

MORRISTOWN UTILITY SYSTEMS



STANDARD SANITARY SEWER SPECIFICATIONS

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MORRISTOWN UTILITY SYSTEMS STANDARD SEWER SPECIFICATIONS

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SECTION 01320

PRE AND POST CONSTRUCTION VIDEO AND PHOTOGRAPHIC RECORDS

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all equipment, labor, and materials required to provide the Owner with construction videos and photographs of the Project.
- B. Original documents and negatives respectively shall become the property of the Owner and none of the videos and photographs herein shall be published without express permission of the Owner.

1.02 PRE AND POST CONSTRUCTION PHOTOGRAPHS

- A. Prior to the beginning of any work, the Contractor shall take video recordings of the entire project work area and project photographs of any existing conditions that appear to be of special interest.
- B. Following completion of the work, another recording shall be made showing the same areas and features as in the pre-construction videos and photographs.
- C. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.
- D. The pre-construction videos and photographs shall be submitted to the Engineer within 25 calendar days after the date of receipt by the Contractor of Notice to Proceed. Post-construction videos and photographs shall be provided prior to final acceptance of the project.

1.03 SUBMITTALS

- A. Photographs shall be submitted in digital format (.jpeg) on compact discs.
- B. Video recordings shall be DVD format.

PART 2 - PRODUCTS

(Not used)

PART 3 - EXECUTION

(Not used)

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit Shop Drawings, Product Data, and Samples required by Contract Documents.

1.02 RELATED REQUIREMENTS

- A. Section 00300: Bid Proposal
- B. Section 00700: General Conditions
- C. Section 01310: Construction Schedules
- D. Section 01720: Project Record Documents
- E. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that reviewed Shop Drawings, Product Data, and Samples will be needed.

1.03 SHOP DRAWINGS

- A. Drawings shall be presented in a clear and thorough manner.
 - 1. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Drawings.
- B. Minimum Sheet size: 8-1/2" x 11"

1.04 PRODUCT DATA

- A. Preparation:
 - 1. Clearly mark each copy to identify pertinent products or models.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions and clearances required.
 - 4. Show wiring or piping diagrams and controls.
- B. Manufacturer's standard schematic drawings and diagrams:
 - 1. Modify drawings and diagrams to delete information that is not applicable to the work.
 - 2. Supplement standard information to provide information specifically applicable to the Work.

1.05 SAMPLES

- A. Office samples shall be of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture, and pattern.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Review Shop Drawings, Product Data, and Samples prior to submission.
- B. Determine and verify:
 - 1. Field measurements,
 - 2. Field construction criteria,
 - 3. Catalog numbers and similar data, and
 - 4. Conformance with specifications.
- C. Coordinate each submittal with requirements of the Work and of the Contract Documents.
- D. Notify the Engineer in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.
- E. Begin no fabrication or work which requires submittals until return of submittals with Engineer approval.

1.07 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the work, or in the work of any other contractor.
- B. Number of submittals required:
 - 1. Shop Drawings: Submit the number of opaque reproductions which the contractor requires, plus four (4) copies which will be retained by the Engineer.
 - 2. Product Data: Submit the number of copies which the Contractor requires, plus four (4) which will be retained by the Engineer.
 - 3. Samples: Submit the number stated in each specification section.
- C. Submittals shall contain:
 - 1. The date of submission and the dates of any previous submissions.
 - 2. The project title and number.
 - 3. Contract identification.
 - 4. The names of:

- a. Contractor
 - b. Supplier
 - c. Manufacturer
5. Identification of the project, with the specification section number.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8" x 3" blank space for Contractor and Engineer stamps.
12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work.

1.08 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by the Engineer and resubmit until approved.
- B. Shop Drawings and Product Data:
 1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 2. Indicate any changes which have been made other than those requested by the Engineer.
- C. Samples: Submit new samples as required for initial submittal.

