Grade 60 #4 bars at 12-inch centers) may be constructed on a level and compacted stone sub base of 6 inches of #57 or #67 stone. Concrete for the manhole base shall be as specified in Section 06500 – Concrete for Utility Lines. After a 24-hour waiting period, the “saddle” precast concrete riser section with "horseshoe" cutouts shall be placed on this base and then grouted in place so that a watertight seal is achieved between the riser, pipe, and base. A water proof grout designed for such application shall be used to join the riser to the base and to seal the openings around the pipe. Manhole inverts shall be formed to the pipe sizes, deflections, and elevations as shown on the plans. Manhole inverts may be pre-poured or formed in place; however, no bricks or blocks may be used in the construction of inverts. Inverts shall be sized to accommodate the mandrel for deflection testing. Inverts shall be formed with smooth radius transitions as large as is permitted by the manhole diameter, to provide optimum hydraulic efficiency. A water-stop is required for bringing new PVC pipe into the manhole. Cement grouting is not acceptable. If new piping is included into the base and invert of the new manhole, the pipe within the manhole shall be saw-cut to provide a smooth edge with care to prevent pieces of pipe from entering the line and to prevent “rag hangers”.

3.4 MANHOLE SPACING:

Typically, the maximum center-to-center distance between manholes shall be 300 feet unless otherwise shown on the drawings or as approved in writing by CUB.

3.5 MANHOLE DIAMETERS:

The internal diameter of most precast manhole riser sections shall be 48 inches. Internal diameters may be larger to accommodate larger piping or as directed by CUB and as shown on the approved construction drawings.

Requests to use any other size manhole shall be submitted in writing to CUB for their review, and CUB’s approval must be in writing to allow such alternate size.

3.6 MANHOLE GRADE ADJUSTMENTS:

In general, the top surface of the manhole frame and covers must match the surface of the existing pavement, have a smooth transition between the frame top and the surrounding pavement, and be virtually unnoticeable to vehicular traffic as it passes over the manhole at the posted speed limit of the roadway. Manholes that must be adjusted to provide for such a match to final pavement grades shall be raised or

lowered to the final grades in a manner that will result in a watertight structure, including all joints between sections of concrete as well as between the frame and cover and the manhole itself.

- A. Two rings of butyl mastic sealant shall be used for installing all grade rings. Where manhole ring-and-covers need to be raised more than 12 inches to match final grade, the existing cone section shall be removed and full diameter pre-cast sections added to the manhole barrel. Then the cone shall be reinstalled, or, if the cone section has been damaged when it was removed, CUB may require that a new cone section to also be installed. No more than two six-inch (6") or three four-inch (4") concrete grade rings may be installed above the manhole cone.
- B. Clay brick can only be used for grade adjustment on slopes where precast concrete grade rings (donuts) or rubber composite adjusting rings cannot be used to achieve the required grade or slope of grade, and then only with the advance approval of CUB. However, even in this case, the maximum grade adjustment between the top of the manhole cone section and the bottom of the cast iron ring frame shall be 12 inches.
- C. Cast iron frames shall be set at the required elevation and properly bonded to the masonry with 2 rings of butyl mastic sealant and anchor bolts.
- D. Wherever manholes are constructed in paved areas, the top surface of the cast frame and cover shall be tilted as necessary to conform to the exact slope, crown, and grade of the existing adjacent pavement as specified herein. All areas where surface water could enter the manhole and all voids between the manhole top section, grade rings, and ring shall be grouted or otherwise sealed to be watertight with a grouting mixture approved by CUB.
- E. The tops of the manhole ring-and-covers shall be set 6 to 12 inches above final grade, or as otherwise directed by CUB, when they have been located in unpaved or non-traffic areas.

3.7 MANHOLE ABANDONMENT PROCEDURES:

- A. Cut all pipes on the outside of the manhole, and plug with brick and mortar.
- B. Brick and mortar all pipe openings inside the manhole, including drop connections and laterals.
- C. Remove the manhole ring, lid, and grade rings. CONTRACTOR's disposal of manhole materials shall be at the discretion of CUB. However, if CUB does not desire to keep any such materials CONTRACTOR will be required to properly dispose of these materials at no cost to CUB. Pre-cast cones and risers shall also be removed if they are exposed at final grade.
- D. Abandoned manholes shall be filled with backfill material as specified in Section 01600 - Unclassified Excavation and Backfilling.

- E. Lines that are to be abandoned, but that enter an existing manhole that will remain, shall be cut on the outside of the manhole and the inlets shall be plugged with brick and mortar as necessary to ensure a watertight seal.

3.8 MANHOLE VACUUM TESTING:

Vacuum testing shall be conducted on each manhole. The test shall be performed such that the integrity of each component (i.e. pipe connections, seals between manhole sections, seal between manhole and cover frame, etc.) is verified to be watertight.

- A. The CONTRACTOR shall provide all labor, materials and equipment for vacuum testing.
- B. All manholes are to be vacuum tested following backfill and compaction. All grade rings, if used, and the frame and cover casting assembly shall be installed prior to testing. The testing equipment shall consist of a gasoline-powered vacuum pump with sufficient vacuum hose length and a test head of proper size to fit the inside opening of the manhole. The test head shall be equipped with an inflatable rubber bladder to affect the seal to the manhole, an air pressure gauge, and a safety valve for filling the bladder, a 30-inch mercury liquid-filled vacuum gauge, a double air exhaust manifold with quarter turn ball valves, three bolt-on feet, and a bridge assembly with height adjustment rod.
- C. The CONTRACTOR shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6" beyond the manhole wall.
- D. With the vacuum tester in place, inflate the compression band to effect a seal between the vacuum base and the structure. Connect the vacuum pump to the outlet port with the valve open and evacuate the manhole to 10 inches of Mercury (Hg) (0.3 bar), which is equivalent to approximately 5 PSIG backpressure.
- E. Close vacuum inlet/outlet ball valve, disconnect the vacuum pump, and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1 inch of Mercury (Hg) over the specified time period (see table below) then the manhole is considered acceptable and passes the test.
- F. If the manhole fails the test, CONTRACTOR shall find/identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. And, once the leaks have been identified, CONTRACTOR shall complete all necessary repairs by sealing the leaks on the outside of the manhole to the satisfaction of CUB, and repeat test procedures until satisfactory results are obtained.

MINIMUM TIMES FOR MANHOLE VACUUM TEST

Manhole Diameter - Inches

Depth in Feet	48"	60"	72"
4	10 sec.	13 sec.	16 sec.
8	20 sec.	26 sec.	32 sec.
12	30 sec.	39 sec.	48 sec.
16	40 sec.	52 sec.	64 sec.
20	50 sec.	65 sec.	80 sec.
24	60 sec.	78 sec.	96 sec.
*	5.0 sec.	6.5 sec.	8.0 sec.

** Add this amount of extra testing time for each additional 2 foot depth. (The values listed above have been extrapolated for ASTM designation C924)*

- G. CUB reserves the right to reject any and all manholes that do not pass vacuum testing requirements and replacement shall be at the CONTRACTOR's expense. A significant number of leaks on a single manhole, or a significant number of manholes leaking shall be considered as a basis for rejection and required replacement of manholes by CONTRACTOR at CONTRACTOR's sole expense.

END OF SECTION

SECTION 04200

WASTEWATER FORCE MAIN

PART 1. GENERAL

- 1.1 The work to be performed shall consist of the installation of wastewater force mains according to the Specifications and the Standard Detail Drawings herein including and more specifically in accordance with the provisions and requirements Parts 1, 2 and 3 of SECTION 04000 - WASTEWATER COLLECTION SYSTEM.
- 1.2 Contractor shall furnish all material, equipment, tools, and labor in connection with the wastewater force main complete and in accordance with the drawings and these specifications.
- 1.3 The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project. The CONTRACTOR shall keep the interiors of all pipes, fittings, and other accessories free from dirt and foreign matter at all times.
- 1.4 Reaction blocking (thrust blocks) shall be installed as shown on the Standard Detail Drawing. Wherever reaction blocking is necessary, it shall be considered an integral part of the force main work.
- 1.5 Pipe Laying and bedding conditions, along with proper backfill, are critical to the performance and dependability of the pipelines. Site conditions will be reviewed by CUB during construction and as requested by the Contractor. In areas of rock, or where CUB determines proper bedding and backfill collectively will not be or cannot be provided to adequately protect Class 200 or Class 250 PVC pipe, at CUB's discretion Class 350 ductile iron pipe or AWWA C900 PVC shall be used (see Part 2. Products, 2.1 below).

PART 2. PRODUCTS

2.1 PIPE

All materials furnished by CONTRACTOR shall be in accordance with the appropriate STANDARD AND APPROVED PRODUCTS LISTS. Materials and products furnished will be visually inspected by CUB at the site for conformance to the specifications. At CUB's discretion, the CONTRACTOR may be required to supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications.

- A. Polyvinyl chloride (PVC) pipe and fittings may be used for force mains from 4" to 12" in diameter, in accordance with the requirements of AWWA C900-latest revision and the Materials Specifications herein. The pressure class

rating shall be selected based upon the design requirements of the system, laying and backfill conditions. Class 200 pressure rated may be used where the working pressure does not exceed 135 psi. The pipe must meet the requirement set forth in ASTM Standard D-2241 for 2-inch through 8-inch pipe designated SDR-21. If working pressure exceeds 135 psi for any portion of the main, a higher class of PVC or ductile iron pipe meeting the requirements of Paragraph B. in this section of this Standard shall be used as CUB's discretion and direction.

- B. Ductile iron pipe shall be made of good quality ductile iron that meets the requirements of ASTM E8-61T, and is in conformance with the latest revision of ANSI/AWWA C151/A21.51 Standard. The pipe shall be push-on joint with a pressure class of 350 psi, cement-lined according to ANSI 21.4/AWWA C-104, and coated inside and outside with an asphaltic coating, designed for use as a wastewater collection sewer main. Ductile iron pipe and fittings shall conform to the requirements of the Materials Specifications herein.
- C. HDPE pipe (2-inch to 6-inches in diameter) and fitting shall be SDR-11 high-density polyethylene meeting the requirements of ASTM D3035, ASTM D2239, ASTM D2737, ASTM F714, AWWA C901/C906. The pipe shall be manufactured from premium PE3408/PE3608 resin material that conforms to ASTM D3350 with the cell classification of 345464C/E and is listed with the Plastic Pipe Institute's TR4. It is to be formulated with carbon black and /or ultraviolet stabilizer for maximum protection against UV rays. Except for special installation, piping and fittings shall be joined together using socket, heat or saddle fusion procedures and/or compression fittings designed specifically for use on HDPE pipe, and approved by CUB and installed by acceptable directional drilling methods.
- D. All force main piping, whether PVC or HDPE shall be installed with 12-gauge wire, attached by taping or tying the wire to the pipe at regular intervals as it is being installed, to allow post-construction tracing and locating.
- E. Fittings for force mains shall comply with CUB's standard specifications for the construction of water distribution lines, and will depend upon the materials used for the force main piping.
- F. Ductile iron or cast iron fittings or other fittings approved by CUB shall be used in conjunction with ductile iron and AWWA C900 PVC pipe.

2.2 AIR RELEASE, COMBINATION, AND AIR/VACUUM RELEASE VALVES

Air Release, Combination, and Air/Vacuum Valves to be installed on sanitary sewer force mains shall be as shown on plans and as described here. Air release valves for use on pressure sewage mains are typically to be of the combination air release / vacuum breaker design. Internal valve components shall be constructed of stainless steel, brass, and/or bronze to minimize corrosion.

- A. SEWAGE COMBINATION AIR VALVES shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. These valves shall be designed to allow air to escape when filling the line, and also allows entrained air to escape during normal operations of the force main.
- B. SEWAGE AIR/VACUUM VALVES shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. These valves shall be designed to allow entrained air to both escape and enter the pipe during normal operations of the force main.
- C. SEWAGE AIR RELEASE VALVES shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST with 2-inch NPT or 3-inch NPT as shown on plans. These valves shall be designed to allow air to escape when filling the force main.

PART 3. EXECUTION

3.1 INSTALLATION OF FORCE MAIN

- A. Force mains shall be installed at the lines and grades required by the drawings with all fittings at the required locations.
- B. The installation standards listed as follows are hereby included by reference as a part of these Contract Documents. Copies of these Standards can be obtained by contacting AWWA or ASTM.
 - ⇒ **Ductile Iron (DI)** Wastewater Force Mains and appurtenances shall be installed in general accordance with the latest revision of AWWA Standard C600 – *Installation of Ductile Iron Water Mains and Their Appurtenances*.
 - ⇒ **Polyvinyl Chloride (PVC)** Wastewater Force Mains and appurtenances shall be installed in general accordance with the latest revision of AWWA Standard C605 – *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fitting for Water*.
 - ⇒ **High-Density Polyethylene (HDPE)** Wastewater Force Mains and appurtenances shall be installed in general accordance with the latest revision of ASTM D2774 - *Standard Practice for Underground Installation of Thermoplastic Pressure Piping*.
- C. All PVC and HDPE pipe shall be installed with a continuous 12-gauge (minimum size) copper wire for location, which shall be tied into metallic mains and valve boxes. The ends of the wire shall terminate in a valve box or other acceptable location – having an access length of at least two (2) feet – whereby detection equipment may be attached. CONTRACTOR shall furnish and install this wire incidental to the installation of the water main and shall not be an additional expense to CUB.
- D. Unless otherwise indicated by the drawings, all force mains shall have at least 30 inches of cover. **The pipe shall slope continuously between high and low points to eliminate the formation of air pockets.** The pipe shall have a

minimum of 36 inches of cover, or more, at the high points as necessary to allow for the installation of air-release or air-vacuum relief valves. Exceptions may be approved by CUB, depending upon actual field conditions.

- E. The CONTRACTOR shall provide and use tools and facilities that are satisfactory to CUB and that will allow the work to be performed in a safe and convenient manner. A derrick, ropes, or other suitable equipment shall be used to lower all pipe and fittings into the trench one piece at a time. Each piece shall be lowered carefully so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances shall force main materials be dumped or dropped.
- F. Pipes and fittings shall not be lowered into the trench until they have been swabbed to remove any mud, debris, etc., that may have accumulated within them. After the pipe has been lowered, all unnecessary materials shall be removed from it. Before any pipe is laid, the outside of its spigot end and the inside of its bell shall be cleaned and left dry and oil-free.
- G. Every precaution shall be taken to keep foreign material from getting into the pipe while it is being installed. No debris, tools, clothing, or other materials shall be placed in the pipe during laying operations.
- H. For DI and PVC, after a length of pipe has been placed in the trench, the spigot end shall be centered in the bell of the adjacent pipe, and then inserted to the depth specified by the manufacturer. Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, the bottom of the trench shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire length.
- I. Wherever pipe laying is not in progress, the open ends of the pipe shall be closed either with a watertight plug or by other means approved by CUB.
- J. Pipe shall be cut so that fittings can be inserted in a workmanlike manner and without any damage to the pipe. The manufacturer's recommendations shall be followed concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis. A carborundum saw shall be used for ductile iron pipe, and a handsaw, reciprocating or circular "cut-off" saw shall be used for PVC pipe, and a pipe cutter designed for use in cutting plastic pipe shall be used for HDPE pipe. CUB may consider other methods for cutting 12-inch diameter and larger pipe.
- K. Pipe shall be installed with the bell ends of DI and PVC facing in the direction of laying unless otherwise directed by CUB.
- L. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions, or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by CUB. Bend fittings shall only be used when the pipe deflections are inadequate, according to manufacturer's recommendations, or as directed by CUB.

- M. No pipe shall be installed in water or when it is CUB's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project.
- N. Thrust blocks shall be installed wherever the force main changes direction (at tees and bends), at dead ends, or at any other point recommended by the manufacturer or required by CUB. Thrust blocks shall be considered an integral part of the force main work.
- O. All pipes shall be jointed in the exact manner specified by the manufacturer of the pipe and jointing materials.
- P. Air-Release Valves shall be located at the highest elevations of the line, or as otherwise shown on the plans. Valves shall be tapped to the top of the main, and enclosed in valve boxes, vaults, or manholes as shown on the plans and in accordance with the Standard Details for such installations.
- Q. Force mains (outlet end) 2 inches and smaller may be tied directly into a manhole or 6-inch clean out as approved by CUB.
- R. Force mains (outlet end) larger than 2 inches in diameter shall be installed in manholes as shown on the Standard Detail Drawing.

3.2 LEAKAGE TESTING

It is the intent here to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance. Initial proof testing will be required when the total footage of a contracted project is greater than 4,000 linear feet and when 50% of the project footage has been installed or in the event the run between manholes is greater than 12-feet in depth. Acceptance does not initiate a reduction in retainage for that section of completed work.

- A. Before the sewer force main is accepted and before the pumping station is placed into service, all newly installed and backfilled sewer force main pipes shall be subjected to a leakage test, conducted in the presence of CUB.
- B. The force main shall be slowly filled with water, and the specified test pressure shall be applied (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) with a pump connected to the pipe in a manner satisfactory to CUB. The CONTRACTOR shall furnish the pump, pipe, connections, gauges, and all necessary apparatus.
- C. Before applying the specified test pressure, all air shall be expelled from the pipe. If necessary, the CONTRACTOR shall make taps at the points of highest elevation before testing, and shall insert plugs after the test has been completed.
- D. The leakage test shall be conducted by measuring, through a calibrated meter, the amount of water which enters the test section under 150 psi or normal working pressures, whichever is greater, for a period of at least 2 hours. No

installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

For Ductile Iron Pipe

$$L = \frac{SD \sqrt{P}}{37,750}$$

For PVC Pipe

$$L = \frac{SD \sqrt{P}}{148,500}$$

L = allowable leakage, in gallons/hour
 S = length of pipeline tested, in feet
 D = nominal diameter at the pipe, in inches
 P = average test pressure during the leakage test, in psig

The following table has been developed for the commonly used sizes of ductile iron pipe and PVC pipe, under a test pressure of 150 psi. The leakage formulas above may be used when conditions differ from those stated parameters.

Allowable Leakage per 100 feet
 (gallons per hour)

Pipe Diameter (inches)	Ductile Iron Pipe	PVC Pipe
4	0.13	0.033
6	0.20	0.050
8	0.26	0.066
12	0.39	0.099
16	0.52	0.132

- E. Any cracked or defective pipes or fittings discovered in consequence of this leakage test shall be replaced with sound material in the manner specified at no cost to CUB. The test shall be repeated until the results are satisfactory to CUB.

3.3 CLEANUP

After completing each section of the force main, all debris and construction materials shall be removed from the work site. Then the surface shall be graded and smoothed on both sides of the line. The entire area shall be left clean and in a condition satisfactory to CUB. The CONTRACTOR shall keep cleanup operations as close to active pipe laying activities as practical, generally following by less than 300 feet, or as otherwise approved by CUB.

3.4 WARRANTY PERIOD

- A. Twelve (12) months following acceptance of the water and/or wastewater system improvements, extensions, etc. a follow-up inspection will be made by CUB to determine if any failures/deficiencies have occurred as a direct result of the contractor's work and/or materials. Present at this inspection will be a representative of CUB, the Owner and/or Developer and/or the Contractor.
- B. The Owner, Developer and/or Contractor will be responsible for correction of any and all failures and/or deficiencies that have occurred during the first year of service as determined by CUB and at no expense to CUB.

END OF SECTION

SECTION 04300

PRESSURE WASTEWATER VALVES

PART I. GENERAL

- 1.1 This section covers in-line valves, isolation valves, ball valves, air release valves, check valves and valve boxes specified under Section 04200 – Wastewater Force Main.
- 1.2 Valves in wastewater force mains shall, where possible, be located within the public right-of-way, unless otherwise directed by CUB.
- 1.3 The direction of opening for all valves in CUB wastewater force mains shall be counter-clockwise as viewed from the top.
- 1.4 The operating nut shall be between 30 and 36 inches below the finished grade.

PART 2. PRODUCTS

For CUB's pre-approved wastewater mains and service piping materials and fittings, refer to APPENDIX A – STANDARD AND APPROVED PRODUCTS LISTS located near the back of these Standard Specifications. Materials shall be in accordance with the materials specifications contained herein.

2.1 BALL VALVES

- A. Ball valves installed on all PVC wastewater force mains 1-1/2 inches through 4 inches shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.. Ball valves shall have a pressure rating of 225 psi @ 70⁰F. Valves shall be installed as shown on the plans, at all intersections of mains and at each tee as directed by CUB, but at no time greater than 1,000 feet apart.
- B. Ball valves installed in pits or meter boxes and that are less than 30 inches deep (measured from the surface of the ground) shall be full port design with a handle for operating.

2.2 GATE VALVES

- A. Gate valves shall be installed in traffic areas, when within the paved surface of a street, and shall be full port design with a 2" square operating nut and shall have a standard cast iron valve box for access to the valve nut. Gate valves shall be located as shown on the construction drawings
- B. Gate valves in non-traffic areas shall be installed in CUB-approved meter pits as shown on the construction drawings.

2.3 CHECK VALVES

- A. Check valves shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. Check valves shall be installed within meter pits, vaults or in manholes as shown on the construction drawings or on the Standard Detail Drawing.

2.4 AIR RELEASE, COMBINATION, AND AIR/VACUUM RELEASE VALVES

- A. Air Release, Combination, and Air/Vacuum Valves to be furnished complete with 2-inch shut off valve and all components necessary for flushing operations, all in accordance with the construction drawings and Standard Detail Drawings and as described here:
 - 1. SEWAGE COMBINATION AIR VALVES shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. These valves shall be designed to allow air to escape when filling the line, and also allows entrained air to escape during normal operations of the force main.
 - 2. SEWAGE AIR/VACUUM VALVES shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST. These valves shall be designed to allow entrained air to both escape and enter the pipe during normal operations of the force main.
 - 3. SEWAGE AIR RELEASE VALVES shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST with 2-inch NPT or 3-inch NPT as shown on plans. These valves shall be designed to allow air to escape when filling the force main.
- B. Air release valves shall be installed in pits or boxes at locations shown on the construction drawings, and in accordance with the construction drawings and Standard Details.

2.5 VALVE BOXES

- A. Valve boxes in non-traffic areas shall be CUB's standard plastic meter box, with a nominal size of 16 inches by 10-3/4 inches by 12 inches tall with a maximum of two (2) 6 inch extensions if necessary. The meter box shall be injection molded meeting ASTM D2853-70, Class 1212. It shall be a rigid combination of polyolefin with inorganic component reinforcing, and UV stabilizer additive to assure resistance to material degradation from ultraviolet light. The cover shall be molded of the same material and designed with no molded protrusions for latching. A 2-1/2 inch diameter 16 gauge steel reflector with dichromate coating shall be applied to the under side of the plastic cover for electronic detection. The cover shall be green with the word "SEWER" imprinted on the top.
- B. Valve boxes in all traffic areas shall be concrete vaults with the appropriate metal tops and hatches, or manholes as shown on the Construction Drawings and/or in the Standard Details.

PART 3. EXECUTION

3.1 SETTING VALVES AND FITTINGS

A. General

Valves, fittings, plugs, and caps shall be set and jointed to pipe in the manner heretofore specified for cleaning, laying, and jointing pipe, and as furthermore recommended by valve and fitting manufacturers.

3.2 LOCATION OF VALVES

A. Line Valves, or isolation valves, in wastewater force mains shall be located where shown on the construction drawings or as otherwise directed by CUB.

3.3 VALVE BOXES AND VALVE PITS

A. A valve box shall be provided for every valve, unless the valve is less than 24 inches deep and then it shall be located in a CUB-approved meter pit or concrete vault which will provide for full access to the valve.

B. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement, or centered over the valve and cleanout or approximately 1/2 inches above the ground surface or such other level as may be directed.

END OF SECTION

SECTION 04400

PREFABRICATED GRINDER SEWAGE PUMP STATION

PART I. GENERAL

1.1 GENERAL DESCRIPTION

- A. The Contractor shall furnish all labor and additional materials required to install grinder pump stations as approved by CUB at locations shown on the construction drawings.
- B. The grinder pump(s) shall be furnished by CONTRACTOR or CUB in accordance with the Contract Documents. Each station shall be installed complete including a CUB-approved grinder pump mounted in a fiberglass basin, a shut off valve, anti-siphon valve and check valve assembled within the basin, remote electrical alarm/disconnect panel, and electric conduit with EQD.
- C. CUB's current Standard individual grinder pump station is an E-ONE Model 2010 as manufactured by the Environment One Corporation. A typical station installed in this area has an approximate bury depth of 4 feet 4 inches, allowing about 6 inches from the finished grade to the top of the lid. For deeper installation, these pumping stations also come in the following depths of bury: 5 feet 8 inches and 7 foot 3 inches. Deeper and larger stations are available to meet virtually any specific installation needs. Actual station depths shall be approved in advance by CUB and as shown on the construction drawings.
- D. CONTRACTOR shall field-verify station depths and service requirements of the particular house to be served prior to ordering the pumping stations.
- E. As approved by CUB, and at locations shown on the construction drawings, CONTRACTOR shall install the service line from the new grinder pump station to a CUB-approved low-pressure sewer system, CUB's public gravity wastewater collection system main or a cleanout located on the end of the service line which has been extended from the main to the public street or easement right-of-way.

1.2 MANUFACTURER

- A. Unless otherwise approved in writing by CUB, the prefabricated grinder sewage pump station specified shall be a product of the company Environment One Corporation.

PART 2. PRODUCTS

2.1 PUMP

- A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suited for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, good aging properties, and outstanding wear resistance.

2.2 GRINDER

- A. The grinder shall be placed immediately below the pumping element and shall be direct-driven by a single, one-piece 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 stationary hardened and ground chrome steel shredding ring spaced in accurate close annular alignment of the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars. This assembly shall be balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour 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:
 - 1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
 - 2. The inlet shroud shall have a diameter no less than 5 inches.
 - 3. At maximum flow the average inlet velocity must not exceed 0.2 feet per second.
 - 4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- B. 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 fine particles which will pass freely through the passages of the pump and the 1-1/4 inch diameter discharge piping.

2.3 OPERATING CONDITIONS

- A. CUB's Standard grinder pump, for individual residential service, shall be capable of delivering 11 gpm against a total dynamic head of 92 feet (40 psig) and 8 gpm at 138 feet (60 psig). The pump(s) must also be able to operate at negative heads without overloading the motor(s). Larger E-ONE grinder pumps may be specified for duplex, multi-family, or commercial/business service, but if so these will be clearly specified on the construction drawings and in the Bid Form.

2.4 MECHANICAL SEAL

- A. The core 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.

2.5 ELECTRIC MOTOR

- A. As a minimum, the motor shall be a 1 HP, 1725 RPM, 240 volt, 60 hertz, 1 phase, capacitor start, ball bearing, squirrel cage 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.

2.6 TANK

- A. The tank shall be custom molded of fiberglass reinforced polyester resin and shall be furnished with two PVC factory installed closet inlet flanges to accept a 4.50 inch OD DWV pipe. Tank capacities and dimensions shall be as shown on the drawings. The access way shall be an integral extension of the FRP tank and shall be made of high density polyethylene (HDPE) of a grade selected for environmental stress cracking resistance, and have a minimum burial of depth as shown on the drawings. It shall have an access opening at the top to accept an HDPE cover with skirt.
- B. All discharge piping shall be constructed of 304 series stainless steel and terminate outside the access way bulkhead with a stainless steel, 1-1/4 inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
- C. The access way shall include a single NEMA 4X EQD, factory installed with access way penetration warranted by the manufacturer to be watertight. The access way shall also include a 2 inch PVC vent to prevent sewer gases from entering access way.

2.7 CORE UNIT

- A. The grinder pump station shall have a cartridge type easily removable core assembly containing pump, motor, grinder, controls, check valve, anti-siphon valve and wiring. The watertight integrity of the core unit, including wiring and access cover, shall be established by 100% factor test at a minimum of 5 psig.

2.8 CHECK VALVE

- A. The pump discharge shall be equipped with factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge pipe. 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.
- B. Working 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 non-metallic 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 a high gloss injection molded part made of PVC type I-II.

2.9 ANTI-SIPHON VALVE

- A. The pump shall be constructed in a positively-primed flooded suction configuration, to assure the pump cannot lose prime, even under negative pressure conditions in the discharge piping system.
- B. The pump shall be equipped with a factory installed, integral anti-siphoning air relief valve in the discharge piping immediately below the check valve. This valve will automatically open when the pump is off.

2.10 CONTROLS

- A. Necessary controls shall be located in the top housing of the core unit inside a waterproof access cover. The cover will be attached with stainless steel, tamperproof fasteners.
- B. Non-fouling wastewater level detection for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air-bell level sensor connected through air-tight tubing 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.
- C. Each level control shall have its own built-in fail safe design which will prevent the entrance of moisture into the controls. To assure reliable operation of the pressure sensitive switches, each core shall be equipped with a quick disconnect breather assembly, complete with a check valve to prevent accidental entry of water into the motor compartment.

- D. The grinder pump core will be furnished with a length of 6-conductor, 12-gauge, type SJOW cable, pre-wired and water tight.

2.11 ALARM/DISCONNECT PANEL

- A. Each grinder pump station shall include a NEMA 3R, UL listed Alarm/Disconnect Panel suitable for wall or pole mounting. The NEMA 3R enclosure shall be manufactured of thermoplastic or fiberglass to assure corrosion resistance. The enclosure shall include a hinged, pad lockable cover, secured dead front and component knockouts.
- B. For each core, the panel shall contain one (1) – 15 amp double pole circuit breaker for the power circuit and one (1) – 15 amp single pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, and a complete alarm circuit.
- C. The Alarm/Disconnect Panel shall include an audio-visual alarm device with alarm sequence as follows:
 - 1. When liquid level in sewage wet-well rises above alarm level, visual and audio alarms will be activated.
 - 2. Audio alarm may be silenced by means of the externally mounted, push-to-silence button.
 - 3. Visual alarm remains illuminated until sewage in wet-well returns to normal operating level.
- D. The visual alarm shall be a red fluted lens at least 2-5/8 inches in diameter and 1-11/16 inches in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain rain proof integrity. For duplex units, in addition to the above, two high level indicator lights shall be mounted behind the access cover. During a high level alarm condition the appropriate light will illuminate to indicate which pump core requires servicing.
- E. The audio alarm shall be a printed circuit board in conjunction with an 86 dB buzzer with quick mounting terminal strip mounted in the interior of the enclosure. The entire alarm configuration, mounted on the printed circuit board, shall not exceed 3 inches W x 3 inches L x 1 inch D. The audio alarm shall be capable of being de-activated by depressing a push-type silence switch which is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.
- F. The entire Alarm/Disconnect Panel as manufactured shall be listed by Underwriters Laboratories, Inc.

2.12 SERVICEABILITY

- A. The grinder pump core unit shall have two lifting eyes complete with nylon lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide

easy disconnect accessibility for core unit removal and installation. All maintenance tasks for the grinder pump station must be possible without entry of the grinder pump station.

2.13 CORROSION PROTECTION

- A. All materials exposed to wastewater shall have inherent corrosion protection, i.e., cast iron, fiberglass, stainless steel, PVC.

2.14 SAFETY

- A. The grinder pump station shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station in its tank shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in eight individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the National Sanitation Foundation seal.

PART 3. EXECUTION

3.1 ANTI-FLOTATION

- A. The CONTRACTOR must provide and install concrete weight with anchors to prevent floatation of the pumping station as recommended by the pump station manufacturer and as shown on the Standard Details.

3.2 INSTALLATION

- A. Earth excavation and backfill are specified under Site Work, but are also to be done as a part of the work under this section, including any necessary sheeting and bracing. The CONTRACTOR shall be responsible for handling ground water to provide a firm, dry sub-grade for the structure, and shall provide adequate weight, as recommended by the pump station manufacturer, to prevent flotation or other damage resulting from general water or flooding. The grinder pump stations shall not be set into the excavation until the installation procedures and excavation have been approved by CUB.
- B. Remove packing material. User's instructions must be given to the Owner. Hardware supplied with the unit, if required, will be used at installation. The basin will be supplied with a standard 4 inch DWV (4.50 inch OD) inlet hub for connecting to the incoming sewer line and a standard 4 inch DWV (4.50 inch OD) outlet hub for connection of an emergency overflow to connect to the existing sewer system. Appropriate piping must be used. When moving

the tank, it should be lifted using all four lifting eyes provided at the lower end of the basin. Do not use these eyes if a concrete collar has been attached to the tank. The basin may not be dropped, rolled or laid on its side for any reason.

- C. Installation shall be accomplished so that 6 inches of the access way extends above the finished grade line, and so as to provide for the finished grade to slope away from the unit. The diameter of the hole must be large enough to allow for the concrete anchor.
- D. A 6-inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8 inch or more than 3/4 inch shall be used as bedding material under each unit. A concrete anti-flotation collar 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 (3) lifting eyes for loading and unloading purposes. 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 inch sleeve is required over the inlet prior to the concrete being poured.
- E. Backfill of clean native earth, free of rocks, roots, and foreign objects shall be thoroughly compacted in lifts not exceeding 12 inches to a final Proctor Density of not less than 85%. The grinder pump station shall be installed at a minimum depth from grade to the top of the 1-1/4 inch discharge line, to assure maximum frost protection. The finish grade line shall be 6 inches below the top of the access way, and final grade shall slope away from the grinder pump station.
- F. All site 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 and seeding, and restoration of the traveled ways, as directed by the CUB.
- G. The electrical enclosure shall be furnished with the grinder pump station by the CONTRACTOR. An alarm device is required on every installation; there shall be no exceptions.

3.3 START-UP

- A. The CONTRACTOR shall provide start-up and field testing services prior to acceptance by the Owner. All equipment and materials necessary to perform testing shall be the responsibility of the CONTRACTOR. This will include, as a minimum, a portable generator (if temporary power is required), ammeter, and water in each basin.
- B. Upon completion of the installation, the Contractor will perform the following test on each station:

1. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
 2. Turn ON the alarm power circuit.
 3. Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.
 4. Turn ON pump power circuit. Initiate pump operation to verify automatic “on/off” controls are operative. Pump should immediately turn ON. Within one (1) minute alarm light will turn OFF. Within three (3) minutes the pump will turn OFF.
 5. Record voltage and amperage readings to verify proper electrical conditions are met.
- C. Upon completion of the start-up and testing, the CONTRACTOR shall submit to CUB the Manufacturer’s start-up authorization form describing the results of the tests performed for each grinder pump station tested bearing the signature of the Manufacturers authorized technician. Final acceptance of the system will not occur until all authorization forms have been received by CUB for each pump station installed.

3.4 WARRANTY PERIOD

- A. Twelve (12) months following acceptance of the wastewater grinder pumping stations and their installations a follow-up inspection will be made by CUB to determine if any failures/deficiencies have occurred as a direct result of the contractor’s work and/or materials.
- B. The Owner, Developer and/or CONTRACTOR shall be responsible for correction of any and all failures and/or deficiencies that have occurred during the first year of service as determined by CUB and at no expense to CUB.

END OF SECTION

**SECTION 02546
CURED-IN-PLACE PIPE (LINER PROCESS)**

PART 1 GENERAL

1.01 SCOPE

- A. Rehabilitation of existing gravity sanitary sewer lines by the Cured-in-Place Pipe (CIPP) process.
- B. The CIPP process is defined as the reconstruction of gravity sewer pipe by the installation of polyester or an epoxy vinylester, thermosetting resin, vacuum impregnated flexible polyester felt fiber tube, having an impermeable inner surface. The resin-impregnated tube is formed to the host pipe by means of a water column. Curing is accomplished by circulating hot water throughout the length of the tube in accordance with the specified curing schedule supplied by the resin manufacturer. The CIPP shall extend the full length of the pipe reach being rehabilitated and shall provide a structurally sound, impermeable, jointless, and close fitting pipe that when cured is mechanically bonded to the host pipe.

1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this Section:
 - 1. ASTM International (ASTM):
 - a. D543, Standard Practices for Evaluating Resistance of Plastics to Chemical Reagents.
 - b. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - c. D3839, Standard Guide for Underground Installation of Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Pipe.
 - d. F1216, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
 - 2. National Association of Sewer Service Companies (NASSCO): Recommended Specification Guidelines for Sewer Collection System Rehabilitation.

1.03 DESIGN CRITERIA

- A. Design liner thickness upon the following criteria:
 - 1. Pipes considered to be fully deteriorated.
 - 2. Pipes subjected to full soil load with applicable live load and with water table at the top of the ground. Under pavement, live load shall include AASHTO HS20-44 Truck Loading in each pavement lane.
 - 3. Minimum Ovality of Pipe: 3 percent of circumference.

4. Design calculations shall be based upon Appendix X1 of ASTM F1216 with a Factor of Safety of 2.
 5. Pipe Thickness:
 - a. Pipe 10 inches in Diameter or Less: Rounded to the next higher multiple of 0.5 mm, with a minimum thickness of 6 mm.
 - b. Pipe Greater than 10 inches in Diameter: Rounded to the next higher multiple of 0.5 mm, with a minimum thickness of 7.5 mm.
 6. Creep Retention: Not less than 50 percent.
 7. Poisson's Ratio: 0.3.
 8. Enhancement Factor: $K = 7$.
 9. Liner shall be watertight.
- B. Provide analysis of design criteria and calculations for liner thickness to OWNER for approval. OWNER may vary liner thickness for same size sewer depending upon field condition of pipes or depths.

1.04 SUBMITTALS

- A. Action Submittals: Product data.
- B. Informational Submittals:
 1. Design calculations.
 2. Manufacturer's installation instructions and procedures. Furnish information, essentially in the same format as below, or give details of the procedure and the steps to be followed for the installation of the CIPP, even if the process is named in the Specification.
 - a. Wet Out.
 - b. Insertion.
 - c. Curing.
 - d. Cool Down.
 - e. Finished Pipe.
 3. "Wet out" schedule.
 4. Installer's statement of qualifications.
 5. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards.

6. Certified copies of test reports of factory tests required by the applicable standards and this Section.
7. DVD or USB Flash Drive of CCTV inspection.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Keep products safe from damage. Promptly remove damaged products from Site. Replace damaged products with undamaged products.
- B. Maintain resin-impregnated tubes in refrigerated truck trailers at a temperature below 45 degrees F to prevent premature curing. Prior to beginning inversion, no portion of the resin-impregnated liner shall be subjected to sunlight or ultraviolet radiation. Resin-impregnated tubes with signs of premature curing shall not be installed and shall be removed from the Project Site.

1.06 SPECIAL GUARANTEE

- A. Provide manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Resin: Unless otherwise specified, CONTRACTOR shall furnish a general purpose, unsaturated, polyester or thermosetting vinylester resin and catalyst system compatible with the reconstruction inversion process that provides the cured physical strengths and properties specified herein.

Physical Characteristic	Minimum Values	Test Method
Flexural Strength	4,500 psi	ASTM D790 mod.
Modulus of Elasticity	250,000 psi	ASTM D790 mod.

- B. Resins shall be shipped directly to the wet-out facility from the resin manufacturer and shall be one of the following:
 1. Reichhold; PolyLite #33420 or DION 9800-20.
 2. Interplastic Corporation; #COR72-AA-455HV or #CORVE8190.
 3. Ashland Specialty Chemical Company; #AROPOL MR12018 or HETRON Q6405.
 4. AOC; 701, Vipel; L704NET-11, or Vipel; L704AAP-12.

- C. PET resins, resin fillers, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
- D. Tube:
 - 1. In accordance with ASTM F1216.
 - 2. Liner tube shall consist of layers of flexible nonwoven polyester felt.
 - 3. Sewage-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt.
 - 4. Manufacturers:
 - a. Applied Felt.
 - b. Insituform Technologies.
 - c. Liner Products.
- E. Catalysts:
 - 1. Primary catalyst shall not exceed 1 percent of the resin by volume.
 - 2. Secondary catalyst shall not exceed 1/2 percent of the resin by volume.
 - 3. Catalysts shall be:
 - a. Primary Catalyst: Akzo; Perkadox 16 or Norox 600.
 - b. Secondary Catalyst: Akzo; Trigonox C or Norox TBPB.

2.02 ACCESSORIES

- A. Hydrophilic Rubber Joint Seal: Greenstreak, Inc.; Hydrotite.
- B. PVC Saddle Tees: Solvent welded type for 8-inch CIPP sewer main connection. Tee shall fit the existing pipe and have an integral 6-inch branch connection with gasket. The saddle shall include two stainless steel straps. Saddle tees shall meet the requirements of ASTM D3034 and ASTM F477.
- C. Coupling: Flexible PVC coupler, 3/8-inch thick, with multiple sealing ribs and stainless steel T-bolt clamps as manufactured by Fernco, Inc. or approved equal.

PART 3 EXECUTION

3.01 PRE-INSTALLATION PREPARATIONS

- A. Complete the following activities, unless approved otherwise by OWNER:

1. Safety: Perform operations in accordance with applicable OSHA Standards. Particular attention shall be paid to those safety requirements involving work on an elevated platform and entry into a confined space.
2. Pre-Insertion Cleaning: Rewash, reclean and ready existing sewer pipe immediately before the pre-insertion television inspection.
3. Pre-Insertion CCTV Inspection: Inspect sewer pipe before insertion of the resin-impregnated tube to ensure the pipe is clean and the existing pipe conditions are acceptable for lining. Provide a DVD of the CCTV inspection.
4. Dye Testing: Where sewer line segments may contain abandoned services, CONTRACTOR may be directed to perform dye testing to determine if the services are live and require re-instatement.
5. Bypassing Sewage: Reference Section 04820, Sewer Flow Control.
6. Line Obstructions: If pre-insertion video CCTV inspection reveals an obstruction in the existing pipe (such as heavy solids, dropped joints, protruding service taps or collapsed pipe which may prevent completion of the inversion process), that cannot be removed by sewer cleaning equipment, then a point repair using flexible coupling may be made with the approval of OWNER.