1.09 DISTRIBUTION

- A. Distribute reproductions of Shop Drawings and copies of Product Data which carry the Engineer stamp of approval to:
 1. Job site file
 2. Record documents file
 3. Other affected contractors
 4. Subcontractors
 5. Supplier or fabricator
- B. Distribute samples which carry the Engineer stamp of approval as directed by Engineer.

1.10 ENGINEER DUTIES

- A. Review submittals with reasonable promptness and in accordance with schedule.

- B. Affix stamp and initials or signature, and indicate requirements for resubmittal, or approval of submittal.
- C. Return submittals to Contractor for distribution, or for resubmission.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01370

SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit to the Engineer a Schedule of Values allocated to the various portions of the Work, within ten (10) days after award of contract, for lump sum contracts only.
- B. Upon request of Engineer, support the values with data which will substantiate their correctness.
- C. The Schedule of Values, unless objected to by the Engineer, shall be used only as the basis for the Contractor's Applications for Payment for lump sum contracts only.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract
- B. Section 01152: Applications for Payment

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on 8-1/2" x 11" white paper; Contractor's standard forms and automated printout will be considered for approval by Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of Project and location
 - 2. Engineer and project number
 - 3. Name and address of Contractor
 - 4. Contract designation
 - 5. Date of submission
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Follow the table of contents of this Project Manual as the format for listing component items.
 - 1. Identify each line item with the number and title of the respective major section of the specification.
- D. For each major line item, list sub-values of major products or operations under the item.
- E. For the various portions of the Work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for stored material, break down the value into:

- a. The cost of the materials, delivered and unloaded, with taxes paid.
- b. The total installed value.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a subschedule of unit costs and quantities for:
 - 1. Products on which progress payment will be requested for stored products.
- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in Schedule of Values.
- C. The unit quantity of bulk materials shall include an allowance for normal waste.
- D. The unit values for the materials shall be broken down into:
 - 1. Cost of the material, delivered and unloaded at the site, with taxes paid.
 - 2. Installation costs, including Contractor's overhead and profit.
- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01410

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 LABORATORY SERVICES

- A. Owner will employ and pay for services of an Independent Testing Laboratory, acceptable to the Engineer, to perform specified services. See respective specification sections for required services.
- B. Inspection, Sampling, and Testing are required for:
 - 1. Concrete mixing and placing.
 - 2. Steel erection.
 - 3. Site grading and foundation excavation.
 - 4. Other areas as specified elsewhere.

1.02 QUALIFICATION OF LABORATORIES

- A. Meet "Recommended Requirements for Independent Laboratory Qualifications", edition which is current when Agreement is signed by Owner and Contractor, published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E329-77 "Standards for Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction."
- C. Be licensed to operate in the State of the project.
- D. Have properly calibrated equipment, calibrated within the past twelve (12) months by devices of accuracy traceable to either:
 - 1. National Bureau of Standards.
 - 2. Accepted values of natural physical constants.

1.03 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor and provide qualified personnel promptly on notice.
- B. Perform specified inspections, sampling and testing of materials, and methods of construction.
- C. Comply with specified standards, ASTM, other recognized authorities, and as specified.

- D. Ascertain compliance with requirements of Contract Documents.
- E. Promptly notify Engineer and Contractor of irregularities or deficiencies in Work which are observed during performance of duties.
- F. Promptly submit three (3) copies of reports of inspections and tests to Engineer, and submit two(2) copies of those reports to Contractor at the project site, including:
 - 1. Date issued.
 - 2. Project title, number, and location.
 - 3. Testing laboratory name and address.
 - 4. Name and signature of inspector.
 - 5. Date of inspection and sampling.
 - 6. Date of test.
 - 7. Identification of product and specifications section.
 - 8. Type of inspection or test.
 - 9. Observations regarding compliance with Contract Documents.

1.04 LIMITATIONS OF AUTHORITY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of Work.
 - 3. Perform any duties of the Contractor.