3.02 PRIVATE SERVICE LATERAL SHUTDOWN

- A. Notify OWNER at least 1 week prior to the shutdown when it is necessary to shutdown a private service line while Work is in progress and before the service lines are reconnected.
- B. Notify building occupants regarding service lateral disconnection by placing a door hanger approved by the OWNER. Place door hangers 3 days prior to disconnection.
- C. When a service lateral will be disconnected from the main for more than 1 day, lateral shall be positively drained or pumped a minimum of once every 24 hours. Monitor status of flow and storage. Pump lateral more frequently where flows exceed the storage capacity of the lateral or temporary storage as may be provided by CONTRACTOR.
- D. Temporarily restore services in uncompleted sections during non-work hours.
- E. Notify building occupants when Work is complete and full uninterrupted service restored.
- F. No service is to remain shutdown for more than a period of 8 hours, unless CONTRACTOR provides substitute services for the residents. If the service is to be shutdown for more than 8 hours and CONTRACTOR cannot provide substitute services, then CONTRACTOR shall provide temporary living quarters (i.e., hotel) for the resident at no additional cost to OWNER or the resident. Temporary living quarters shall be approved by OWNER and coordinated through OWNER's Customer Support Representative.

- G. Maintain commercial sewer services while businesses are open. No sewage from the services or main line shall be allowed to be discharged on the ground or in waterways. Holding pits or tanks are not allowed unless permitted by TDEC.

3.03 INSTALLATION PROCEDURES

- A. Liner shall be water cured only. Steam curing is prohibited.
 - 1. Curing Time: 3 hours minimum.
 - 2. Minimum interface temperature between liner and tube shall be 120 degrees F.
 - 3. Water Temperature: 180 degrees F minimum.
- B. The finished CIPP shall:
 - 1. Be continuous over entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
 - 2. When passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by OWNER.
 - 3. Annular space between existing pipe and the CIPP shall be sealed.
 - 4. Meet leakage requirements of pressure test as specified in Section 04000, Wastewater Collection System.
- C. OWNER requires a continuous, uniform liner for a pipeline section. The owner will not allow intermediate excavation for the new manhole.

3.04 SEALING AND BENCHES IN MANHOLE

- A. CIPP shall make a tight fitting seal with existing pipe(s) in manhole. For CIPP that is installed continuous through manhole, the top half of the pipe shall be neatly cut off and not broken or sheared off at least 2 inches away from wall. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other pipes or channels, if any. Channel cross-section shall be U-shaped.
- B. At each pipe opening into manhole, hydrophilic rubber joint seal shall be bonded with adhesive to the host sewer pipe or to the opening in the manhole barrel to hold it in place during inversion. Seal shall be Insignia™ End Seal Sleeve as manufactured by LMK Enterprises or approved equal.
- C. Seal CIPP and existing pipe in manhole as stated above before proceeding on to next manhole section. Manholes shall be individually inspected for liner cut-offs, benches, and sealing of liner annular space.

3.05 SERVICE REINSTATEMENTS

- A. The exact location and number of service connections shall be determined from CCTV. Field locate existing service connections. Perform service cut outs at active service connections immediately after liner has cured. Initial internal service cut outs shall be made to the lesser of a 6-inch diameter opening or 90 percent of the original diameter of the connection. If the service cannot be replaced through excavation, internally reinstate the service to 100 percent of original opening, and provide a smooth opening with no ragged edges. Services shall not be reconnected from abandoned or vacant lots, unless directed otherwise by OWNER. Restore and correct missed or faulty reconnections as well as damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners. Services which are reconnected to rehabilitated liner shall be shown on “as-built drawings” with the distance from the nearest downstream manhole.

3.06 SERVICE CONNECTION BY EXCAVATION

- A. Excavate existing active service connections. Disconnect at joints and existing sewer (now the carrier pipe for the liner) and remove to expose the liner to the extent necessary. Do not damage liner pipe or allow to normalize to ambient temperature and cool down before 6-inch diameter hole is drilled out. Coat cut out hole in liner with approved resin/epoxy that will cure at the ambient temperature.
- B. Install PVC saddle tee with gasketed PVC connection for the new sewer service lateral over the cut out. Saddle shall be a one-piece saddle attached to the liner with epoxy and equipped with a neoprene gasket so that a complete seal is accomplished when the strap-on saddle is tightened with two stainless steel bands; one on each side. The stub-out attached to the saddle shall protrude into liner a distance equal to the wall thickness of liner.
- C. Replace sewer service laterals per Section 04000, Wastewater Collection System.

3.07 TESTING FOR ACCEPTANCE

- A. Sampling and Measuring: One minimum 12-inch long restrained pipe section shall be cut from the cured liner. Measurements of sample thickness will be taken by OWNER from four locations on each section. The average thickness of the measurements shall be equal to or greater than the required design thickness.
- B. Laboratory Testing: One sample shall be sent to an independent laboratory and tested for modulus of elasticity and flexural strength. Preparation and testing standards shall be performed in accordance with the approved submittals. Failure of any test can be grounds for rejection of the CIPP liner. At the direction of OWNER, a second sample shall be tested.
- C. Destructive Testing: In cases where test results of samples from the 12-inch long pipe section are lower than required values, at the direction of OWNER, CONTRACTOR shall cut samples from liner along length of pipe. The size and shape of the samples shall be determined by OWNER. The CONTRACTOR shall repair the CIPP liner and host pipe at no additional cost to OWNER. Failure of the thickness test shall be grounds for rejection for the CIPP liner.

- D. Resin Sampling: “Wet-out” facility resin mixing equipment shall have a valve downstream of the mixing functions and immediately upstream of the application of the mixed resin to the tube where OWNER can draw resin samples. CONTRACTOR’s batch mix facilities, if any, shall provide for sampling of the mixed batch. Submitted “wet-out” schedule cannot be modified without 24-hour notice to OWNER. Resin samples shall be drawn at times determined by OWNER. The OWNER drawing the samples will arrive unannounced and shall be afforded immediate access to the equipment.
- E. CCTV shall be as specified in Section 04810, Sewer Television Inspection. Televising shall be done after service connections have been made, unless required earlier by OWNER. Provide CCTV information in a digital format and or DVD/Flashdrive after liner has been installed in existing sewer pipe.
- F. Low-pressure air test as specified in 04000, Wastewater Collection System, shall be required after liner has been installed in existing sewer pipe and service lateral connections have been completed.
- G. No visible leak around liner at manhole connections will be allowed.
- H. Correct failed liner or liner deemed unacceptable by OWNER as a result of the post-video inspection or test reports for structural values and thickness.
 - 1. Remedy shall be defined as shown in the following table and shall be based upon lowest test in each test category. Where pipe replacement is required, payment shall be made in full for the cured-in-place pipe. No payment will be made to construct a new sewer segment.

PIPE CORRECTION			
TEST	REQ'D VALUE	TEST RESULT	REMEDY
Flexural Strength	4,500 psi	4,300 to 4,490 psi	10% Unit Price Reduction
	4,500 psi	4,100 to 4,290 psi	30% Unit Price Reduction
	4,500 psi	Less than 4,100 psi	Pipe Replacement
Flexural Modulus	250,000 psi	238,000 to 249,000 psi	10% Unit Price Reduction
	250,000 psi	225,000 to 237,900 psi	30% Unit Price Reduction
	250,000 psi	Less than 225,000 psi	Pipe Replacement
Thickness	6.0 mm	5.7 to 5.9 mm	10% Unit Price Reduction
	6.0 mm	5.4 to 5.6 mm	30% Unit Price Reduction
	6.0 mm	Less than 5.4 mm	Pipe Replacement
	7.5 mm	7.1 to 7.4 mm	10% Unit Price Reduction
	7.5 mm	6.7 to 7.1 mm	30% Unit Price Reduction
	7.5 mm	Less than 6.7 mm	Pipe Replacement

End of Section

SECTION 04510

CURED-IN-PLACE PIPE LATERAL LINER

PART 1 GENERAL

1.01 SCOPE

- A. The Work of this Section includes providing a cured-in-place pipe (CIPP) liner to stabilize structural defects and constructional inadequacies in sanitary sewer lateral pipelines. The liner shall be smooth, hard, strong, and chemically inert.
- B. CONTRACTOR to provide materials, labor, equipment, and services necessary for: bypass pumping or diversion of sewage flows, pre-installation procedures, rehabilitation of existing sanitary sewer services by lining existing pipe, re-establishing connections to existing sewer main, initial and final CCTV inspection, and final testing of the CIPP system.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Manufacturer's technical literature on proposed lining system conforming to this Specification and the standards referenced herein.
- 2. Information from resin manufacturer, including specifications, physical and chemical properties.

B. Informational Submittals:

1. Design Calculations:

- a. For the liner thickness per ASTM F1216. Design shall be signed and sealed by a professional Engineer registered in the State of Tennessee and certified by the manufacturer as to the compliance of its material to the values used in the calculations.
- b. Data and design calculations for each lining segment, together with an installation method statement.

2. CIPP sampling, preparation/curing and testing procedures.

3. CIPP repair methods.

4. Proposed testing laboratory with qualifications and experience history and references.

5. Certificates:

- a. Affidavit attesting to the previous successful use of the material for lining sanitary sewer laterals and references for projects completed within the past 5 years that total a minimum of 500 lateral liners installed.
- b. Written certification from manufacturer that installer is an approved applicator of lining materials, with a minimum of 3 years' experience in sewer rehabilitation.

- c. Written certification that the resin material is appropriate for the intended application.
6. Test Reports:
- a. Certified copies of test reports on physical properties and chemical resistance of the proposed resin.
 - b. Sample liner coupons.
7. Installation and wet out process control sheets.
8. Pre and Post CCTV inspection DVDs.
9. CIPP manufacturer certification of proper installation.

1.03 QUALITY ASSURANCE

- A. Qualifications: Installer shall be licensed by the lining system manufacturer.

1.04 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

- A. It shall be the responsibility of the CONTRACTOR to schedule and perform its work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.
- B. In the event CONTRACTOR's work activities contribute to overflows or spills, the CONTRACTOR shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the OWNER in a timely manner.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. If the flexible tube is impregnated with resin at the factory, it shall be transported, installed, and cured before expiration of the shelf life.
- B. Impregnated tube shall be stored and transported under refrigerated, ultraviolet light-free conditions.
- C. Each liner shall be accompanied by the appropriate documentation indicating time and date of liner manufacturing, felt thickness, number of layers, length of liner, resin type and name, hardener type and name, batch numbers, and mixing ratios.
- D. No cuts, tears, or abrasions shall occur during handling. CONTRACTOR shall not place the tube into the host pipe before the OWNER inspects the tube.

1.06 SPECIAL GUARANTEE

- A. Provide manufacturer's extended guarantee or warranty, with OWNER named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the OWNER, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and

obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
1. LMK Enterprises, Inc.; T Liner.
 2. AMerik Supplies, Inc.; TOP HAT System.
 3. Insituform Technologies, Inc.; Service Lateral Rehabilitation System.

2.02 MATERIALS

- A. Resin:
1. The resin used to impregnate the tube shall produce a cured tube that shall be resistant to shrinkage, shall not corrode or oxidize, and shall be resistant to abrasion from solids, grit, and sand.
 2. Proven resistance to the municipal wastewater environment that may comprise, as a minimum, all of the following factors:
 - a. Immersion in septic sewage at temperatures up to 75 degrees F.
 - b. Exposure in hydrogen sulfide gas from septic sewage at temperatures up to 75 degrees F.
 3. Proven resistance to ultra-violet light (sunlight) at any stage prior to installation.
 4. Solvent free epoxy resin. Polyester and vinylester resins are not acceptable.
 5. Shall not contain silicones, stearates, or natural waxes that would adversely affect the adhesives properties or any other chemical or physical properties of the CIPP liner.
 6. The internal wall color of the cured liner shall be a light reflective color so that a clear detailed CCTV inspection can be accomplished.
 7. Chemical resistance of resin system shall have been tested by resin manufacturer in accordance with ASTM D543. Exposure to the chemical solutions listed in Table 1 shall be conducted at temperatures of up to 75 degrees F. This test shall be conducted for a 1-month minimum period and shall result in a loss of not more than 20 percent of the initial structural properties.

Table 1 Minimum Chemical Resistance Requirements for Typical Municipal Sewer Applications (ASTM D543)	
Chemical Solution	Concentration (%)
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Gasoline	100
Vegetable Oil	100
Detergent or Soap	0.1

8. Resin system shall be manufactured by a company selected by the CIPP supplier. Use epoxy resins complying with requirements in Table 2.

B. CIPP Lateral Lining Tube:

1. General:

- a. One or more layers of flexible needled felt or an equivalent nonwoven material.
- b. Tube shall be continuous in length and wall thickness shall be uniform. Overlapping sections are not allowed in the circumference or the length of the lateral liner.
- c. Capable of conforming to offset joints, bells, 45-degree bends, 90-degree bends, and disfigured pipe sections.

2. CIPP Properties: After curing shall meet the minimum structural properties listed below:

Table 2 CIPP Initial Structural Properties (ASTM F1216)		
Property	ASTM Method	Minimum Value
Tensile Strength	D638	3,000 psi
Flexural Strength	D790	4,500 psi
Short Term Flexural		
Modulus of Elasticity	D790	250,000 psi

3. CIPP Thickness:

- a. Calculate minimum thickness after curing based on the following design conditions in accordance with ASTM F1216:
 - 1) Fully deteriorated pipe condition.
 - 2) Subjected to a full soil load of 120 pounds per cubic foot.
 - 3) Soil reaction modulus for pipe zone backfill material is 1,000 psi.
 - 4) Subject to a groundwater elevation at ground surface.
 - 5) Long-term flexural strength and long-term flexural modulus of elasticity shall be equivalent to 50 percent of the initial flexural strength and initial flexural modulus of elasticity, respectively, as measured in accordance with ASTM D790.
 - 6) Safety: Minimum factor of 2.0.
 - 7) Design life of CIPP repair shall be 50 years..

C. Interface Seal:

1. Structural properties in accordance with ASTM F1216 and as referenced in Table 2.
2. Meet the 50-year design life of the CIPP lateral liner.
3. Conform to one of the following two methods:
 - a. Method A: A full-circle 16-inch long CIPP mainline liner integrally manufactured to lateral liner providing a seamless connection between mainline liner and lateral liner.
 - b. Method B: One-piece construction designed such that when expanded shall tightly fit both “T” and “Y” connections at interface between mainline and lateral pipe.
4. Shall provide a minimum of a 3-inch overlap inside the mainline and shall extend inside the lateral pipe past the first lateral joint up to 3 feet.
5. Designed for either “T” or “Y” fittings and able to accommodate either condition without wrinkles or folds when installed.
6. Provide a watertight connection between service connection and mainline.

D. Cleanouts and Boxes: As specified in Section 04000, Wastewater Collection System.

PART 3 EXECUTION

3.01 TEMPORARY FLOW BYPASS AND DIVERSION PUMPING

- A. CONTRACTOR shall provide for the transfer of flow, through or around section or sections of pipe that are to be repaired. The proposed bypassing system shall be approved in advance by

OWNER. The acceptance of the bypassing system in advance by OWNER shall in no way relieve CONTRACTOR of responsibility or public liability. Temporary flow bypass and diversion pumping shall be carried out in accordance with Section 02542, Sewer Flow Control.

3.02 PRIVATE LATERAL SHUTDOWN

- A. Prior to shutdown of private service lines provide notifications and comply with the requirements as specified in Section 02546, Cured-in-Place Pipe (Liner Process).

3.03 TRAFFIC CONTROL

- A. CONTRACTOR shall provide traffic control in accordance with Section 01570, Work Zone Traffic Control.

3.04 PRE-INSTALLATION PROCEDURES

- A. Submittals shall be approved, including traffic management measures, safe pedestrian passage, provisions of vehicular access to property, bypass/diversion pumping, and emergency measures prior to the commencement of the Work.
- B. Lateral lining shall only occur after the corresponding mainline sewer has been lined, tested and approved by OWNER. It is the responsibility of the CONTRACTOR to ensure the proper sequence of work between the mainline and lateral lining activities. Lining of laterals before planned mainline lining activities have been completed and accepted by OWNER, will require CONTRACTOR to completely re-line laterals that were previously lined along the corresponding mainline pipe segment at no cost to the OWNER.
- C. CONTRACTOR shall notify property owners or tenants affected by this construction at least 24 hours prior to any service disruption affecting their service connection. The mainline sewer shall be kept in operation at all times during the rehabilitation of the lateral lines.
- D. CONTRACTOR shall CCTV inspect the lateral line immediately prior to reconstruction and determine the overall structural condition of the lateral.
- E. Preconditioning shall be carried out in accordance Section 04800, Sewer Cleaning. In addition, CONTRACTOR shall prior to installation of the lining high pressure flush and vacuum the lateral and remove grease buildup or other obstruction that may interfere with lining operations.
- F. If lateral liner installation requires the use of a cleanout, the rehabilitation work shall be accomplished utilizing existing cleanouts. No cleanouts shall be installed without the express written authorization from the OWNER.
- G. CONTRACTOR shall obtain approval from OWNER before connection seal can be installed.

3.05 INSTALLATION

- A. General:
 - 1. Install CIPP in accordance with practices outlined in ASTM F1216 for direct inversion installations.

2. CIPP lateral liner installation shall be accomplished remotely using air or water for inversion and curing. The cured-in-place pipe shall provide be smooth conforming to existing pipe and shall eliminate groundwater infiltration or connection to the outside of the host pipe/service.

B. Wet Out:

1. Thoroughly saturate flexible tube prior to installation. Catalyst system or additives compatible with the resin and flexible tube shall be as recommended by the manufacturer.
2. Resin impregnated flexible tube shall be handled to retard or prevent resin setting until it is ready for insertion.
3. CONTRACTOR shall complete a wet-out process control sheet for every lining completed. The control sheets shall provide the following information:
 - a. Liner manufacturer.
 - b. Liner diameter.
 - c. Number of layers.
 - d. Resin amount.
 - e. Resin type.
 - f. Resin manufacturer.
 - g. Batch number.
 - h. Hardener name.
 - i. Batch number.
 - j. Mixing ratios.
 - k. Vacuum pressure of impregnation process.
 - l. Wet-out start time and date.

C. Insertion:

1. Install CIPP short lateral liner/interface seal from mainline sewer and extend up to 3 feet inside the lateral. No cleanout is required for the installation of the connection seal and the short lateral liner system.
2. The CIPP lateral liner in excess of 3 feet shall be installed utilizing existing 4-inch or 6-inch diameter cleanout installed at the property line. It is the intent of these Contract

Documents that lateral lining work be accomplished utilizing existing cleanouts. If a lateral has been identified to be repaired by means of a lateral liner installation and no cleanout exists at the property line, the CONTRACTOR shall obtain authorization from the PROGRAM MANAGER to install a new cleanout.

3. The CONTRACTOR shall document the placement of the CIPP lateral liner by internal video inspection with the camera being inserted from the lateral cleanout down to mainline pipe. Installer shall be capable of viewing the lateral liner contacting the lateral pipe from the beginning to the end of the repair.
4. Use lubricant to reduce friction between the host pipe and the liner during the inversion and pull-in process. The lubricant used shall be a nontoxic product with no detrimental effects on the liner and shall be compatible with the wastewater treatment plant operations.
5. The addition of water pressure shall be adjusted to cause the impregnated flexible tube to invert from the mainline to lateral cleanout, holding the tube tight against the host sewer pipe.
6. If water is used to accomplish the inversion process, the CONTRACTOR shall complete an installation process control sheet for every lining completed. The control sheets shall provide the following information:
 - a. Liner length.
 - b. Hydrostatic head at point of inversion.
 - c. Hydrostatic head at termination point.
 - d. Time when inversion process starts.
 - e. Time start cutting ends.
7. If air is used in the inversion process, the liner manufacturer shall provide the minimum pressure required to hold the tube tight against the host pipe and the maximum pressure allowable to not damage the tube. Once the inversion has started, the pressure shall be maintained between the recommended pressure ranges until the inversion has been completed. Should the pressure deviate from within this range, the installed liner shall be removed. The CONTRACTOR shall complete an installation process control sheet for every lining completed. The control sheets shall provide the following information:
 - a. Liner length.
 - b. Minimum pressure.
 - c. Maximum pressure.
 - d. Time and pressure when inversion process started and every ten minutes until inversion process completes.
 - e. Time start cutting ends.

8. Trim cured tube/resin composite pipe left protruding from the service connection back using a hydraulic-powered robotic cutting device specifically designed for cutting cure-in-place pipe.