1.05 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with Laboratory personnel and provide access to Work.
- B. Provide to Laboratory, representative samples of materials to be tested, in required quantities.
- C. Furnish copies of mill test reports.
- D. Furnish casual labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the site.
 - 3. To facilitate inspections and tests.
 - 4. For Laboratory's exclusive use for storage and curing of test samples.
- E. Notify Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
- F. Pay Laboratory travel and labor costs when Laboratory is notified that Work to be sampled will be in progress, and Laboratory personnel come to the site to perform their duties and that phase of the Work is not performed within a reasonable time.

- G. Pay for additional tests when initial tests indicate Work does not comply with Contract Documents.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01510

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain temporary utilities required for construction; remove on completion of Work.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work
- B. Section 01590: Field Offices and Sheds

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with Federal, State, and local codes and regulations, and with utility company requirements.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING

- A. Arrange with utility company, provide service required for power and lighting, and pay all costs for service and for power used.
- B. Install circuit and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords.
- C. Provide adequate artificial lighting for all areas of work when natural light is not adequate for work and for areas accessible to the public.

2.03 TEMPORARY HEAT AND VENTILATION

- A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.
- B. Provide adequate forced ventilation of enclosed areas for curing of installed material, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
- C. Portable heaters shall be standard approved units complete with controls.
- D. Pay all costs of installation, maintenance, operation and removal, and for fuel consumed.

2.04 TEMPORARY TELEPHONE SERVICE

- A. Arrange with local telephone service company, provide direct line telephone service at the construction site for the use of personnel and employees. Service required:
 - 1. One direct line instrument in field office.
 - 2. Other instruments at the option of the Contractor, or as required by regulations.
- B. Pay all costs for installation, maintenance and removal, and service charges for local calls. Toll charges shall be paid by the party who places the call.

2.05 TEMPORARY WATER

- A. Arrange with utility service company, provide water for construction purposes; pay all costs for installation, maintenance and removal, and service charges for water used.
- B. Install branch piping with taps located so that water is available throughout the construction by the use of hoses. Protect piping and fittings against freezing.

2.06 TEMPORARY SANITARY FACILITIES

- A. Provide sanitary facilities in compliance with laws and regulations.
- B. Service, clean, and maintain facilities and enclosures.
- C. Existing facilities may be used during the construction period.

PART 3 - EXECUTION

3.01 GENERAL

- A. Maintain and operate systems to assure continuous service.
- B. Modify and extend systems as work progress requires.

3.02 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore existing facilities, if any, used for temporary services, to specified or original condition.
- D. Restore permanent facilities, if any, used for temporary services to specified condition. Prior to final inspection, remove temporary lamps and install new lamps.

END OF SECTION

SECTION 01520

CONSTRUCTION AIDS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain required construction aids, remove on completion of Work.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required by personnel and to facilitate execution of the Work; scaffolds, staging, ladders, stairs, ramps, runway, platforms, railings, hoists, cranes, chutes, and other such facilities and equipment.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Consult with Engineer, review site conditions and factors which affect construction procedures and construction aids, including adjacent properties and public facilities which may be affected by execution of Work.

3.02 GENERAL

- A. Comply with applicable requirements specified in sections of Divisions 2-16.
- B. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements of Owner and other contractors employed at the site.

3.03 REMOVAL

- A. Completely remove temporary materials, equipment, and services:
 - 1. When construction needs can be met by use of permanent construction.
 - 2. At completion of Project.
- B. Clean and repair damage caused by installation or by use of temporary facilities.
 - 1. Remove foundations and underground installations for construction aids.
 - 2. Grade areas of site affected by temporary installations to required elevations and slopes, and clean the area.
- C. Restore existing facilities used for temporary purposes to specified or original condition.
- D. Restore permanent facilities, if any, used for temporary purposes to specified condition.

END OF SECTION

SECTION 01530

BARRIERS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain suitable barriers as required to prevent public entry, and to protect the Work, existing facilities, trees, and plants from construction operations; remove when no longer needed, or at completion of the Work.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work
- B. Section 01520: Construction Aids

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 FENCING

- A. Materials to Contractor's option, minimum fence height six (6') feet.

2.03 BARRIERS

- A. Materials to Contractor's option, as appropriate to serve required purpose.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install facilities of a neat and reasonably uniform appearance, structurally adequate for required purposes.
- B. Maintain barriers during entire construction period.
- C. Relocate barriers as required by progress of construction.

3.02 FENCES

- A. Prior to start of work at the Project site, install enclosure fence with suitably locked entrance gates.
 - 1. Locate as shown on drawings.

3.03 TREE AND PLANT PROTECTION

- A. Preserve and protect existing trees and plants at site which are designated to remain, and those adjacent to site.
- B. Consult with Engineer and remove agreed-on roots and branches which interfere with construction.
 - 1. Employ qualified tree surgeon to remove, and to treat cuts.
- C. Provide temporary barriers to a height of six (6') feet, around each, or around each group of trees and plants.
- D. Protect root zones of trees and plants:
 - 1. Do not allow vehicular traffic or parking.
 - 2. Do not store materials or products.
 - 3. Prevent dumping refuse or chemically injurious materials or liquids.
 - 4. Prevent puddling or continuous running water.
- E. Carefully supervise excavating, grading, filling, and subsequent construction operations to prevent damage.
- F. Replace, or suitably repair, trees, and plants designated to remain which are damaged or destroyed due to construction operations.

3.04 REMOVAL

- A. Completely remove barricades, including foundations, when construction has progressed to the point that they are no longer needed and when approved by the Engineer.
- B. Clean and repair damage caused by installation, fill and grade areas of the site to required elevations and slopes, and clean the area.

END OF SECTION

SECTION 01540

SECURITY

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide a Project security program, to:
 - 1. Protect Work stored products and construction equipment from theft and vandalism.
 - 2. Protect premises from entry by unauthorized persons.
- B. Comply with local security requirements.

1.02 RELATED REQUIREMENTS

- A. Section 01510: Temporary Utilities
- B. Section 01530: Barriers

1.03 MAINTENANCE OF SECURITY

- A. Initiate security program in compliance with Owner's system, prior to job mobilization.
- B. Maintain security program throughout construction period, until Owner occupancy or Owner acceptance precludes the need for Contractor security.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01560

TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and related areas under Contractor's control; remove physical evidence of temporary facilities at completion of work.

1.02 RELATED REQUIREMENTS

- A. Section 01510: Temporary Utilities
- B. Section 01570: Traffic Regulations
- C. Section 01710: Cleaning

1.03 DUST CONTROL

- A. Provide positive methods and apply dust control materials to minimize raising dust from construction operation, and provide positive means to prevent airborne dust from dispersing into the atmosphere.

1.04 WATER CONTROL

- A. Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.
 - 1. Control fill, grading, and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.
- B. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface and groundwater.
- C. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site, or to adjoining areas.

1.05 DEBRIS CONTROL

- A. Maintain all areas under contractor's control free of extraneous debris.
- B. Initiate and maintain a specific program to prevent accumulation of debris at construction site, storage and parking areas, or along access roads and haul routes.
 - 1. Provide containers for deposit of debris as specified in Section 01710 - Cleaning.
 - 2. Prohibit overloading of trucks to prevent spillages on access and haul routes.

- a. Provide periodic inspection of traffic areas to enforce requirements.
- C. Schedule periodic collection and disposal of debris as specified in Section 01710 - Cleaning.

1.06 POLLUTION CONTROL

- A. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by discharge of noxious substances from construction operations.
- B. Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.
 - 1. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- C. Take special measures to prevent harmful substances from entering public waters.
 - 1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
- D. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutants into the atmosphere.