D. Interface Seal Installation:

1. Install interface seal and lateral liners according to the following two instances:
 - a. On main line sewers that have been lined under this Contract, each reinstated lateral that has not been identified to be rehabilitated by means of a CIPP lateral lining shall have a connection seal installed in accordance with Method B of this Specification. The connection seal shall extend at least past the first lateral joint, past the connection to the mainline pipe, and up to 3 feet into the lateral.
 - b. Each reinstated lateral that has been identified to be rehabilitated by means of a CIPP lateral lining shall have an interface seal installed in accordance with Method A or Method B of this Specification. The interface seal and lateral liner shall extend at least 15 feet into the lateral.
2. If the interface seal requires insertion, the seal shall be completely installed via remote device without excavation. The interface seal between the lateral liner and the mainline sewer pipe shall be compatible with the mainline liner and the lateral liner/pipe.
3. The interface seal shall be properly expanded to tightly fit the lateral interface. A full protocol for time and temperature shall be completed and documented for the proper curing of the seal.
4. The CONTRACTOR shall complete a curing process control sheet for every lining completed. The control sheets shall provide the following information:
 - a. Temperatures and time for the different steps of the curing process, such as initial cure, post-cure, and cooling, as outlined in ASTM F1216..
5. The curing process shall be conducted in accordance with the practices outlined in ASTM F1216.
6. Fit heat source with suitable monitors in accordance with ASTM F1216. The temperature of the incoming and outgoing heat source shall be recorded in order to determine when uniform temperature is achieved throughout the length of the liner. Thermocouples shall be installed at the top and bottom of the liner between the liner and the host pipe to appropriately control the resin curing process.
7. If air is used in the curing process, the liner manufacturer shall provide the minimum pressure required to hold the tube tight against the host pipe and maximum pressure allowable to not damage the tube. Once the inversion has started, the pressure shall be maintained between the recommended pressure ranges until the inversion has been completed. Should the pressure deviate more than 2.3 feet of water from within this range, the installed liner shall be removed.
8. If the curing process occurs at ambient temperature, the CONTRACTOR shall record the time when the curing process starts, the time for initial hardness, and the time when full cure is accomplished.

- E. Transport debris removed from the sewer during cleaning in watertight containers and disposed of in accordance with all local, State, and Federal regulations.

3.06 FIELD QUALITY CONTROL

A. Inspection:

- 1. The finished CIPP shall be continuous and free from visual defects such as foreign inclusions, dry spots, pinholes, delamination, and wrinkles greater in length than 1 percent of the pipe ID.
- 2. Section of lining with such defects shall either be removed and replaced at no additional cost to the OWNER or the CONTRACTOR will not receive payment for any work associated with rehabilitating the lateral in question (including connection seal).

B. Post-Televising of Completed Work:

- 1. Following completion of CIPP liner installation, a CCTV inspection shall be completed in accordance with Section 04810, Sewer Television Inspection.
- 2. NASSCO Pipeline Assessment and Certification (PACP) codes are not required for this inspection.
- 3. Correction of failed CIPP or CIPP deemed defective from post-installation television inspection or test reports for structural values, thickness, etc., shall be repaired as determined by OWNER at no extra cost to the OWNER. Method of repair, which may require field or workshop demonstration, shall be approved by OWNER.

3.07 TESTING

A. Laboratory Testing:

- 1. Samples: For every 10 laterals lined, two flat plate samples shall be processed and tested. Samples removed for testing shall be individually labeled and logged to record the following:
 - a. OWNER's project number and title.
 - b. Sample number.
 - c. Segment number of line as noted on supplements.
 - d. Date and time of sample.
 - e. Name of CONTRACTOR.
 - f. Location and by whom tested.
 - g. Street name and address.
 - h. Test results.

2. CONTRACTOR shall prepare the flat plate samples onsite using the actual CIPP liner being installed. Once the liner is applied to the clamped mold, the Sample shall be placed in either the upstream or downstream manhole, to simulate the environmental conditions that the lateral liner being installed will experience during the curing process. After the curing process has being completed, the sample shall be removed, labeled, and sent to the laboratory facility for physical properties testing.
3. Samples shall be tested for modulus of elasticity and flexural strength in accordance with ASTM D790. Preparation and testing samples shall be performed in accordance with the approved submittals. Failure of either the modulus or flexural strength tests on either sample shall be grounds for the rejection of all CIPP liners installed since the last successful test.
4. Samples shall be numbered as follows:
 - a. Sample No. 1: Flat plate sample.
5. Testing shall be completed by an accredited laboratory at the CONTRACTOR's expense. The CONTRACTOR shall submit the chosen laboratory with appropriate accreditation documentation for approval by the OWNER prior testing. Testing results shall be provided to the OWNER within 7 days of receipt.

3.08 CLEANING

- A. After liner installation has been completed and accepted, the CONTRACTOR shall clean up the entire project area and restore Site to its original condition prior to the commencement of work. Excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

End of Section

SECTION 04600

SANITARY SEWER PIPE BURSTING WITH HIGH-DENSITY POLYETHYLENE PIPE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society for Testing and Materials (ASTM):
 - a. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - b. D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - c. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - d. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
 - e. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - f. D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
 - g. F585, Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers.
 - h. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 2. Plastic Pipe Institute (PPI).

1.02 DEFINITIONS

- A. CCTV: Closed-circuit television.
- B. DVD: Digital Video Disc.
- C. SDR: Standard Dimension Ratio.

1.03 SUBMITTALS

- A. Action Submittals:
1. Catalog cuts and specifications:
 - a. Pipe.
 - b. Electrofusion fittings.
 - c. Joining equipment..
 2. Dimensioned drawings including, installation details and sketches.

B. Informational Submittals:

1. Manufacturer's Certificates:
 - a. Certificate of material compliance.
 - b. CONTRACTOR Certifications:
 - 1) Certifications of training by pipe bursting system manufacturer stating that operators have been fully trained in the use of the pipe bursting equipment by an authorized representative of the equipment manufacturer.
 - 2) Certification from pipe manufacturer of training in the proper method for handling and installing the new pipe.
 - 3) Certifications of training by the pipe fusion equipment manufacturers that the operators have been fully trained in the use of the fusion equipment by an authorized representative of the equipment manufacturer.
2. Test Results: Certified factory.
3. Installation Instructions:
 - a. Detailed construction procedures, and layout plans to include sequence of construction.
 - b. Locations, sizes and construction methods for the service reconnection pits.
 - c. Methods of construction, reconnection and restoration of existing service laterals.
 - d. Detailed descriptions of the methods of modifying existing manholes.
 - e. Detailed procedures for the installation and bedding of the new pipe in the launching and receiving pits.
 - f. Description of the method to remove and dispose of the host pipe, if required.
4. Sewer Bypass Plan: Methods and list of equipment to be utilized, including:
 - a. Emergency response plan to be followed in event of bypass pumping system failure.
 - b. Backup bypass pump on construction site for the main sewer and sewer service laterals.
5. Contingency Plan: Provide for the following potential conditions at a minimum:
 - a. Unforeseen obstruction causing burst stoppage, such as unanticipated change in host pipe material, repair section, concrete encasement or cradle(s), buried or abandoned manhole or changes in direction not depicted on Drawings provided by the OWNER.
 - b. Substantial surface heave occurs due to the depth of the existing pipe versus the amount of upsizing.
 - c. Damage to existing service connections or to the replacement pipeline's structural integrity.
 - d. Damage to other existing utilities.
 - e. Soil heaving or settlement.
 - f. Loss of and return to line and grade.
6. DVD Documentation:

- a. Preinstallation DVD, original.
- b. Post-installation DVD, original.

1.04 QUALITY ASSURANCE

- A. The CONTRACTOR shall be certified by pipe bursting system manufacturer as a fully trained user of the pipe bursting system. Operation of the pipe bursting system shall be performed by trained personnel. Such training shall be conducted by a qualified representative of the pipe bursting system manufacturer. The CONTRACTOR shall provide certificates of training for any employee directly involved in the supervision or operation of the pipe bursting system.
- B. Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and the recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Such training shall be certified and conducted by a qualified representative of the pipe manufacturer.
- C. Installation of other materials shall be performed by personnel qualified by the specific product manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping:
 - 1. Markings: Pipe materials shall be legibly marked by manufacturer with the following:
 - a. Name and trademark of manufacturer.
 - b. Nominal pipe size.
 - c. SDR.
 - d. Letters PE, followed by polyethylene grade per ASTM D1248, followed by Hydrostatic Design Basis in hundreds of psi.
 - e. Manufacturing standard reference.
 - f. Production code from which date and place of manufacture can be determined.
- B. Acceptance at Site:
 - 1. After unloading and before installation, inspect pipe to verify its condition. Pipe condition inspection report shall be reviewed by OWNER prior to installation.
 - 2. Unload and store pipe to ensure that pipe is not cut, gouged, scored, or otherwise damaged. Pipe segments with pipe wall cuts exceeding 10 percent of wall thickness shall be removed from Site.
- C. Storage and Protection:
 - 1. HDPE pipe without ultraviolet inhibitor shall not be stored unprotected against outside elements.
 - 2. Store pipe so as not to be deformed axially or circumferentially.
- D. Handling: Use wide band slings for lifting and moving pipe. Use of chains is prohibited.

1.06 SITE CONDITIONS

- A. Provide adequately designed pipe bursting equipment to accomplish replacement of existing pipe under adverse conditions.
- B. Determine location of receiving and insertion pit excavations needed due to existing manholes that are not designated to be replaced.

1.07 SEQUENCING AND SCHEDULING

- A. Upon completion of pipe insertion and installation, expedite reconnection of lateral service connections so as to minimize inconvenience to customers.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pipe:
 - 1. Materials:
 - a. High molecular weight, solid wall, high-density polyethylene pipe, in accordance with ASTM F714.
 - b. Virgin grade material.
 - c. Plastic Pipe Institute (PPI) designation of PE 3408.
 - d. Minimum cell classification of 345434C, D, or E as described in ASTM D3350.
 - e. Meet requirements for Type III, Class B or C, Category 5, Grade P34 material as described in ASTM D1248.
 - f. Shall contain no recycled compound except that generated in manufacturer's own plant from resin of same specification from same raw material.
 - g. Pipe (excluding black colored pipe) stored outside shall not be recycled.
 - h. Pipe shall be manufactured by the following:
 - 1. Performance Pipe.
 - 2. Rinker Polypipe.
 - 3. Uponor North America.
 - 4. ARNCO.
 - 2. Color:
 - a. Inside: Inner wall shall be a light color interior (soft gray or white).
 - b. Outside: Outer wall black with co-extruded green cover or extruded green stripes designating use for sanitary sewer. Pipe with extruded green stripes shall have a minimum of three equally space stripes. Pipe shall have a heat indented print line containing the information required in ASTM D3035. Color print lines are not an acceptable method for designation of sewer mains.
 - 3. SDR:
 - a. Nominal Size: 8 inches and larger with DIP outside diameters.
 - b. SDR: Minimum 17.

- B. Fittings shall be HDPE butt fusion welded fittings in accordance with ASTM D3261 as modified for the specified material.
- C. Joints:
 - 1. Pipe jointing shall be by butt fusion welding, as specified in Paragraph Pipe Joining.
 - 2. Electrofusion Couplings:
 - a. May be used for repairs or connecting pipe burst segments in the trench with approval of the OWNER.
 - b. Manufacturers:
 - 1) Central Plastics Company; Central Electrofusion System.
 - 2) IPEX, Inc; Friatec.
- D. Service Connections:
 - 1. Service saddles shall be butt fusion or electrofusion saddle type fitting with DIP outside dimension branch connection:
 - a. Specifically designed for connection to the type of HDPE being installed.
 - b. Manufacturers:
 - 1) Central Plastics Company; Central Electrofusion System.
 - 2) IPEX Inc.; Friatec.
 - 2. Option: For HDPE pipe sizes greater than 10 inches an Inserta Tee by Inserta Fittings Company may be used.
- E. Equipment:
 - 1. Pipe Bursting: Provide equipment of sufficient size and power to accomplish the specified pipe replacement under adverse conditions. Utilize hydraulically powered constant tension static pull pipe bursting system or pneumatic hammer.
 - 2. Joining: Capable of meeting conditions recommended by pipe manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure.

2.02 SOURCE QUALITY CONTROL

- A. Certify laboratory data confirming that said tests have been performed on sample of pipe to be provided under this Contract, or pipe from that production run, and that satisfactory results were obtained prior to shipping.
- B. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other injurious defects. It shall be uniform in density and other physical properties. Pipe not meeting these criteria shall be rejected.

PART 3 EXECUTION

3.01 PREPARATION

- A. Work shall be supervised by personnel experienced in installation of similar pipe and shall be onsite at all times from time of commencement to time of completion.
- B. Existing pipe shall be clean and free of obstructions so as not to prohibit pipe bursting operations.
 - 1. The CONTRACTOR shall perform a pre-installation CCTV inspection.
 - 2. If the pre-installation CCTV inspection reveals obstructions in the existing sewer (heavy solids, dropped joints, protruding service taps or collapsed pipe) which will prevent completion of the pipe bursting process, and that cannot be removed by conventional sewer cleaning equipment, then a point repair shall be made by the CONTRACTOR, with the approval of the OWNER.
- C. CCTV inspections shall be completed in accordance with Section 04810, Sewer Television Inspection.

3.02 LOCATING UTILITIES

- A. The CONTRACTOR shall, prior to starting work, verify the location of all adjacent utilities. The minimum clearance from other utilities shall be approximately two feet. The OWNER may at its discretion reduce the minimum clearance with justification from the CONTRACTOR.
- B. The CONTRACTOR shall expose all interfering and crossing utilities by spot excavating at the planar intersection of the pipe and removing the soil from around the utility. The cost of exposing these utilities shall be borne by the CONTRACTOR as part of the pipe bursting operation.
- C. Locate existing utilities in accordance with Section 04000, Wastewater Collection System .

3.03 SUB-SURFACE CONDITIONS

- A. OWNER will furnish the CONTRACTOR with available information listed in the Contract Documents, if any are available. The CONTRACTOR shall verify this information in the field. All additional subsurface investigations deemed necessary by the CONTRACTOR to complete the work shall be included in the Contract at no additional cost to OWNER.
- B. Copies of all reports and information obtained by additional subsurface investigations by the CONTRACTOR shall be provided to the OWNER.
- C. The minimum depth of cover over the installed pipe shall be 4 feet for size-on-size pipe bursting, and shall be 8 feet for increased pipe size pipe bursting. The CONTRACTOR may request approval of the OWNER reduce the minimum depth of cover.
- D. A minimum amount of ground heaving may be allowed, as determined by the OWNER, if soil conditions are not favorable and up-sizing of the pipe is required.
- E. Unless otherwise noted, settlement or heaving of the ground surface during or after construction will not be allowed. The CONTRACTOR is solely responsible for the costs for repairing any surface heaving, unless specified otherwise.

3.04 LOCATING SERVICE CONNECTIONS

- A. Sewer service connections shall be identified and located by CCTV prior to start of pipe bursting operation and pipe insertion.
- B. The CONTRACTOR shall locate all and expose all sewer service connections prior to pipe insertion to expedite reconnection.
- C. The CONTRACTOR shall exercise due diligence in excavating the existing pipe sufficiently to allow for uniform circumferential expansion of the existing pipe through the service connection pit. Upon commencement of the bursting process, pipe insertion shall be continuous and without interruption from one entry point to another, except as approved by the OWNER.
- D. Upon completion of insertion of the new pipe, the CONTRACTOR shall conduct the reconnection of services to minimize any inconvenience to the customers.

3.05 PIPE JOINING

- A. The HDPE pipe shall be assembled and joined at the Site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted.
- B. All equipment and procedures used in shall be in strict compliance with ASTM D2657 and with the pipe manufacturer's recommendations.

- C. Fusion shall be performed by technicians certified by a manufacturer of pipe fusion equipment.
- D. Prior to pipe installation, two trial fusion welds shall be performed, and reviewed and approved by the OWNER. Full penetration welds shall provide homogeneous material across the cross section of weld. Fusion machine employed for trial welds shall be same machine utilized for project installation.
- E. The butt-fused joint shall be true alignment and shall have uniform rollback beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure.
- F. The fused joint shall be watertight and shall have tensile strength equal to or greater than that of the pipe.
- G. All joints shall be subject to acceptance by the OWNER prior to insertion.
- H. The CONTRACTOR shall cut out and replace defective joints at no additional cost to OWNER.
- I. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10 percent of the wall thickness (ASTM F585), shall not be used and shall be removed from the Site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above.
- J. Any section of the pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER shall be discarded and not used.
- K. Terminal sections of pipe that are joined within the insertion pit shall be connected with an electrofusion coupling (e.g., Central Plastics couplings).
- L. All connections shall be in conformance with the manufacturer's installation procedures.

3.06 BYPASSING OF FLOWS

- A. When blocking flow in upstream sewers is not appropriate, use flow bypass pumping for reducing flow below the maximum depth or for completely bypassing flow.
- B. Bypassing of flows shall be provided in accordance with Section 04820, Sewer Flow Control.

3.07 PIPE INSTALLATION

- A. Pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by OWNER.
- B. Advancement of bursting head with "chain" shall be prohibited.

- C. Void created by bursting device shall be sufficient in size to accommodate HDPE pipe.
- D. Rescue Shafts:
 - 1. In the event that the pipe-bursting machine encounters an obstruction and is halted, the CONTRACTOR will be required to excavate down to the machine to free the obstruction and continue the installation.
 - 2. The CONTRACTOR is notified that the construction of such shafts will be considered incidental to the installation by the pipe bursting construction method.
 - 3. Any rescue shafts will be properly braced, shored, or utilize trench boxes to meet applicable Federal, State, and local requirements.
 - 4. Backfill and compaction for such rescue shafts shall be in accordance with Section 04000, Wastewater Collection System .

3.08 LUBRICATION

- A. Lubrication shall be used if in the opinion of CONTRACTOR such lubrication is necessary to ensure the successful completion of the job.
- B. The CONTRACTOR shall make arrangements for the injection of bentonite into the annular space behind the pipe bursting head, as the lubricant if required.

3.09 SERVICE RECONNECTION

- A. The installed pipe shall be allowed the manufacturer's recommended amount of time but not less than 4 hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines.
- B. Prior to reconnecting sewer services, installed pipe shall have been successfully tested.
- C. The CONTRACTOR, after a suitable relaxation period and testing shall reconnect all service connections as approved by the OWNER.
- D. Sewer service connections shall be connected to new pipe and installed in a hole drilled to the full inside diameter of the outlet. Service connections shall be an Inserta-T or an electrofusion saddle per the requirements above.
- E. The slope of the existing lateral toward the newly installed sewer main shall be maintained at the existing slope. For reconstructed laterals, a minimum pipe slope of 1 percent is required.

3.10 RESTORATION

- A. Restoration of Manholes:
 - 1. The CONTRACTOR shall restore all manholes and associated surface areas to their original condition.

2. Prior to restoring manholes, the installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than 4 hours, for cooling and relaxation due to tensile stressing prior to the sealing of the annulus or backfilling of the insertion pit.
3. Sufficient excess length of new pipe, but not less than 2 inches to 4 inches, shall be allowed to protrude into the manhole. Connections to manholes shall be per Section 04100, Manholes.

B. Restoration of Pits:

1. The CONTRACTOR shall restore all lateral, launching pits and associated surface areas to their original condition.
2. Prior to backfilling lateral and launching pits the CONTRACTOR shall ensure that the new pipe is properly supported and on the required grade.
3. Backfill per Section 04000, Wastewater Collection System shall be used for the new pipe as support in order to avoid sagging after backfill and compaction.

3.11 POST INSTALLATION CCTV INSPECTIONS

A. The CONTRACTOR shall perform post-installation CCTV inspections in accordance with Section 02541, Sewer Television Inspection.

1. Post construction video tapes shall be submitted to the OWNER on DVD's in Subcam software format for review prior to final payment. Should any portion of the inspection video be of inadequate quality or coverage, as determined by the OWNER, the CONTRACTOR will have that portion re-video taped at no additional expense to the OWNER.
2. All original DVD's remain property of the OWNER. The CONTRACTOR may retain a second copy, if desired.

B. From the CCTV inspection, the newly installed pipe shall be visibly free of defects, which may affect the integrity or strength of the pipe. If in the opinion of the OWNER such defects exist, the pipe shall be repaired or replaced at the CONTRACTOR's expense.

C. If the CCTV inspection reveals a sag in the new sewer after pipe bursting has been completed, the CONTRACTOR shall notify the OWNER to determine if a point repair is necessary to correct the sag. At the direction of the OWNER, the CONTRACTOR shall take the necessary measures to eliminate these sags by performing a point repair and bringing the bottom of the newly installed pipe to a uniform grade by excavating the pipe, lifting it, and placing compacted crushed stone bedding under and around the pipe to eliminate the sag.

3.12 TESTING OF GRAVITY SEWERS

A. Testing of gravity sewers shall be in accordance with Section 04000, Sanitary Sewers (Gravity).

3.13 FIELD QUALITY CONTROL

- A. Low pressure air testing from manhole-to-manhole section of sanitary sewer shall be performed after the pipe has been bursted and prior to service lines being connected. Air testing shall be in accordance with ASTM F1417.

3.14 FINAL CLEANING

- A. Prior to inspection and acceptance of pipe by OWNER, flush and clean system to remove accumulated construction debris, rocks, gravel, sand, silt, and other foreign material.

End of Section

SECTION 04700

MANHOLE REHABILITATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rehabilitation of physically deteriorated, leaking or structurally unsound sanitary sewer manholes by polymer applied coatings (either epoxy or polyurethane). Sauereisen, Sprayroq, Raven, and SpectraShield products are the only approved polymer-based coating methods for this project.
- B. The repair and sealing of the manhole base, invert, walls, corbel/cone and chimney of brick, block or precast manholes.
- C. Reinstallation or replacement of manhole frames and cover for grade adjustment, frame alignment, poor condition, or for inflow elimination as specified in paragraph 3.05.
- D. The installation of manhole to frame (chimney) seals, as specified in paragraph 3.06.
- E. Inspection and testing of the various types of work to ensure compliance.

1.02 PERFORMANCE REQUIREMENTS

- A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against corrosion.
- B. Contractor's personnel involved in installation of materials: Certified by manufacturer that they have successfully completed training in handling, applying and finishing materials used.
- C. Contractor: Inspecting pre-rehabilitation work, rehabilitation operation, and post-rehabilitation work.
- D. Manufacturer's Product Support
 - 1. Through the Contractor, manufacturers of wall sealing, coating or lining systems shall submit to the Engineer for review and approval a detailed description of the proposed rehabilitation process. Describe surface preparation, independent laboratory test results, mix design procedures and methods of controlling uniform thickness.
 - 2. A representative employed by the manufacturer and/or the liner system shall be a company that specializes in the design, manufacture, or installation of corrosion protection systems for manholes. Applicator shall be completely trained in leak repair, surface preparation, and corrosion protection materials application for manholes. Corrosion protection materials/products shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner. Representative shall be named and available for consultation by telephone during business hours and on site upon 48 hours notice.

1.03 SUBMITTALS

- A. Product Data: Submit product data for both repair materials to be lined and the lining product, including surface preparation instructions, application instructions, and cure times from manufacturer.
- B. Installer Qualifications: Installers of liners and wall repair systems shall submit qualifications to the Engineer at least 14 days prior to start of any material application. Submittal shall consist of:
 - 1. Manufacturer's approved equipment list, by name and model number for application of product and contractor's equipment list showing approved equipment available for use in product application.
 - 2. List of contractor's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each person.
 - 3. Five (5) recent references of contractors indicating successful application of the lining product specified herein, applied by spray application within the municipal wastewater environment.
- C. Work Procedures: Submit confined space entry and flow diversion and/or bypass plans as necessary to perform the specified work.
- D. Progress Photographs:
 - 1. After cleaning and preparing each manhole, submit either 3"x5" color photographs or digital photographs of manhole's interior walls for review by the Engineer. The Engineer may inspect the manhole before giving approval to begin lining.
 - 2. After liner installation of each manhole, submit a minimum of three additional 3"x 5" color photographs or digital photographs to show final condition of rehabilitated manhole.
 - 3. Provide photographs of sufficient quality and clarity so that interior condition can be readily determined by the Engineer.
 - 4. Annotate each photograph. Give date, manhole number, material used, and appropriate remarks either on the back using permanent ink, or in a corresponding electronic file.

1.04 PROJECT CONDITIONS

- A. Contractor shall conform with all local, state, and federal regulations.
- B. Manholes Containing Mechanical or Electrical Equipment:

1. Contract Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment, immediately notify the Engineer.
2. Reschedule work in such manholes until equipment has been removed by Owner and further instructions are given.
3. Do not subject manholes with mechanical hardware or electrical equipment to diversion/bypass pumping.
4. Damage to installed equipment, due to negligence of Contractor, will be repaired by Owner and cost of repairs charged to Contractor.

C. Field Location of Manholes, Cleanouts and Inlets:

1. Contractor is responsible for locating and uncovering all manholes and cleanouts in lines being rehabilitated. If difficulty is encountered in locating a manhole or clean-out covered by ground or pavement, notify the Engineer and await instructions.
2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting cleaning and sealing operations.

1.05 SALVAGE

- A. Manhole covers, frames, and adjusting rings from abandoned manholes and inlets remain the property of the Owner. Deliver salvaged items to locations designated by the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. General

1. The materials used shall be designed, manufactured and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages and clearly labeled with the manufacturer's identification and printed instructions. All materials shall be stored and handled in accordance with recommendations of the manufacturer. All materials shall be mixed and applied in accordance with the manufacturer's written instructions.
2. The installer shall warrant and save harmless the Owner and his Engineer against all claims for patent infringement and any loss thereof.
3. The Contractor shall handle and store all material and shall dispose of all wastes in accordance with applicable regulations.

4. Each lining system shall be designed for application over wet (but not active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.

B. Stopping active leaks in concrete and masonry manholes:

1. A chemical or hydraulic sealant designed for use in field sealing of ground water. Product shall be formulated for topcoating with the specified coating products. Product shall be approved by owner/engineer prior to installation.

C. Patching, repointing, filling, and repairing nonleaking holes, cracks, and spalls in concrete and masonry manholes:

1. 100% solids, solvent – free epoxy grout specifically formulated for topcoating with the specified coating products.
2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be suitable for topcoating with the specified coating products.

D. Spray applied Epoxy Coating for manholes:

1. The material sprayed onto the surface of the manhole shall be a 100% solids, solvent-free, ultra high-build two or three part epoxy system.
2. A monolithic liner shall be formed which covers all manhole surfaces and shall have the following physical properties:

Minimum thickness	250 mils
Adhesion to Concrete ASTM D4541	Substrate (concrete) failure
Working time at 70 degrees F	min. 30 minutes
Initial set time at 70 degrees F	17 hours

E. Spray applied Polyurethane Coating for manholes:

1. The material sprayed onto the surface of the manhole shall be a 100% solids, volatile organic compounds (VOC) free, two part polyurethane lining.
2. A monolithic liner shall be formed which covers all manhole surfaces and shall have the following physical properties:

Minimum thickness	100 mils
Tensile strength (ASTM D638)	min. 2,700 psi

F. Manhole frames and covers.

1. Standard and non-traffic bearing watertight frames and covers shall be as per CUB standards.
2. Watertight frames and covers shall be installed in easement areas.

G. Manhole to frame seal.

1. Frame-to-chimney seals shall be installed as specified in bid form.

PART 3 EXECUTION

3.01 REHABILITATION OF MANHOLE STRUCTURES

A. General Procedures:

1. Safety: The Contractor shall perform all work in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements regarding confined space entry. Provide barricades, warning lights and signs for excavations.
2. Cleaning: All concrete and masonry surfaces to be rehabilitated shall be clean. All grease, oil, laitance, coating, loose bricks, mortar, unsound concrete and other foreign materials shall be completely removed. Water blasting utilizing a 210 degree steam unit and proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface. All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.
3. Stopping Infiltration: After surface preparation and prior to the application of linings and coatings, infiltration shall be stopped either by plugging or chemical grout sealing as specified above.
4. Patching: All large holes or voids around steps, joints or pipes, all spalled areas and all holes caused by missing or cracked brick shall be patched and all missing mortar repointed using a non-shrink patching mortar or grout as specified above. All cracked or disintegrated material shall be removed from the area to be patched or repointed, exposing a sound sub-base. All cracks not subject to movement and greater than 1/16-inch in width shall be routed out to a minimum width and depth of 1/8-inch and patched with non-shrink patching mortar or grout.
5. Maintaining waste water flows: The Contractor shall be responsible for maintaining sewer flows in accordance with bypass pumping requirements.
6. Remove all loose grout and rubble from existing channel. Rebuild channel if required by reshaping, repairing slope of shelves or benches. Work shall include aligning inflow and outflow ports in such a manner as to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve as large a radius as the size of the manhole will permit, but will be shaped to allow easy entrance of maintenance equipment including buckets, T.V. camera, etc.

7. Manhole steps: Existing manhole steps shall be cut and removed and not replaced after rehabilitation.
8. Each lining system shall be installed in accordance with the manufacturer's recommendation to withstand a groundwater pressure of at least 15 feet above the manhole bench.

3.03 SPRAY APPLIED EPOXY COATING

- A. The material shall be spray applied to a minimum uniform dry film thickness of 250 mils to insure all cracks, crevices, and voids are filled and a somewhat smooth surface remains. The material shall be a two or three part 100% solid, corrosion resistant epoxy coating that can be applied to dry or wet surfaces. The proposed coating system shall be a Raven, Sauereisen, or approved equal.
- B. The primer system shall be familiar to Raven, Sauereisen, or approved equal.
- C. The proposed system shall be 100% solids by volume and shall contain no volatile organic compounds (VOC's).
- D. Epoxy manhole liner manufacturer shall warrant against failure for a period of 10 years. "Failure" will be deemed to have occurred if the protective lining fails to (a) prevent the internal deterioration or corrosion of the structure, (b) protect the substrate and environment from contamination by effluent, or (c) prevent groundwater infiltration. If any such failure occurs within 10 years of initial completion of work on a structure, the damage will be repaired to restore the lining at no cost to the Owner within 60 days after written notification of the failure. "Failure" does not include damage resulting from mechanical or chemical abuse or act of God. Mechanical or chemical abuse means exposing the lined surfaces of the structure to any mechanical force or chemical substance not customarily present or used in connection with structures of the type involved. There are no warranties express or implied other than those specifically stated in this section 3.04 D. Any liability for consequential and incidental damages is expressly disclaimed. Liability is limited to and shall not exceed the purchase price paid.

3.04 SPRAY POLYURETHANE COATING

- A. The material shall be spray applied to a minimum uniform dry film thickness of 100 mils to ensure all cracks, crevices, and voids are filled and a somewhat smooth surface remains. The material shall be a two-part 100% solid, corrosion resistant polyurethane coating that can be applied to dry or wet surfaces. The material shall be light in color. The proposed coating system shall be Sprayroq, Spectrashield, or approved equal.
- B. The primer system shall be familiar to Sprayroq, Spectrashield, or approved equal.
- C. The proposed system shall be 100% solids by volume and shall contain no volatile organic compounds (VOC's).
- D. Polyurethane manhole liner manufacturer shall warrant against failure for a period of 10 years. "Failure" will be deemed to have occurred if the protective lining fails to (a) prevent the internal deterioration or corrosion of the structure, (b) protect the substrate and environment from contamination by effluent, or (c) prevent groundwater infiltration. If any such failure occurs within 10 years of initial completion of work on a structure, the damage

will be repaired to restore the lining at no cost to the Owner within 60 days after written notification of the failure. "Failure" does not include damage resulting from mechanical or chemical abuse or act of God. Mechanical or chemical abuse means exposing the lined surfaces of the structure to any mechanical force or chemical substance not customarily present or used in connection with structures of the type involved. There are no warranties express or implied other than those specifically stated in this section 3.04 D. Any liability for consequential and incidental damages is expressly disclaimed. Liability is limited to and shall not exceed the purchase price paid.

3.05 MANHOLE FRAME AND COVER REINSTALLATION OR REPLACEMENT

- A. The Contractor shall remove the existing manhole frame and cover and, if they are not being reused, dispose of them as directed by the Engineer. It shall be the responsibility of the Contractor, at no additional cost to the Owner, to repair any damage to the chimney or corbel caused by the removal of the existing manhole frame.
- B. If the manhole frame is to be raised, a sufficient number of new precast concrete grade rings or brick shall be installed to enable the frame and cover to meet the new grade. The manhole cover may also be raised to meet the grade by installing an approved steel or iron manhole adjusting ring in the top of the existing manhole frame.
- C. The frame and adjustment rings shall be set in a bed of Butyl Mastic Sealant.
- D. Existing frames and covers that are to be reused shall be thoroughly cleaned before reinstallation. The Contractor shall then install the new or reused frames so that the top of the covers are at the required grade.

3.06 MANHOLE TO FRAME SEAL

- A. Manhole to frame seals shall be installed as specified in the Bid Form.
- B. Internal double pleated elastomeric sleeve shall be mechanically attached to and sealed against the manhole frame and chimney with internal expanding bands.
- C. The inside diameter of both the base of the manhole frame and the chimney or cone/corbel section shall be accurately measured as recommended by the manufacturer to obtain the proper size and shape of the seal.
- E. The contact surfaces for the sleeve shall be circular, clean, reasonably smooth, and free of loose material and excessive voids. If the masonry surface is rough or irregular and will not provide an effective seal, it shall be smoothed with mortar. A bed of butyl rubber caulk shall be applied to the sealing surface of the sleeve to fill minor irregularities in the masonry surface. After the sleeve has been placed in proper position, the bands are positioned and individually tightened or expanded as required to provide a watertight seal. Detailed installation instructions shall be in accordance with the manufacturer's instructions.

3.07 MANHOLE REHABILITATION ACCEPTANCE

- A. Per manufacturer specifications, spark or holiday testing may be required to ensure a continuous pinhole-free lining. Manhole must pass manufacturer specified test for work to be accepted by the Engineer.

- B. After the manhole rehabilitation work has been completed, the manhole shall be visually inspected during high groundwater by the Contractor in the presence of the Engineer and the work shall be accepted if found satisfactory to the Engineer. No evidence of visible leaks shall be allowed. In addition, at the Owner's request, the Contractor may be required within one year to visually inspect the manholes that were rehabilitated. Any work that has become defective within the one year period shall be redone by the Contractor at no additional expense to the Owner.

3.08 MANHOLE VACUUM TESTING

- A. Manholes shall be tested upon completion of the rehabilitation work as specified.
- B. The CONTRACTOR shall provide all labor and equipment for vacuum and holiday testing.
- C. All manholes are to be vacuum tested following rehabilitation. The ring and lid casting assembly shall be installed prior to testing. The testing equipment shall consist of a gasoline powered vacuum pump with sufficient vacuum hose length and a test head of proper size to fit the inside opening of the manhole. The test head shall be equipped with an inflatable rubber bladder to affect the seal to the manhole, an air pressure gauge, and a safety valve for filling the bladder, a 30-inch Hg liquid-filled vacuum gauge, a double air exhaust manifold with quarter turn ball valves, three bolt-on feet, and a bridge assembly with height adjustment rod.
- D. The Contractor shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6" beyond the manhole wall.
- E. With the vacuum tester in place, inflate the compression band to effect a seal between the vacuum base and the structure. Connect the vacuum pump to the outlet port with the valve open and evacuate the manhole to 10" Hg (0.3 bar), which is equivalent to approximately 5 PSIG back pressure.
- F. Close vacuum inlet/outlet ball valve, disconnect the vacuum pump, and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1" Hg over the specified time period, the manhole is considered acceptable and passes the test. If the manhole fails the test, identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. Once the leaks have been identified, complete all necessary repairs by sealing the leaks on the outside of the manhole to the satisfaction of the OWNER, and repeat test procedures until satisfactory results are obtained.

VACUUM TEST TIMETABLE			
Manhole Diameter - Inches			
Depth - Feet	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
8'	20 sec.	26 sec.	32 sec.
12'	30 sec.	39 sec.	48 sec.
16'	40 sec.	52 sec.	64 sec.
20'	50 sec.	65 sec.	80 sec.
24'	60 sec.	78 sec.	96 sec.
*	5.0 sec.	6.5 sec.	8.0 sec.
* Add extra testing time, "T", for each additional 2 foot depth. (The values listed above have been extrapolated for ASTM designation C924-85.)			

- G. The OWNER reserves the right to reject any and all manholes that do not pass vacuum testing requirements, and replacement shall be at the CONTRACTOR'S expense. A significant number of leaks on a single manhole, or a significant number of manholes leaking shall be considered as a basis for rejection and replacement of manholes.

End of Section

SECTION 04800

SEWER CLEANING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section covers the Cleaning of sewers to remove all debris, solids, sand, grease, grit, roots, etc. from the sewers and manholes to improve pipe flow, facilitate television inspection for sewer evaluation, for proper application of root control chemical, or as required for other specified rehabilitation.
- B. The Work covered by this section includes furnishing all labor, equipment, and materials required to clean and inspect sanitary sewer lines as specified.

1.02 SUBMITTALS

- A. Action Submittals: Catalog and manufacturer's data sheets for cleaning equipment.
- B. Informational Submittals:
 - 1. Sample of the finished picture from the picture capture system.
 - 2. Equipment manufacturer's operational manual and guidelines.
 - 3. Liquid Waste Manifest.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Sewer Television Equipment shall be in compliance with Section 02541, Sewer Line Television Inspection.
- B. Hydraulically-Propelled Equipment: The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment, which cannot be collapsed, is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.
- C. Cleaning:
 - 1. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor and produce at least 2,000 psi pressure. The gun shall be capable of producing flows from a fine spray to a solid stream.
 - 2. Sewer line cleaning equipment shall be a combination of high-velocity (hydro-cleaning) jet and vacuum system, truck-mounted for mobility and ease of

- operation. The hydro-cleaning equipment for sewer lines shall include a minimum 1,000-gallon water storage tank, auxiliary engines and pumps, and include a minimum of 600 feet of 1-1/4-inch I.D. high-pressure hose on a power-driven hose reel. Pump nozzle combinations shall be capable of producing water flow rates up to 120 gpm, and a minimum of 60 gpm at a working pressure up to 2,000 psi. The vacuum system shall be a positive displacement blower with a minimum of 4,200 cfm at 15 inches of mercury. OWNER must approve any variations to this pumping rate, in advance.
3. A working pressure gauge shall be used on the discharge of all high-pressure water pumps.
 4. CONTRACTOR shall use in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-inch and larger.
- D. Heavy Cleaning: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

PART 3 EXECUTION

3.01 GENERAL

- A. Prior to the start of any Work under this Project, CONTRACTOR shall make available to OWNER all equipment that is to be utilized in the execution of this contract. OWNER will hold a preconstruction conference at which the sequence of work, methods, inspection, and monitoring requirements and debris disposal shall be discussed.
- B. When sewer flow depth is greater than 25 percent, flow depth shall be decreased by plugging or bypass pumping. Plugs shall be designed to pass any desired portion of sewage flow. If bypass pumping is required, CONTRACTOR shall provide all necessary equipment, manpower, and expertise. CONTRACTOR shall be responsible for all damage to public or private property resulting from these operations.
- C. Designated sanitary sewers and manholes shall be cleaned using mechanical hydraulically propelled or high velocity sewer cleaning equipment. The cleaning process shall remove all grease, roots, sand, silt, solids, rags, debris, etc. from each sewer segment, including the manhole(s).
- D. Selection of cleaning equipment and the method for cleaning shall be based on the condition of the sanitary sewer mains at the time Work commences and will be subject to OWNER's approval.
- E. All cleaning equipment and devices shall be operated by experienced personnel.
- F. Satisfactory precautions shall be taken to protect the sanitary sewer mains and manholes from damage that might be inflicted by the improper use of the cleaning process or equipment. Any damage done to a sewer by CONTRACTOR shall be repaired by the

CONTRACTOR at no additional cost to and to the satisfaction of the OWNER.

- G. Cleaning shall also include the initial manhole wall washing by high-pressure water jet.
- H. CONTRACTOR, when instructed by OWNER, will be required to demonstrate the performance capabilities of the cleaning equipment proposed for use on the Project. If the results obtained by the proposed sanitary sewer cleaning equipment or attachments are not satisfactory, CONTRACTOR shall use different equipment/attachments, as required, to meet Specifications. More than one type of equipment/attachments may be required at a location.
- I. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction shall be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.
- J. If water backups a lateral and enters a building or residence during cleaning, the CONTRACTOR shall notify the OWNER of the occurrence. It is the CONTRACTOR's responsibility to clean any backups which occur. If prior knowledge of backups is available, the CONTRACTOR shall take measures to prevent another backup from occurring (i.e., plugging the lateral) before cleaning.
- K. Cleaning operations shall be performed with the flow direction of the sewer, that is, from the upstream manhole towards the downstream manhole. Any damage that occurs from sewer backups resulting from cleaning activities shall be the Contractor's responsibility and shall be repaired/resolved at the Contractor's expense.

3.02 HYDRAULIC CLEANING

- A. Prior to televising, CONTRACTOR shall thoroughly clean the pipelines of debris, grease, roots, sediment, broken pipe, or other obstructions that could retard the movement of the television camera. Precautions shall be taken to protect the sewer lines being cleaned from damage by the cleaning equipment.
- B. Hydraulically propelled devices, which require a head of water to operate, must utilize a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer, property, etc.
- C. When using hydraulically propelled devices, precautions shall be taken to insure that the water pressure created does not cause damage or flooding to public or private property.
- D. CONTRACTOR shall not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or into structures.