1.07 EROSION CONTROL

- A. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold the areas of bare soil exposed at one time to a minimum.
 - 2. Provide temporary control measures such as berms, dikes, and drains.
- B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.
- C. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01570

TRAFFIC REGULATIONS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide, operate, and maintain equipment, services, and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow on haul routes, at site entrances, on-site access roads, and parking areas.
- B. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.02 RELATED REQUIREMENTS

- A. Section 01530: Barriers
- B. Section 01560: Temporary Controls

1.03 TRAFFIC SIGNALS AND SIGNS

- A. Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.
- B. Provide traffic control, directional signs, and warning signs mounted on barricades or standard posts:
 - 1. At each change of direction of a roadway and at each crossroads.
 - 2. At detours.
 - 3. At parking areas.
 - 4. Well in advance of the work area toward oncoming traffic.

1.04 FLAGMEN

- A. Provide qualified and suitably equipped flagmen when construction operations encroach on traffic lanes, as required for regulation of traffic.

1.05 FLARES AND LIGHTS

- A. Provide flares and lights during periods of low visibility:
 - 1. To clearly delineate traffic lanes and to guide traffic.
 - 2. For use by flagmen in directing traffic.
- B. Provide illumination of critical traffic and parking areas.

1.06 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.
- B. Monitor parking of construction personnel's private vehicles.
 - 1. Maintain free vehicular access to and through parking areas.
 - 2. Prohibit parking on or adjacent to access roads, or in non-designated areas.

1.07 HAUL ROUTES

- A. Consult with governing authorities and establish public thoroughfares which will be used as haul routes and site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to expedite traffic flow to minimize interference with normal public traffic.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain temporary field offices during entire construction period.
- B. Furnish, install, and maintain storage and work sheds needed for construction.
- C. At completion of work, remove field offices, sheds, and contents.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work
- B. Section 01510: Temporary Utilities

1.03 OTHER REQUIREMENTS

- A. Prior to installation of offices and sheds, consult with Engineer on location, access, and related facilities.

1.04 REQUIREMENTS FOR FACILITIES

- A. Construction:
 - 1. Structurally sound, weathertight, with floors raised above ground.
 - 2. Temperature transmission resistance: compatible with occupancy and storage requirements.
 - 3. At Contractor's option, portable or mobile buildings may be used.
 - a. Mobile homes, when used, shall be modified for office use.
 - b. Do not use mobile homes for living quarters.
- B. Office for Engineer and Owner's Representative:
 - 1. A separate space for sole use of designated occupants, with secure entrance doors and one (1) key per occupant.
 - 2. Area: 150 square feet minimum, with minimum dimension of eight (8') feet.
 - 3. Windows:
 - a. Minimum: Total area of 10% of floor area.
 - b. Operable sash and insect screens.
 - c. Locate to provide view of construction areas.
 - 4. Furnishings:
 - a. One (1) standard size desk with three (3) lockable drawers.

- b. One (1) drafting table: 30" x 72" x 36" high, with one (1) equipment drawer.
 - 1. Locate table oriented in relation to the site at a window with a view of the site.
 - c. One (1) plan rack to hold a minimum of six sets of Project drawings.
 - d. One (1) chair per occupant.
 - e. One (1) drafting table stool.
 - f. One (1) waste basket per desk and table.
 - g. One (1) tackboard, 36" x 30".
- 5. Services:
 - a. Lighting: 50 foot-candles at desk top height.
 - b. Exterior lighting at entrance door.
 - c. Automatic heating and mechanical cooling equipment to maintain comfortable conditions.
 - d. Minimum of four (4) 110 volt duplex electric convenience outlets, at least one (1) on each wall.
 - e. Electric distribution panel: Two (2) circuits minimum, 110 volt, 60 hertz service.
 - f. Convenient access to drinking water and toilet facilities.
 - g. Telephone: One (1) direct line instrument. Local service to be paid by contractor. Long distance charges to be paid by Engineer.