3.03 HIGH-VELOCITY CLEANING

- A. CONTRACTOR shall operate the equipment so that the pressurized nozzle continues to move at all times.
- B. The pressure nozzle shall be turned off or water pressure be reduced anytime the hose is held or delayed in order to prevent damage to the line. In heavy debris the step cleaning method should be used.

3.04 MECHANICAL CLEANING

- A. Mechanical cleaning, in addition to normal cleaning when required by ENGINEER, shall be approved equipment and accessories driven by power winching devices.
- B. All equipment and devices shall be operated by experienced operators in an effort to prevent pipe damage during the cleaning process.
- C. Buckets, scrappers, scooters, porcupines, kites, heavy duty brushes, metal pigs and other debris removing equipment/accessories shall be used as appropriate and necessary in the field, in conjunction with the approved power machine(s).
- D. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites and other approved equipment, in conjunction with hand winching device, and/or, gas, electric rod propelled devices, shall be considered normal cleaning equipment.

3.05 WATER USAGE

- A. Any and all OWNER water used by CONTRACTOR shall be from a metered supply with an approved backflow device to protect the water supply. All metered water shall be paid for by CONTRACTOR to OWNER through the regular billing system.
- B. CONTRACTOR shall be responsible for obtaining transient water meter(s) from OWNER, which shall be installed on the trucks or at fire hydrant(s). All related charges for the set-up shall be considered incidental to the cleaning of the existing sanitary sewer mains.
- C. CONTRACTOR shall be responsible for preventing contamination of the potable water system. CONTRACTOR when drawing water from a public hydrant shall use a backflow preventer and/or an eighteen (18) inch air gap.
- D. No fire hydrant shall be obstructed or used when there is a fire in the area.
- E. It shall be CONTRACTOR's responsibility to obtain approval to use OWNER'S fire hydrants.
- F. CONTRACTOR shall remove the water meter(s)/piping etc. from all fire hydrants at the end of each working day.

3.06 REMOVAL AND DISPOSAL OF DEBRIS

- A. All materials removed from the sewer lines during cleaning operations shall be trapped and removed from the system at the downstream manhole of the section being cleaned. All materials shall be disposed of in compliance with all applicable laws and regulations and in a manner approved by OWNER.
- B. Passing of debris from upstream manhole section to downstream manhole section will not be allowed.
- C. All debris from the manholes shall be loaded into an enclosed container that is permitted by OWNER and the Tennessee Department of Environment and Conservation (TDEC) for liquid waste hauling.
- D. All solids or semi-solids resulting from the cleaning operations shall be removed from the

site at the end of each workday and disposed of at a landfill at the Contractor's expense.

- E. CONTRACTOR shall pay landfill-tipping fee and is responsible for all permits required.
- F. CONTRACTOR shall not be allowed to accumulate debris, and/or liquid waste, sludge, etc. on the site except in totally enclosed containers approved by ENGINEER.
- G. All waste shall be hauled to the disposal site by a transporter, which is arranged for by CONTRACTOR and holds a valid Liquid Waste Transporter Permit.
- H. CONTRACTOR shall submit and maintain a "Liquid Waste Manifest" as per OWNER and TDEC requirements. OWNER'S and TDEC's copies of the completed manifest shall be sent to ENGINEER within 24 hours after the disposal of the waste materials.
- I. Under no circumstances shall sewage or solids removed in the cleaning process be dumped onto streets or into ditches, catch basins, storm drains, sanitary sewer manholes, cleanouts, or dumps.

End of Section

SECTION 04810

SEWER LINE TELEVISION INSPECTION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Work covered by this section includes furnishing all labor, equipment, and materials required to clean and inspect the designated sanitary sewer lines specified.
- B. Closed-circuit television inspection of sanitary sewers as follows:
 - 1. TV inspection on all lines proposed for rehabilitation, including root control chemical application, under this Contract, shall be performed where no videotape of the sewer is available from OWNER.
 - 2. TV inspection of line segments specified for chemical root removal, shall be required to confirm cleaning and location of service connections. TV inspection shall also be required to confirm the need for mechanical root removal and to determine its location.
 - 3. CONTRACTOR shall use the Television Inspection Form and Rehabilitation Tables approved by OWNER prior to beginning of any inspection.
 - 4. Digital videos, data, photos shall be delivered to the OWNER with an external hard drive which will be returned to the CONTRACTOR.

1.02 SUBMITTALS

- A. Action Submittals: Catalog and manufacturer's data sheets for television equipment.
- B. Informational Submittals:
 - 1. References: Contact names and telephone numbers.
 - 2. List of staff and equipment to be used on Project.
 - 3. Crew chief qualifications.
 - 4. Traffic control plan.
 - 5. Look-ahead inspection schedules, minimum of 7 days in advance of the Work.
 - 6. Initial first days' CCTV digital videos and inspection logs within 24 hours of start of CCTV inspection.
 - 7. Certification that staff to be used for the Work is properly trained in confined space entry and hazardous atmospheres.
 - 8. Training and inspection plan, 7 days prior to manual inspection.
 - 9. Final report.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. CONTRACTOR: Performed work successfully for at least three other projects, within last 5 years, with pipe lengths and pipe diameters similar to this Project.
 - 2. Crew Chief: Minimum of 5 years' experience on projects similar to this Project and experienced using proposed equipment for this Project.
- B. Pre-startup Meeting: At least 5 days prior to beginning CCTV inspection work, schedule with OWNER to review proposed sewer flow bypassing plan, traffic control plans, and inspection methods.

- C. Submit digital videos, photos and logs for quality review and comment to OWNER within 24 hours after the first days' work is completed. Submit tapes and logs on a routine basis within 7 days after completing each tape. Picture quality and definition shall be to the satisfaction of OWNER. Inspection equipment that fails to produce satisfactory inspection quality shall be removed.

1.03 NOTIFICATIONS

- A. Notify OWNER:
 - 1. A minimum of 5 days prior to the anticipated commencement of inspections in any one area and 24 hours in advance of actual start.
 - 2. When obstruction, restricting flow in pipeline, is discovered.
 - 3. If depth of flow in pipeline exceeds 33 percent of pipe diameter.
 - 4. If conditions for CCTV inspection are found to be unsafe or impractical.
 - 5. Pipe configuration in field is different than shown on maps. Notification shall include diagram clearly indicating location of structure in relation to immediately adjacent structures.

PART 2 PRODUCTS

2.01 TELEVISION INSPECTION EQUIPMENT

- E. CONTRACTOR shall provide a mobile vehicle with video monitoring equipment specifically compatible with the camera equipment being used. The equipment shall include dual video recorders, dual monitors, and picture capture capability. The vehicle shall be large enough to accommodate at least three people at any time for viewing of the monitor. OWNER shall have unrestricted access to observe the television screen and all other operations at all times.
- F. The basic equipment for use in cleaning and inspection operations shall consist of hydraulically propelled or mechanical cleaning equipment and a self-propelled full color television inspection camera with footage meter, pan, and tilt functions.
- G. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear color picture of the entire periphery of the pipe. The camera shall be capable of a 360-degree viewing area. The camera, television monitor, and other components of the video system shall be capable of producing a minimum 500-line resolution picture. Backup camera shall be available on the Project Site. The camera shall be operative in 100 percent humidity conditions. Camera shall be operative in a hazardous and corrosive environment.
- H. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of OWNER.
- I. The television inspection equipment shall have an accurate footage counter that shall display on the monitor the exact distance of the camera from the centerline of the starting manhole.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prior to televising, CONTRACTOR shall thoroughly clean the pipelines of debris, grease, roots, sediment, broken pipe, or other obstructions that could retard the movement of the television camera. Precautions shall be taken to protect the sewer lines being cleaned from damage by the cleaning equipment.
- B. Immediately after cleaning, the sewer line section shall be visually inspected by means of closed-circuit television to determine the condition of the line and to locate existing service connections. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified. (See Section 02542, Sewer Flow Control).
- C. All internal pipe damage shall be photographed in color by CONTRACTOR utilizing picture capture equipment, and shall be clearly labeled as to date, each number, footage, and type of defect. The photographs shall be the property of OWNER.

3.02 TELEVISION INSPECTION

- A. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer line section condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
- B. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to ensure good communications between members of the crew.
- C. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to OWNER.
- D. The camera height shall be adjusted such that the camera lens is always centered in the pipe being televised.
- E. Lighting system shall be adequate for quality pictures. A reflector in front of the camera may be required to enhance lighting in black pipe.

3.03 PASSAGE OF TV CAMERA

- A. There may be occasions during the TV inspection of a sewer line section, when the camera will be unable to pass an obstruction even though flow is continuing. CONTRACTOR shall televise the line section from the other direction in order to obtain a "full" video of this line section. Whenever such condition arises, OWNER shall be notified to determine if a point repair is necessary. No additional payment shall be made for reverse set-ups required due to an obstruction.

- B. TV videos shall be submitted in one continuous section from manhole to manhole, and not in broken pieces, unless specifically approved by OWNER.
- C. When the camera is being pulled from the “other end” and a second repair location is encountered away from the first repair/obstruction location, OWNER shall be notified and allowed to review the TV DVD at the Site in a timely manner. Obtain OWNER’s permission to make the two point repairs. No downtime shall be allowed.
- D. If the two point repairs are allowed and completed, CONTRACTOR shall again proceed to re-televiser the sewer line section. Generally, up to 20 feet of the line from each of the ends of the two point repairs may be lamped or physically inspected at the Site, to verify the condition of the line without further TV.
- E. OWNER makes no guarantee that all of the sanitary sewer mains proposed to be TV inspected after the cleaning, are clear for the passage of the camera set-up. The equipment, tools and method(s) used for securing the passage of the camera are to be at the discretion of CONTRACTOR, with the approval of OWNER. The decision to repair or not to repair a location shall always be made by OWNER.
- F. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be reset on the other manhole and cleaning again attempted. If again, successful cleaning cannot be performed or the equipment fails to traverse the entire pipeline section, it will be assumed a major blockage exists and the cleaning effort shall be terminated only at the direction of OWNER.
- G. During all sewer-cleaning operations, satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically-propelled cleaning tools, which depend on water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not cause any damage to or flooding of public or private property being served by the sewer section involved.
- H. Roots shall be removed in the sections where root intrusion is a problem. Special precautions should be exercised during the cleaning operation to assure complete removal of visible roots from the joint area. Any visible roots that may impact rehabilitation efforts shall be removed. Procedures may include the use of mechanical devices such as rodding machines, expanding root cutters and porcupines, and hydraulic procedures such as high-pressure jet cleaners.
- I. To aid in the removal of roots and at the option of CONTRACTOR, sewer sections that have root intrusion may be treated with a OWNER -approved herbicide. The application of the herbicide to the roots shall be done in strict accordance with the manufacturer’s recommendations and specifications in such a manner to preclude any damage to the surrounding vegetation. CONTRACTOR shall replace any damaged vegetation so designated by OWNER, at no additional cost to OWNER. All safety precautions as recommended by the manufacturer shall be strictly adhered to concerning handling and application of the herbicide.
- J. CONTRACTOR, after cleaning a section of pipe, shall utilize the television camera to inspect the main. No line shall be considered cleaned until OWNER approves.

- K. The television camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to insure proper documentation of the sewer's condition, but in no case shall the television camera travel at a speed greater than 30 feet per minute.
- L. The television camera shall travel through the lines using its own power. The pictures taken of the entire inside periphery of the pipe shall be clear and visible. Picture quality and definition shall be to the satisfaction of OWNER, and if unsatisfactory, the equipment shall be removed and no payment made for the unsatisfactory inspection.
- M. At all service laterals the camera shall be stopped and panned to such an angle that an internal view of the service lateral is available to determine if the lateral is active or dead or plugged. Where other pipe deficiencies are noted, the camera shall be stopped to observe the condition, record information and take photographs. Any service lateral or deficiency observed in the sewer line shall be photographed and described on the photograph.

3.04 FLOW CONTROL

- A. TV inspection shall be done one sewer line section at a time, and the flow in the section being televised shall be suitably controlled. The depth of wastewater flow shall not exceed that shown below:

6" – 10" Pipe: 20% of pipe's
diameter

12" -24" Pipe: 25% of pipe's
diameter

Over 24" Pipe: 30% of pipe's diameter

- B. When the depth of flow in the section being worked is above the maximum allowable for the television inspection, the flow shall be reduced to allowable levels by performing the inspection during minimum flow hours, with diversion pumping or by pulling camera with swab or a high velocity jet nozzle, as approved by OWNER.
- C. No separate payment shall be made for sewer flow control.
- D. CONTRACTOR shall not be allowed to float the camera unless permitted by OWNER.
- E. When flow in a sewer line is plugged, blocked, or bypassed; sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

3.05 DOCUMENTATION

- A. CONTRACTOR shall submit in electronic format digital videos, photos, and evaluation reports, to OWNER for review. OWNER's review and comment period may require up to 10 working days from the date of submittal.
- B. The digital video shall be recorded at Standard Play and each digital video segment information entered in the software as required under Article Basic Module (1) – Survey/Logging Report.

- C. If digital videos are of such poor quality that OWNER is unable to evaluate the condition of the sanitary sewer main, locate the sewer service connections, or verify the cleaning CONTRACTOR shall be required to re-televised the sanitary sewer and provide new digital videos of good quality, at no additional cost to OWNER.
- D. All digital videos will become the property of OWNER.
- E. Payment deduction of \$50 per digital video shall apply for poor and unacceptable quality digital videos or for portions of sewer not televised. Camera distortions, inadequate lighting, dirty lens or blurred/hazy picture will be cause for rejection of the Work.

3.06 BASIC MODULE (1) – SURVEY/LOGGING REPORT

- A. The software’s core module shall be capable of providing complete survey reports and be PACP (Pipeline Assessment and Certification Program) certified by NASSCO. The software shall be the latest version of Subcam.
- B. There shall be PACP Complaint codes pre-programmed and grouped by PACP Groups.
- C. The software shall be capable of customization with the ability to modify or add to the pipeline condition and group them for ease of use.
- D. The footage reading from the camera equipment shall be automatically entered into the Survey Log through RS232 cable and shall directly correspond to the noted defect location throughout the pipe graphic and tabular reports generated.
- E. The inspection and reporting software program shall be menu-driven and shall have a complete on-screen help file.
- F. Drop-down boxes shall be utilized to quickly reference common information such as defects, pipe materials, survey purpose, locations, pipe usage, etc.
- G. The browser screen shall allow quick viewing of:
 - 1. Sequential survey/segment as setup number (automatic input by software).
 - 2. User-selected categories.
 - 3. Up-stream and down-stream manhole numbers.
 - 4. Street name.
 - 5. Pipe segment details.
 - 6. Drainage basin number.
- H. All relevant pipe segment information shall be entered prior to the actual survey. The below listed minimum pipe details must be supplied in the software for proper system management. The graphic and tabular survey reports generated shall include the following information:
 - 1. Pipe diameter.
 - 2. Starting manhole number.
 - 3. Ending manhole number.
 - 4. Starting manhole depth.
 - 5. Ending manhole depth.
 - 6. Direction of survey.

7. Pre-clean (y/n).
 8. Total surveyed length.
 9. Pipe material.
 10. Pipe section length.
 11. Pipe shape.
 12. Road name.
 13. Address or place name.
 14. Work Order number.
 15. Video CD number.
 16. Engineering drawing number.
 17. Purpose of survey.
 18. Pipe age (year of construction).
 19. Inspection of survey date.
- I. The CCTV software shall maintain a database of underground pipe and manhole assets. The database(s) shall have structure similar to the one referencing pipe usage (i.e., sanitary storm drainage, etc.) sections (i.e., projects, areas, or quadrants). Surveys shall include a method of pipe segment numbering and a chronological survey set-up numbering system.
 - J. The basic module database shall have the means to sort in ascending and descending order according to date, pipe segment, reference number, road name, manhole number(s), observed footage, pipe materials, pipe diameters, work order numbers, etc. A filtering system shall also be made available.
 - K. The basic module software shall have search capabilities in order to find information about past surveys located in the database(s).
 - L. A summary paragraph shall be made available for a conclusive pipe segment assessment.
 - M. The graphical reports shall print in color for quick glance referencing of the defect category. The color-coding scheme shall allow for quick reference as to the quality of service, structural, hydraulic, and constructional defects within a particular survey.
 - N. A scoring system incorporated in the software will assist the user/management personnel in making proper assessment of pipe conditions. Scoring is to be based upon defect severity entered by the operator.
 - O. An inspection “health check” feature shall be incorporated to insure that the information has been correctly entered. The health check allows for verification of essential information to complete a survey. This feature can be implemented individually or on a total selection basis.
 - P. A Site sketch feature shall also be supplied so that a drawing or sketch shall indicate special details or locations about a particular set-up Site.
 - Q. The software shall also have the capability to import and export survey results in a variety of industry standard formats.

3.07 BASIC MODULE (1) – SUMMARY REPORTING

- A. Summary reports compiling data from multiple inspections shall be available. Such reports shall indicate individual survey results in tabular form and list (sort) surveys based on a user-defined description field.
- B. Defect report shall be programmable to list specific defects observed with corresponding footage, starting and ending manhole number, structural pipe defects (i.e., cracks, offsets, defective laterals, collapsed pipe, etc.) and service-oriented defects (i.e., roots, grease, obstructions, infiltration, etc.).
- C. A drainage schedule report shall include starting and ending manhole numbers, depths, pipe material, total survey length, and pipe diameter.
- D. The grading scores report shall summarize the manhole numbers, pipe material, pipe diameter, and the grade scores for each survey with totals.
- E. Service and structural aspect scoring reports are to list the pipe segment, reference number, total observed length, number of defects, and total score with reference to the condition of the total pipe, average of the pipe, total defects, and average of defects.
- F. Section summary reports are to be made available so that all surveys within a section are listed showing purpose of inspection, date, work order numbers, manholes, road names, and total lengths.
- G. All software shall be compatible with OWNER's current system.

3.08 EVALUATION REPORTS

- A. Each video shall be accompanied by a TV inspection report, which shall be a written/narrated log of all pipe defects, sags, service connection locations and conditions, etc., recorded on a footage basis. Report shall be provided in an electronic (computer usable) format that is transferable to a Microsoft Access database.
- B. The pipe defects shall include separate codes for the following: Radial Cracks, Longitudinal Cracks, Misaligned Joints, Broken Joints, Root Intrusion, Laterals, and Infiltration. The size/length of the defect shall be reported. The beginning of all sags of the pipe, the length that is underwater as well as where the camera pulls out of the sag shall be reported. The clock position of each service connection and the condition shall be reported. The condition of each service connection will include the distance protruding when appropriate and the type. All other information required for analysis such as degrees of deterioration, deformation or collapsed pipe shall be reported. All reports and/or submittals shall adhere to Pipeline Assessment Certification Program (PACP) Standards.
- C. This log shall also identify the section being televised, flow and camera direction, type of pipe, pipe condition, weather conditions, type of surface cover, or any other information required by OWNER.
- D. OWNER may provide CONTRACTOR a log form that utilizes codes for the above-mentioned defects.
- E. At the end of the Project CONTRACTOR shall provide a summary listing of all videos provided under this Project.

End of Section

SECTION 04820

SEWER FLOW CONTROL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Sewer flow control required to conduct the sewer line replacement, television inspection, sewer line testing, chemical root control application, and sewer line sealing operations effectively. In general, flow control will be required when sewer line flows are greater than $\frac{1}{3}$ of the pipe diameter.

1.02 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, CONTRACTOR shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.

1.03 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Test:
CONTRACTOR shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. ENGINEER will be given 24 hours notice prior to testing.
- B. Inspection:
CONTRACTOR shall inspect bypass-pumping system every two hours to ensure that the system is working correctly.
- C. Maintenance Service:
CONTRACTOR shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

PART 2 PRODUCTS

- A. Not Applicable.

PART 3 EXECUTION

3.01 PLUGGING OR BLOCKING

- A. Insert a sewer line plug into the line at a manhole upstream from the line segment that is to be inspected, tested, and sealed. The plug shall be designed so that a portion of the sewage flow can be released. During the inspection portion of the operation, shut off or substantially reduce flows so that the pipe can be properly inspected. During the sewer line testing and/or sealing, restore flows to normal, or no more than $\frac{1}{3}$ of the pipe diameter.

3.02 BYPASS PUMPING

- A. When bypass pumping is required to ensure the completion of the replacement, inspection, testing, and sealing work, furnish pumping equipment, conduit, etc. Conduct pumping operations from manhole to manhole, and discharge no flow on the surface or in natural waterways. Any and all sanitary sewer overflows shall be reported to OWNER.
- B. Bypassing Sewage: When required for acceptable completion of an insertion process, CONTRACTOR shall provide for continuous sewage flow around the section(s) of pipe designated for the insertion of liners. For lines 18-inch in diameter and larger, CONTRACTOR shall submit a bypass-pumping plan to ENGINEER.

3.03 LIABILITY

- A. CONTRACTOR shall be responsible for damages to private or public property that may result from his sewer flow control operations. CONTRACTOR shall be responsible for any violations of laws, regulations or permits and shall indemnify and hold OWNER harmless for any and all damages, including but not limited to, fines and penalties that arise from such violations.

End of Section

SECTION 05000

BORING, CASING, AND ALTERNATIVE TUNNELING

PART 1. GENERAL

The work to be performed herein shall consist of the installation of a casing pipe for the purpose of installing sanitary sewer or water lines as shown on the construction drawings or as called for in these specifications. The work shall include the coordination of all proposed activities with all agencies having jurisdiction, layout/survey of work including location of all site utilities, excavation of a boring pit, auger boring between the points specified on the construction drawings or as directed by CUB, installation of the carrier pipe, and disposing of the excavated materials in the manner provided in these Standards. CONTRACTOR shall be responsible for all costs necessary to perform all work and provide for a complete project.

- A. All work performed within State Highway rights-of-way shall be performed in strict accordance with the requirements of the Tennessee Department of Transportation (TNDOT), the TNDOT Permit for the project, and the appointed representative of TNDOT who may be on-site during the work.
- B. All work performed with City of Clinton rights-of-way shall be performed in strict accordance with the requirements of the City of Clinton Public Works Department.
- C. All work performed within Anderson County rights-of-way shall be performed in strict accordance with the requirements of the Anderson County Highway Department.

PART 2. PRODUCTS

2.1 CASING PIPE

- A. The casing pipe shall be steel meeting the latest approved American Railway Engineering Association "Specifications for Pipelines for Carrying Flammable and Nonflammable Substances" and the requirements of the Tennessee Department of Transportation. Unless otherwise required by the agency having jurisdiction, the steel casing pipe shall have a minimum yield strength of 35,000 psi and shall have the minimum wall thickness shown in the following table:

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING
PIPE FOR E72 LOADING

<u>CARRIER PIPE</u> (inches)	<u>CASING PIPE</u> (inches)	<u>NOMINAL THICKNESS</u>
2	6	0.281 inch
4	8	0.281 inch
6	12	0.281 inch
8	16	0.312 inch
10	20	0.344 inch
12	24	0.406 inch
14	27	0.469 inch
16	30	0.469 inch
18	30	0.469 inch
20	36	0.532 inch
24	36	0.532 inch

- B. When the casing pipe is installed without benefit of a protective coating, the wall thickness shown above shall be increased to the nearest standard size, which is a minimum of 0.063 inch greater than the thickness shown.

2.2 CARRIER PIPE

The carrier pipe shall be restrained-joint, utilizing “Field Lok” gaskets unless otherwise required by the agency having jurisdiction, ductile iron pipe as specified in the Materials Specifications herein and shall be in accordance with the STANDARD AND APPROVED PRODUCTS LIST.

PART 3. EXECUTION

3.1 BORING

The boring shall be accomplished by means of augering or directional drilling to the size, line, and grade shown on the construction drawings or as directed by CUB. The diameter of the hole shall be essentially the same as the outside diameter of the casing pipe.

3.2 INSTALLATION OF CASING PIPE

- A. Jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide watertight joints by operators qualified in accordance with the American Welding Society Standard Procedures.

- B. Do not remove unacceptable casing without prior approval from CUB. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing.

3.3 INSTALLATION OF CARRIER PIPE

Ductile iron carrier pipe shall be installed in the casing pipe using restrained joints unless otherwise required by the agency having jurisdiction. The carrier pipe shall be held concentric in the casing pipe by spacers designed exclusively for installation of pipe in casing pipe and at a longitudinal distance not to exceed 8 feet. The maximum clear space between the blocking and the casing pipe shall not exceed 4 inches. Watertight bulkheads shall be constructed on each end of the casing pipe as necessary to prevent intrusion or infiltration of water, dirt, etc. into the void between the casing and carrier piping but will allow removal of carrier pipe if ever necessary. Methods and materials utilized for installation of carrier pipe and for construction of the bulkheads shall be submitted to and approved by CUB prior to beginning work.

3.4 LAYOUT OF WORK

CONTRACTOR shall be responsible for all field surveys to verify actual site conditions. The CONTRACTOR shall provide the detailed layout required to keep the tunnel or bore on line and on grade.

3.5 INSURANCE FOR RAILROAD CROSSING

The CONTRACTOR shall, at his expense, secure and maintain throughout the construction period the appropriate insurance as required by the agency having jurisdiction.

3.6 GUARANTEE OF WORK

- A. Guarantee a usable completed casing between the points specified and to the line and grade specified. The allowable tolerance at the downstream end point of the bore shall be such that the invert of the carrier pipe may be positioned within a vertical area limited on the top by an elevation no higher than the elevation shown on the construction drawings and on the bottom by an elevation no lower than the existing inlet pipe invert. For sewers, the sides shall be a minimum of 8 inches inside the interior face of the manhole at the end of the bore.
- B. The allowable tolerance at the upstream end point of the bore shall be such that the invert of the carrier pipe may be positioned at the elevation shown on the construction drawings.

3.7 TUNNELING ALTERNATIVE

- A. In the event boring and jacking is impossible because of pipe size, rock, or other factors as determined by CUB, and the highway department or railroad will not permit open cutting but will permit tunneling, then CUB may consider crossings by tunneling using liner plate. However, only tunneling design and installation procedures with prior approval of CUB, the respective highway department and/or railroad company having jurisdiction of the facilities will be allowed. During the installation of approved tunneling work, CONTRACTOR shall keep in close contact with all agencies having jurisdiction over the facilities affected.
- B. After the tunnel liner plates are formed to shape, the plates shall be galvanized on both sides 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 first class commercial quality, free from injurious defects such as blisters, flux, and uncoated spots.
- C. The inside and outside of the plates shall be given a bituminous coating meeting the AASHTO M-190 Specifications for bituminous protected corrugated metal pipe.
- D. Construct the tunnel and completely line on the inside with structural steel liner plates meeting all requirements specified herein. The dimensions of the tunnel shall be as shown on the construction drawings or as specified by CUB.
- E. The tunneling operation is to commence from a pit no larger than required, and sheeted and shored, if necessary to meet OSHA and TOSHA requirements. The CONTRACTOR shall furnish all line and grade stakes.
- F. All excavation for the entire length of the tunnel shall be done by tunneling, and the work may be done from either end, but not both. Trim the periphery of the tunnel smooth to fit the outside of the steel liner plate as nearly as is practical, and fill all space outside of the steel liner plate with a sand-cement grout mixture.
- G. Install the steel liner plates immediately after the excavated material has been removed. Do not remove material more than 24 inches ahead of the installed liner plates.
- H. Provide all necessary bracing, bulkheads, and/or shields to ensure complete safety to traffic at all times during the progress of the work. Perform the work in such a manner as to not interfere with normal traffic over the work.
- I. The steel lining shall consist of plates 16 or 18 inches wide, and each circumferential ring shall be composed of the number and length of plates necessary to complete the required diameter.

- J. The inside diameter of the completed ring shall be as shown on the construction drawings, detail drawings or as specified by CUB, and no part of the plate or reinforcing ribs will be allowed to extend inside this net diameter.
- K. The strength of the tunnel lining will be determined by its section modulus. In no case shall it be less than 0.0590 inch cubed per inch of plate width based on the average for one ring of plates. Thickness of the metal for these steel plates shall be not less than 10 gauge allowing for standard mill tolerances. The tunnel strength shall be equal to AASHTO railroad E80 loading at the appropriate depth of cover. All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be fabricated so as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type with an offset equal to the gauge of metal for the full width of the plate, including flanges, and shall have staggered bolt construction fabricated 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.
- L. All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be fabricated so as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type with an offset equal to the gauge of metal for the full width of the plate, including flanges, and shall have staggered bolt construction fabricated 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.
- M. The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first class in every respect.
- N. Pour a 6-inch carrier pad to grade using a grout mixture prior to carrier pipe installation.
- O. Install the carrier pipe to the line and grade shown on the construction drawings or as specified by CUB. After the carrier pipe is installed adequately, place support and securing jacks at a longitudinal distance not to exceed 8 feet as shown on the Standard Detail Drawing. Block the carrier pipe and backfill the space between the carrier pipe and the tunnel liner with sand by a method approved by CUB. The CONTRACTOR shall be responsible for securing an adequate water supply for the installation of the sand.
- P. The tunnel shall be grouted every 10 feet or every five consecutive calendar days (including weekends and holidays), whichever comes first, or at more frequent intervals as determined by CUB. If voids are caused by the tunneling operations, fill by pressure grouting or by other approved methods that will provide proper support. This grout shall include filling all voids outside of the liner plates with a sand-cement grout mixture to prevent settlement.

END OF SECTION

SECTION 05500

RIPRAP

PART 1. GENERAL

This item consists of furnishing and placing riprap slope protection in accordance with the construction drawings and specifications or as directed by CUB. For rip-rapping within the city limits of the City of Clinton, CONTRACTOR shall notify of his intent to place rip-rap and obtain approvals of the City of Clinton Public Works Director regarding materials and methods of installation prior to beginning any work. The Public Works Director may desire to be present and/or have a representative present during CONTRACTOR's placing of the rip-rap.

PART 2. PRODUCTS

The riprap material shall be durable and of hard natural stone, free from cracks, seams, or other defects that would tend to cause increased deterioration because of freezing and thawing or other natural causes. Riprap material shall be reasonably well graded from the minimum size stone. At least 90% of the riprap stone shall be not less than 8 inches wide by 12 inches long by 12 inches deep and shall be approximately rectangular in shape. Fragments or spalls shall be used to fill the voids between the larger rocks. The inclusion of appreciable quantities of dirt, sand, clay, or rock fines will not be accepted. All materials considered for use as riprap shall be approved by CUB.

PART 3. EXECUTION

- 3.1 Earth surface on which riprap is to be placed shall be trimmed and graded so as to provide for the thickness of riprap shown on the construction drawings. Surfaces that are below grade shall be brought to grade by fillings with well compacted materials similar to the adjacent materials. Prior to placement of riprap, the prepared earth foundation will be inspected and no materials shall be placed thereon until approved by CUB.
- 3.2 Place riprap to the full course thickness at one operation and in such a manner as to avoid serious displacement of the underlying materials. Deliver and spread the material so that the mass of pieces in place shall be reasonably well graded, with the larger pieces uniformly distributed and the smaller pieces filling the voids between the larger pieces. The finished riprap shall be free from objectionable concentration of large or small pieces.
- 3.3 A tolerance of + 12 inches or -6 inches from slope lines and grades shown on the construction drawings will be permitted in the finished surface of the riprap, except that the extreme minus tolerance shall not be continuous over an area exceeding 200 square feet.

END OF SECTION

SECTION 06000

PAVEMENT REPAIR

PART 1. GENERAL

- 1.1 The work specified by this section shall consist of repairing or replacing any and all damaged pavement, whether public or private, which has been damaged as a result of repairs to, or construction of, public water and/or wastewater system components.
- 1.2 Dirt shoulders, roads, streets, drives, and walks are to be restored to their original condition as an incidental part of the installation of utilities. Repair damaged base on either side of a trench wherever necessary. All pavements which have been undermined during construction operations shall be removed to straight lines back to an area of firm ground. Concrete pavements shall be cut in a manner to prevent spalling or cracking at the edges of the cut.
- 1.3 Both these specifications and the drawings either directly or indirectly make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT), the requirements of the City of Clinton Public Works Department and the requirements of the Anderson County Highway Department. 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.
- 1.4 The CONTRACTOR shall notify the agency or agencies having jurisdiction over the affected pavement prior to cutting any pavement. All pavement repairs shall be as specified in these Standards and performed to the satisfaction of CUB and the agency or agencies having primary jurisdiction of the street, highway or other paved area, and the more stringent regulation(s) shall apply. These agencies and their jurisdiction are as follows:
 - A. All work performed within State Highway rights-of-way shall be performed in strict accordance with the requirements of the Tennessee Department of Transportation (TNDOT), the TNDOT Permit for the project, and the appointed representative of TNDOT who may be on-site during the work.
 - B. All work performed with City of Clinton rights-of-way shall be performed in strict accordance with the requirements of the City of Clinton Public Works Department and the appointed representative of that department who may be on-site during the work.
 - C. All work performed within Anderson County rights-of-way shall be performed in strict accordance with the requirements of the Anderson County

Highway Department and the appointed representative of that department who may be on-site during the work.

PART 2. PRODUCTS

- 2.1 MINERAL AGGREGATE BASE: Class A, Grading D crushed stone in accordance with TDOT specifications, Section 303, subsection 903.05 or as otherwise directed by CUB.
- 2.2 ASPHALTIC CONCRETE BINDER: Grading B or C, in accordance with TDOT specifications, Section 307 or as otherwise directed by CUB.
- 2.3 BITUMINOUS TACK COAT: Emulsified Asphalt SS-1, RS-2, or AE- 3 in accordance with TDOT specifications, Section 403, Subsection 904.03 or as otherwise directed by CUB.
- 2.4 ASPHALTIC CONCRETE SURFACE: Grading D in accordance with TDOT specifications, Section 411 or as otherwise directed by CUB.
- 2.5 QUICK DRY TRAFFIC MARKING PAINT - WHITE AND YELLOW: shall be in accordance with TDOT specifications Subsection 910.05.

PART 3. EXECUTION

In general, paving, pavement replacement and pavement patching shall be as required and/or directed by the agency(s) responsible for the maintenance of the particular roadway section in question.

CONTRACTOR shall contact the responsible agency or agencies prior to placing pavement to find out what specifically is required by that agency for the particular section of roadway to be paved or patched and furnish all information, plans and specifications, as well as obtain permits, pay fees, develop and submit traffic control plans, furnish bonds, etc. as may be required by each and every agency with jurisdiction over the affected pavement or roadway.

In roadway sections where more than one agency claims jurisdiction or responsibility for maintenance, or may affect repairs, all such agencies shall be contacted and their prescribed methods of pavement repairs or patching shall be documented. Copies of this documentation shall then be submitted to CUB's Director–Water & Sewer Department who will then meet with the CONTRACTOR to review requirements and determine how the pavement repairs or patching shall be performed and completed.

3.1 SUBGRADE

- A. Once utility work has been completed and backfilled, but before any pavement material is installed, CONTRACTOR shall temporarily fill and compact the subgrade of the area to be paved as required by CUB or the agency with primary jurisdiction to grade to minimize disruption to traffic until which time the pavement material can be installed. Some agencies may require that the base stone be left at grade, and that the CONTRACTOR maintain the surface of the base stone at grade until which time the excavated area has had a time to settle, before installing the permanent pavement material.
- B. In all roadways where the travel lanes are to remain open to traffic, the CONTRACTOR shall maintain the temporary repair(s) (24 hours per day and seven days per week) to prevent damage to vehicular traffic from holes, ruts, loose gravel, etc. until the permanent pavement material is installed. At that time, the CONTRACTOR shall excavate to the required depth, properly dispose of the excavated material, and compact the backfill to meet the minimum requirements for backfill herein. This shall be considered an incidental part of the work and shall be performed at no cost to CUB.
- C. The minimum requirements for backfill material shall be crushed stone, Class A Aggregate Grading D, as specified in Section 903.05 of the Tennessee Department of Highways, Standard Specifications for Road and Bridge Construction 1981, (pug mix) placed in 6-inch lifts and compacted to 100% of the Standard Proctor Density at 2% less than the optimum moisture content as determined by AASHTO T-99-81. However, as discussed above, backfilling must be conducted to the satisfaction of the TDOT, the City of Clinton Public Works Department and/or the Anderson County Highway Department, whichever has primary jurisdiction of the section of roadway in question, and the more stringent regulations will normally apply.
- D. In preparing to make pavement repairs, CONTRACTOR shall :
 - 1. Cut back the surface course of the existing pavement beyond the limit of the joint between the old and new base course with a saw designed for concrete and/or asphalt cutting, or as may otherwise be directed by CUB,
 - 2. In areas where undermining of the pavement has occurred, remove pavement back to firm ground and add/compact suitable base course material,
 - 3. Take special care to ensure good compaction of the new base course,
 - 4. For concrete pavement repairs (see Section 06100), install reinforcing steel as may be required by CUB or the agency with primary jurisdiction of the affected pavement,
 - 5. For concrete pavement repairs (see Section 06100), drill for and install dowel rods as may be required by CUB to tie new concrete pavement to existing concrete pavement, and

6. Apply and compact the surface of the base material to the point where it will have no surface irregularity and will provide for a uniform thickness of the new pavement.

This work shall be considered incidental and shall be performed at no additional cost to CUB.

3.2 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, or “lift”, shall be 6 inches and the total thickness of the base shall be that indicated on the Standard Detail Drawing or as otherwise shown on the CUB-approved plans or as required by the agency with primary jurisdiction.

3.3 ASPHALTIC CONCRETE BINDER

- A. Install asphalt concrete binder to type and dimensions as specified by CUB, as shown on the plans or as required by the agency with primary jurisdiction.
- B. Carefully place the material to avoid segregation of the mix. Use of a rake to spread out the material will not be allowed. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.
- C. After the base material has been properly compacted, apply the asphaltic concrete binder to the thickness required by CUB, as shown on the plans or as required by the agency with primary jurisdiction. Compact with an approved compactor or roller

3.4 ASPHALTIC CONCRETE SURFACE

- A. If the surface course is to be placed on a binder course, then apply a bituminous tack coat as specified above under PRODUCTS at a rate of 0.05 to 0.10 gallon per square yard.
- B. Take care to prevent the bituminous material from splashing on exposed faces of curbs, gutters, walls, walks, trees, etc. If such splashing does occur, CONTRACTOR shall be responsible to removing it from all such affected surfaces at no cost to CUB.
- C. After the tack coat has been properly cured, apply the asphaltic concrete topping to the thickness required by CUB, as shown on the plans or as required by the agency with primary jurisdiction. Compact with an approved compactor or roller

3.5 SMOOTHNESS

In general, the finished surfaces of the patched area shall conform to the lines and grades of the roadway as it existed prior to construction. No deviations, variations, or irregularities exceeding 1/4 inch in any direction when tested with a 12-foot

straightedge will be permitted in the finished work, nor will any depressions that will not drain.

The surface of the patched area shall be finished to the point where vehicular traffic does not feel the difference between the roadway and the patch as they cross the patch at the speed posted for the roadway in question. If not, and the patch results in a dip or bump that is noticeable to cars and light trucks as they drive over the patch, the CONTRACTOR shall correct all such defects in the patch as may be necessary and until it meet the smoothness requirements of this paragraph.

3.6 THERMALLY BONDED ASPHALT

In general, thermally bonded asphalt will be used when the patch cannot otherwise be made smooth enough or to the point where it will not be noticeable as described in paragraph 3.5 above and where the use of thermally bonded asphalt is thought to be an acceptable means of reaching the smoothness requirements of the patch.

For installation of thermally bonded asphalt, the CONTRACTOR shall:

- A. Backfill the excavated area with materials in accordance with Section 01600, bringing it to the bottom of the pavement or a minimum of four inches from the surface, whichever is greater. If asphalt is overlaid on concrete, the repair shall be to 1-1/2 times the thickness of the concrete plus the thickness of the asphalt.
- B. Clear all loose and foreign material off the vertical edges of the pavement, and apply a bond coat on the asphalt portion before placing the asphalt.
- C. Place the asphalt in lifts no more than two (2) inches of compacted asphalt per lift.
- D. At this time, the repair shall be left to settle for at least seven days, or as directed by CUB.
- E. After the settling period, the repair may be completed by the CONTRACTOR using the thermal bonding method as follows:
 1. Clear the repair of all loose and foreign material.
 2. Lower the thermal bonding heating unit parallel with the repair. Heat the existing asphalt repair and three inches beyond the edges.
 3. Scarify the softened asphalt and remove if necessary to a minimum depth of 1-1/2 inches.
 4. Apply a rejuvenator (Reclamite or equal) to the remaining asphalt at the rate of 1/10 gallon per square yard.
 5. Place the new asphalt material by hydraulically auguring it from the heated storage compartment, molding it to the existing asphalt.
 6. Compact with an approved compactor or roller.

3.7 SAMPLING AND TESTING

- A. Submit to CUB test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, and asphaltic concrete design mixes. Obtain CUB'S approval of these reports before starting paving operations.
- B. Tests shall be made on the completed elements of the pavement to ascertain the compacted thickness of the base and surface courses. If sections with deficient thicknesses are found, the full section for a reasonable distance on each side of the deficiency shall be refused. Remove and reinstall all such sections. Patch all test holes in connection with thickness tests. Tests and repairs shall be made at no cost to CUB.
- C. When making surface tests, the CONTRACTOR shall furnish one person to mark all surface defects for corrections.