C. Contractor's Office and Facilities

- 1. Size: As required for general use and to provide space for project meetings.
- 2. Lighting and temperature control: As specified for Engineer's office.
- 3. Telephone: One (1) direct line instrument.
- 4. Furnishings in Meeting Area:
 - a. Table and Chairs for at least eight (8) persons.
 - b. Racks and files for Project Record Documents in or adjacent to the meeting areas.
- 5. Other furnishings: Contractor's option.
- 6. One (1), ten (10") inch (250 mm) outdoor-type thermometer.

D. Storage Sheds:

- 1. To requirements of various trades.
- 2. Dimensions: Adequate for storage and handling of products stored.
- 3. Ventilation: Comply with specified and code requirements for products stored.
- 4. Heating: Adequate to maintain temperatures specified in respective sections for the products stored.

PART 2 - PRODUCTS

2.01 MATERIALS, EQUIPMENT FURNISHINGS

- A. May be new or used, but must be serviceable, adequate for acquired purpose, and must not violate applicable codes and regulations.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Fill and grade sites for temporary structures to provide surface drainage.

3.02 INSTALLATION

- A. Construct temporary field offices and storage sheds on proper foundations, provide connections for utility services.
 - 1. Secure portable or mobile buildings when used.
 - 2. Provide steps and landings at entrance doors.
- B. Mount thermometer at convenient outside location, not in direct sunlight.

3.03 MAINTENANCE AND CLEANING

- A. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment, and services.

3.04 REMOVAL

- A. Remove temporary field offices, contents, and services when no longer needed.
- B. Remove foundations and debris; grade site to required elevations and clean the areas.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Material and equipment incorporated into Work:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type, and quality specified, or as specifically approved in writing by the Engineer.
 - 3. Manufactured and Fabricated Products:
 - a. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - c. Two (2) or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - 4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract
- B. Section 00300: Bid Proposal
- C. Section 01010: Summary of Work
- D. Section 01340: Shop Drawings, Product Data, and Samples
- E. Section 01710: Cleaning

1.03 REUSE OF EXISTING MATERIAL

- A. Except as specifically indicated or specified, materials and equipment removed from the existing structure, if any, shall not be used in the completed work.
- B. For material and equipment specifically indicated or specified to be used in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation, to assure proper function in the completed Work.

2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration, or renovation. Pay all costs for such work.

1.04 MANUFACTURER'S INSTRUCTIONS

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two (2) copies to Engineer.
 1. Maintain one (1) set of complete instructions at the job site during installation and until completion.
- B. Handle, install, connect, clean, condition, and adjust products in strict accordance with such instructions and in conformity with specified requirements.
 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
 2. Do not proceed with work without clear instructions.
- C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.05 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of Product in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.
 1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.
- B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.06 STORAGE AND PROTECTION

- A. Store Products in accordance with manufacturer's instructions with seals and labels intact and legible.
 1. Store Products subject to damage by the elements in weathertight enclosures.
 2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

- B. Exterior Storage:
 - 1. Store fabricated Products above the ground, on blocking or skids, prevent soiling or staining. Cover Products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
 - 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored Products to assure that Products are maintained under specified conditions, and free from damage or deterioration.
- D. Protection after Installation:
 - 1. Provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.07 SUBSTITUTIONS AND PRODUCT OPTIONS

- A. Products List:
 - 1. Within ten (10) days after contract Date, submit to Engineer a complete list of major Products proposed to be used, with the name of the manufacturer and the installing subcontractor.
- B. Contractor's Options:
 - 1. For Products specified only by reference standard, select any Product meeting that standard.
 - 2. For Products specified by naming several Products or manufacturers, select any one (1) of the Products or manufacturers named, which complies with the specifications.
 - 3. For Products specified by naming one (1) or more Products or manufacturers and stating "or equal," Contractor must submit a request for substitutions for any Product or manufacturer not specifically named.
 - 4. For Products specified by naming only one (1) Product and manufacturer, there is no option.
- C. Substitutions:
 - 1. Major Equipment Items
 - a. For a period of fourteen (14) days after the Bid opening, Engineer will consider written requests from Contractor for substitutions identified in the major equipment Schedule of the Bid Form.
 - 2. Other Products
 - a. For a period of thirty (30) days after Contract Date, Engineer will consider written requests from Contractor for substitutions on Products.