3.8 TEMPORARY PAVEMENT REPAIR

- A. Trenches in paved areas shall be completely backfilled to grade temporarily, using the materials and compaction specified in Section 01600 – Unclassified Excavation and Backfilling. This temporary repair shall be made the same day to allow for traffic flow, except under extenuating circumstances as determined by CUB. The repair shall be maintained by the CONTRACTOR continuously either until the permanent pavement is restored or until the project is accepted by CUB.
- B. On heavily traveled roadways, cold mix or leveling course binder 2 inches thick shall be installed and maintained until permanent pavement is installed.

END OF SECTION

SECTION 06500

CONCRETE PAVEMENT, CURB AND GUTTERS

PART 1. GENERAL

- 1.1 The work covered by this section consists of furnishing all plant, labor, equipment, appliances, and materials and of performing all operations in connection with the repairs to and/or construction of new concrete pavements, curbs and gutters, sidewalks, concrete steps, and driveway ramps on previously prepared subgrades in accordance with the drawings, specifications, or as directed by CUB.
- 1.2 All concrete shall be 4,000 psi, and air entrained, as defined by ACI standards. The slump limit shall be 3 inches, \pm 1 inch. The applicable provisions of ACI 301, Specifications for Structural Concrete for Buildings, are by reference here included as a part of these specifications.
- 1.3 Concrete repair must be conducted to the satisfaction of the agency having primary jurisdiction of the facility, and the more stringent regulations shall apply.

PART 2. PRODUCTS

Not Used.

PART 3. EXECUTION

3.1 SUBGRADE AND FORMS

- A. In preparing to install new concrete pavement and/or to make repairs to existing concrete pavements that have been damaged by CONTRACTOR's activities, CONTRACTOR shall :
 1. Cut back the surface course of the existing pavement beyond the limit of the joint between the old and new base course with a saw designed for concrete cutting, or as may otherwise be directed by CUB,
 2. In areas where undermining of the pavement has occurred, remove concrete pavement back to firm ground and add/compact suitable base course material,
 3. Take special care to install suitable base materials and ensure good compaction of the new base course as described further below,
 4. For concrete pavement repairs, install reinforcing steel as may be required by CUB or the agency with primary jurisdiction of the affected pavement,
 5. For concrete pavement repairs, drill for and install dowel rods as may be required by CUB to tie new concrete pavement to existing concrete pavement, and

6. Apply and compact the surface of the base material to the point where it will have no surface irregularity and will provide for a uniform thickness of the new pavement.
- B. Provide and operate a template for checking the contour of the subgrade. The template shall rest on the side forms and shall be provided with adjustable rods that project downward to the subgrade at 1-foot intervals. Adjust these rods to the required cross sections of the bottom of the slab when the template is supported at its sides.
- C. Forms shall be of metal or wood and subject to approval by CUB.
- D. Extruded machine curb or curb and gutter may be used. CUB reserves the right to approve the machine used, the contour and finish of the curb and gutter, and the design mix and the right to designate the spacings for expansion and contraction joints.
- E. Test the subgrade with respect to elevation and density prior to setting forms. Complete the subgrade to the plane of the typical sections shown on the construction drawings and to the lines and grades established by the drawings. Compact subgrades as specified in Section 01600 – Unclassified Excavation and Backfilling.
- F. After preparing the subgrade as described above, set the forms. The subgrade under the forms shall be firm and cut true to grade so that each form section will, when placed, be firmly in contact for its entire length and base width. Stake the form into position so that the top, when tested by a 10-foot straight edge, conforms to the requirements specified for the surface of the concrete and so that the longitudinal axis of the upstanding leg does not vary more than 1/4 inch. Tightly lock form sections together.
- G. Finish the subgrade to the exact section of the bottom of the pavement shown on the construction drawings. Wet the subgrade down far enough in advance of the placing of the concrete to ensure that it is firm and moist. In cold weather, the subgrade shall be entirely free from frost and/or frozen material when the concrete is deposited.
- H. Leave forms in place at least 24 hours after the concrete has been placed against them. Do not use crowbars or heavy tools against "green" concrete when removing the forms. Clean the forms well before re-oiling and reuse.

3.2 PLACING

- A. Concrete shall be in place within 45 minutes from the time all ingredients are charged from the mixing drum or concrete truck and before the concrete has obtained its initial set. Deposit concrete so that minimum handling will be necessary, and distribute it so that, when consolidated and finished, the slab thickness and surface grade required by the construction drawings will be obtained at all points. Place concrete rapidly and continuously between expansion joints. Use shovels for any necessary hand spreading. Use of

rakes for spreading concrete materials shall not be allowed. Consolidate the concrete adjacent to forms and joints with spades.

- B. Do not place concrete when the ambient temperature is below 35 degrees F, nor when the concrete is without special protections, likely to be subject to freezing temperatures before final setting has occurred. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 90 degrees F. Heating of the mixing water and/or aggregates will not be permitted until the temperature of the concrete has decreased to 55 degrees F. Heated materials shall be free from ice, snow, and frozen lumps before entering the mixer. Methods and equipment for heating shall be subject to CUB's approval. Provide suitable means for maintaining the concrete at a temperature of at least 40 degrees F for not less than 72 hours after placement. Any concrete damaged by freezing shall be removed and replaced at the sole expense of the CONTRACTOR.

3.3 FINISHING

- A. Immediately after placement, properly finish the concrete. The sequence of operations shall be as follows: hand finishing, longitudinal floating, straightedge finishing, and edging the joints.
- B. Provide an approved hand strike template, approved tamping template, and a longitudinal float for the hand finishing of pavement. The templates shall be at least 1 foot longer than the pavement width and at least 4 inches wide. The longitudinal float shall be 6 feet to 8 feet long. The float shall be rigid and substantially braced and provided with suitable handles to ensure smooth and effective manipulation. The bottom edges of the base of the float shall be rounded. Floats made of metal or a combination of wood and metal may be used.
- C. As soon as concrete is placed, strike off and screed to the appropriate cross section and to an elevation above grade which, when the concrete is consolidated and finished, will ensure that the surface of the pavement is at the exact elevation indicated on the construction drawings. Tamp the entire surface, and continue tamping until the required compaction and reduction of internal and surface voids are secured. Immediately after the final tamping of the surfaces, float the pavement longitudinally, by hand. If contact with the pavement is not made at all points by the float, additional concrete shall be required and screeded, and the float operated until a satisfactory surface is obtained.
- D. After the longitudinal floating is complete, eliminate minor irregularities and score marks remaining in the pavement surface by removing surplus material or, if necessary, by adding and working in freshly mixed concrete with long handled floats and filling in open textured areas in the pavement surfaces. Make the final finish with straightedges 8 feet in length. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than 1/2 of the pavement width. Place the straightedge at the centerline and pull uniformly to the edge. Do not advance the straightedge

along the pavement in successive stages more than 1/2 its length. Immediately fill depressions with freshly mixed concrete, strike off, consolidate, and refinish. Remove projections above the required elevation while the concrete is still plastic and workable, doing so in a time sequence that will ensure the removal of all water and laitance from the surface. Continue the straightedge testing and re-floating until the entire surface is free from observable departures from the straightedge, conforms to the required grade and contour, and will, when the concrete has hardened, conform to the surface requirements specified herein.

- E. After hand finishing has been completed but before the concrete has attained initial set, carefully finish the edges of slabs along forms and at joints with an edging tool of 1/2 inch radius to form a smooth, rounded surface. Clean corners or edges of slabs that have crumbled and any areas that lack enough mortar for proper finishing by removing loose fragments and soupy mortar, and then fill solidly and finish with a mixture of the correct proportions and appropriate consistency. Eliminate unnecessary tool marks, and leave edges smooth and true to line. After removing the forms, fill any damaged or honeycombed areas with mortar composed of one part cement and two parts sand.
- F. Form transverse and contraction joints in the finished pavement prior to initial set, spacing them as shown on the construction drawings. Contraction joints shall be 1/4 inch wide and 3/4 inch deep and shall be finished with an edging tool of 1/4 inch radius.
- G. Place transverse and pre-molded expansion joints 1/2 inch thick in such a way that the joint will be filled to within 1/2 inch of the surface of the walk. Place them to run depth and normal to the grade. Wherever concrete walks abut against transverse steps, other walks, or adjacent structures, provide expansion joints. Clean all concrete from the top of the pre-molded joints and edge the concrete as specified above.

3.4 PROTECTION AND CURING

- A. Protect and cure concrete with an approved curing compound applied according to the manufacturer's directions.
- B. CONTRACTOR is responsible for finish of all concrete work performed by him or his subcontractor, including protecting the concrete from vandalism that may occur through the end of the Contract Time. Should vandalism occur, CONTRACTOR shall, at CONTRACTOR's sole expense, be required to replace all such damaged concrete as necessary to provide concrete surfaces free of any and all such defects.

3.5 SURFACE TEST

CONTRACTOR shall remove any portion of the pavement that shows a variation or departure greater than 1/4 inch from the testing edge of a 10-foot straightedge, and replace or correct as directed by CUB.

END OF SECTION

SECTION 06600

CONCRETE FOR UTILITY LINES

PART 1. GENERAL

This item shall include furnishing and installing concrete blocking, cradles, anchors, caps, pipe protection, concrete slabs for manholes over 12 feet in depth and/or encasement at the locations shown on the construction drawings and/or as directed by CUB.

PART 2. PRODUCTS

Not Used.

PART 3. EXECUTION

- 3.1 Concrete work shall conform to latest revision of ACI 301.
- 3.2 Supplemental requirements are listed below:
 - A. Strength - The minimum 28-day strength of concrete shall be 4,000 psi unless otherwise shown on the construction drawings, or as directed by CUB.
 - B. Durability - All concrete exposed to weather shall be air-entrained.
 - C. Slump - Concrete shall be proportional and produced to have a slump of 3 inches with a + or – 1 inch tolerance.
 - D. Admixtures - Air entrainment, mandatory for concrete exposed to weather, may be used. A water-reducing admixture (retarding, normal, or accelerating, depending on placing temperature), may be used if approved by CUB.
 - E. Reinforcing Steel - Yield strength of reinforcing steel, including dowels, shall be 60,000 psi. Reinforcing steel and dowels shall be used as shown on the construction drawings or as directed by CUB.

END OF SECTION

SECTION 07000

FINISH GRADING

PART 1. GENERAL

The work called for by this section shall include, but not necessarily be limited to, finish grading, as well as the spreading and shaping of topsoil to match the existing contours or to the satisfaction of CUB.

PART 2. PRODUCTS

2.1 TOPSOIL

Use stripped topsoil that has been stockpiled as specified elsewhere. If the quantity of topsoil present on the job is inadequate, furnish additional topsoil. Topsoil furnished shall be natural, fertile, friable soil possessing characteristics of representative productive soils in the vicinity and as approved by CUB. It shall be obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic substances that may be harmful to plant growth.

Topsoil shall be without admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stones, stumps, roots, or similar substances 2 inches or more in diameter, debris, or other objects that are a hindrance to planting operations. Such material shall be subject to testing.

PART 3. EXECUTION

- 3.1 Work shall not begin until the soil is dry enough to be tillable.
- 3.2 Subgrades shall be inspected to see that they generally conform to the standards called for elsewhere in these specifications, particularly with regard to the approximate depths required for the work. After work is completed, CUB shall inspect it to ensure that all finish grading complies with design requirements.
- 3.3 Finished grade stakes shall be placed wherever necessary to bring the work accurately to the elevations required by the construction drawings.
- 3.4 For all areas disturbed by construction activities and areas that are to be re-graded as part of the WORK and IMPROVEMENTS CONTRACTOR shall finish-grade to the depths required for the work and/or as shown on the drawings as follows:
 - A. Grade uniformly with rounded surfaces at the tops and bottom of abrupt changes of planes.
 - B. Hand grade steep slopes and areas that are inaccessible for machine work.

- C. Protect graded areas from undue erosion, and repair and re-grade areas where erosion does occur.
 - D. Refill areas where noticeable settlement has occurred.
 - E. Finish grade areas that are to receive topsoil up to 4 inches below the finished contour elevations called for by the construction drawings or, over rock, to 12 inches below these elevations.
- 3.5 Topsoil shall be placed by CONTRACTOR uniformly over disturbed areas that do not receive other work as follows:
- A. Obtain approval of the finish grading plan from CUB before starting to place topsoil.
 - B. Scarify subgrade to a depth of 3 inches.
 - C. Place the topsoil to a depth of 4 inches when lightly rolled or, on rock, to a depth of 12 inches.
 - D. Level the topsoil so that it slopes uniformly and has no water pockets.
 - E. Carefully rake the topsoil by hand to remove all clods, roots, sticks, stones over one (1) inch in diameter and other foreign materials from the surface.
- 3.6 The CONTRACTOR is solely responsible for the removal, hauling, and disposal of waste materials. The CONTRACTOR is responsible for locating disposal sites and for obtaining all related permits from the site property owner and any agency having jurisdiction. CUB shall not be liable for improper disposal of waste materials.

END OF SECTION

SECTION 07200

SEEDING

PART 1. GENERAL

- 1.1 This work shall be performed in all disturbed areas not receiving such site improvements as buildings, roadways, curb and gutter, walkways, sod, plantings, etc., and shall include, but not necessarily be limited to, all seed bed preparation; the supplying and placing of soil additives, seed, and mulch wherever required by the construction drawings or as otherwise directed by CUB.
- 1.2 Unless otherwise approved in writing by CUB, seeding operations shall be limited to the following planting periods:
 - A. Spring planting period - March 1 through May 30
 - B. Fall planting period - August 15 through October 31
- 1.3 Refer to other sections for items affecting seeding. Coordinate this work with that specified by other sections for timely execution.

PART 2. PRODUCTS

- 2.1 GRASS SEED: Kentucky 31 Fescue (*Festuca Elatior*) meeting the requirements of the State Department of Agriculture and furnished in new bags or bags that are sound and not mended; no "below standard" seed accepted.
- 2.2 FERTILIZER: commercially manufactured; Grade 10-10-10; furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.
- 2.3 AGRICULTURAL LIMESTONE: containing a minimum of 85% calcium carbonate and magnesium carbonate combined, 85% of which passes a No. 10 mesh sieve.
- 2.4 MULCH: stalks of rye, oats, wheat, or other approved grain crops properly cured prior to baling, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.

PART 3. EXECUTION

- 3.1 Perform all seeding and related work as a continuous operation. Sow seed as soon as the seedbed has been prepared, and perform subsequent work in a continuous manner.
- 3.2 Before beginning seeding operations in any area, complete the placing of topsoil and final grading, and have the work approved by CUB.

- 3.3 Scarify, disk, harrow, rake, or otherwise work each area to be seeded until the soil has been loosened and pulverized to a depth of not less than 2 inches. Perform this work only when the soil is in a tillable and workable condition.
- 3.4 Remove any clods or rocks from top 2 inches of the surface and rake out or otherwise provide for a smooth surface of the seedbed.
- 3.5 Apply fertilizer and agricultural limestone uniformly over the seedbed, and lightly harrow, rake, or otherwise incorporate them into the soil for a depth of approximately 2 to 4 inches at the following rates:

Fertilizer: 15 pounds per 1,000 square feet
Agricultural Limestone: 40 pounds per 1,000 square feet
- 3.6 Sow seed uniformly by using a rotary seeder, wheelbarrow-type seeder, hydraulic spreading equipment or by other satisfactory means.
- 3.7 The seeding rate shall be 5 pounds per 1,000 square feet for Kentucky 31 Fescue (*Festuca Elatior*).
- 3.8 When seeding during March 1 through April 1 and October 1 through October 31, add an additional 3 pounds per 1,000 square feet of Kentucky 31 Fescue (*Festuca Elatior*).
- 3.9 Perform no seeding during windy weather or when the ground surface is frozen, wet, or otherwise untillable.
- 3.10 When seeding with mulch is specified or otherwise used, spread the mulch material evenly over the seeded areas immediately following the seeding operation. Mulch Rate: 2 bales (100 pound minimum) per 1,000 square feet
- 3.11 The mulch rate may be varied by CUB, depending on the texture and condition of the mulch material and the characteristics of the area seeded. Cover all portions of the seeded areas with a uniform layer of mulch so that approximately 25% of the ground is visible.
- 3.12 No equipment, material storage, construction traffic, etc., will be permitted on newly seeded ground.
- 3.13 Dispose of all surplus materials as directed by CUB.
- 3.14 INSPECTION

CUB shall inspect the seeding within 60 days after planting and determine if it is acceptable.

3.15 GUARANTEE

- A. CONTRACTOR shall secure an acceptable growth of grass in all areas designated for seeding.
- B. An area is considered acceptable if it is represented by a minimum of 100 seedlings per square foot of the permanent species of grass representative of the seed mixture. If an acceptable growth is not obtained on the first planting, reseeding and remulching will be required.
- C. If the planting is less than 50% successful, CONTRACTOR shall rework the ground, refertilize, reseed, and remulch at no additional cost to CUB.

3.16 PAYMENT

All costs associated restoration of disturbed areas by seeding, which shall include but not necessarily be limited to, all seed bed preparation; the supplying and placing of soil additives, seed, and mulch wherever required by the construction drawings or directed by CUB, and all associated work shall be considered incidental to the installation of the mains, and shall not be an additional expense to CUB.

END OF SECTION

SECTION 07300

SODDING

PART 1. GENERAL

- 1.1 This work shall include all soil preparation and the storage, transportation, placing, and maintenance of sod at all locations shown on the drawings or as directed by CUB.
- 1.2 Temporary storage of sod is permitted; however, CONTRACTOR must ensure that all sod to be used on this project is in a live, growing condition at the time of CONTRACTOR's placed of the sod. Sod shall be rejected if it is permitted to decay or dry out to the extent that, in the judgment of CUB, its survival is doubtful. CONTRACTOR shall dispose of rejected sod as directed by CUB at no expense to CUB.
- 1.3 Set sod between March 1 and October 15 and when the soil is in a workable condition.
- 1.4 Do not set sod out of season unless soil conditions are favorable and written permission is obtained from CUB.
- 1.5 Refer to other sections for items affecting sodding. CONTRACTOR shall coordinate this work with that specified by other sections for timely execution. CONTRACTOR shall be wholly responsible for the scheduling, ordering, receiving, storing, and installing of all sodding materials.

PART 2. PRODUCTS

- 2.1 SOD: Kentucky 31 Fescue (*Festuca Elatior*); new sod consisting of live, dense, well rooted growth; well suited for the intended purpose and soil conditions; completely free of noxious weeds and grasses (Bermuda grass, quack grass, Johnson grass, Canada thistle); and containing less than 5 plants of objectionable weeds per 100 square feet if nursery grown or 10 such plants if field grown.
- 2.2 FERTILIZER: commercially manufactured, Grade 10-10-10; furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.
- 2.3 AGRICULTURAL LIMESTONE: containing a minimum of 85% calcium carbonate and magnesium carbonate combined, 85% of which passes a No. 10 mesh sieve.

PART 3. EXECUTION

- 3.1 Before beginning sodding operations in any area, complete the placing of topsoil and final grading, and have the work approved by CUB.
- 3.2 Scarify each area to be sodded a minimum of 2 inches.

- 3.3 Apply fertilizer and agricultural limestone uniformly over the sod bed at the rates shown below. Immediately prior to placing sod, water the sod bed until it is saturated to a depth of 1 inch, and keep it moist until the sod is placed.
 - A. Fertilizer: 15 pounds per 1,000 square feet of 10-10-10
 - B. Agricultural Limestone: 40 pounds per 1,000 square feet
- 3.4 Place sod as soon as practical after its removal from point of origin. Keep it moist while displaced.
- 3.5 Place sod by hand so that the edges are in close contact and in a position to break joints with the long dimension perpendicular to the slope. Fit and pound the sod into place with a 10 inches x 10 inches wood tamp or other similar implements.
- 3.6 Immediately after placing the sod, thoroughly wet and roll it.
- 3.7 Two weeks after the sod is installed, top dress and thoroughly water it. Top dressing shall consist of the following:
 - A. 1/2 to 1 pound: 38% urea formaldehyde per 1,000 square feet
 - B. 20 pounds: 6-12-12 per 1,000 square feet
- 3.8 No equipment, material storage, construction traffic, etc., will be permitted on newly sodded areas.
- 3.9 Dispose of all surplus material as directed by CUB.
- 3.10 CUB will review the sod for acceptance 30 days after installation, at which time the maintenance period will begin as stated in these specifications. This acceptance by CUB is for the purposes of payment only.
- 3.11 INSPECTION
CUB shall inspect the sod within 30 days after installation and determine if it is acceptable.
- 3.12 GUARANTEE
CONTRACTOR shall establish an acceptable growth of the specified sod on all areas indicated on the construction drawings or as directed by CUB. An area is considered acceptable if the majority of each piece of sod is alive and healthy and generally free from weeds, insects, and disease.

END OF SECTION