3. Submit a separate request for each Product, supported with complete data, with drawings and samples as appropriate, including:
 - a. Comparison of qualities of the proposed substitution with that specified.
 - b. Changes required in other elements of the work because of the substitution.
 - c. Effect on the construction schedule.
 - d. Cost data comparing the proposed substitution with the Product specified.
 - e. Any required license fees or royalties.
 - f. Availability of maintenance service, and source of replacement materials.
 4. Engineer shall be the judge of the acceptability of the proposed substitution.
- D. Contractor's Representation:
1. The request for a substitution constitutes a representation that contractor:
 - a. Has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified.
 - b. Will provide the same warranties or bonds for the substitution as for the Product specified.
 - c. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects.
 - d. Waives all claims for additional costs, under this responsibility, which may subsequently become apparent.
- E. Engineer will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.

1.02 RELATED REQUIREMENTS

- A. Conditions of the contract: Fiscal provisions, legal submittals and additional administrative requirements:
- B. Section 01710: Cleaning
- C. Section 01720: Project Record Documents
- D. The respective sections of Specifications: Closeout Submittals Required of Trades.

1.03 SUBSTANTIAL COMPLETION

- A. When Contractor considers the Work is substantially complete, he shall submit to Engineer:
 - 1. A written notice that the Work or designated portion thereof, is substantially complete.
 - 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, Engineer will make an inspection to determine the status of completion.
- C. Should Engineer determine that the Work is not substantially complete:
 - 1. Engineer will promptly notify the Contractor in writing, giving the reasons for Work not being substantially complete.
 - 2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
 - 3. Engineer will reinspect the Work.
- D. When the Engineer finds that the Work is substantially complete, he will:
 - 1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion of NSPE Form 1910-8-D with a tentative list of items to be completed or corrected before final payment.

2. After consideration of any objections made by the Owner as provided in Conditions of the Contract, and when Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.04 FINAL INSPECTION

- A. When Contractor considers the Work is complete, he shall submit written certification that:
 1. Contract Documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 5. Work is complete and ready for final inspection.
- B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that Work is incomplete or defective:
 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective Work.
 2. Contractor shall take immediate steps to remedy the stated deficiencies in the Work and send a second written certification to the Engineer that the Work is complete.
 3. Engineer will reinspect the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.05 REINSPECTION FEES

- A. Should Engineer perform reinspections due to failure of the Work to comply with the claims of status of completion made by the Contractor:
 1. Owner will compensate Engineer for such additional services.
 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.06 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- A. Evidence of compliance with requirements of governing authorities.
- B. Project Record Documents: to requirements of Section 01720
- C. Evidence of Payment and Release of Liens: to requirements of General and Supplementary Conditions.

- D. Certificate of Insurance for Products and Completed Operations, as applicable.

1.07 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to the Contract Sum:
1. The original Contract Sum.
 2. Additions and deductions resulting from:
 - a. Previous Change Orders
 - b. Allowances
 - c. Unit Prices
 - d. Deductions for uncorrected work
 - e. Penalties and Bonuses
 - f. Deductions for liquidated damages
 - g. Deductions for reinspection payments
 - h. Other adjustments
 3. Total Contract Sum, as adjusted
 4. Previous payments
 5. Sum remaining due
- C. Engineer will prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.08 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the conditions of the Contract.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01710

CLEANING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by General Conditions.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract
- B. Section 01560: Temporary Controls
- C. Each Specification Section: Cleaning for specific Products or Work.

1.03 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the Work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris, and rubbish.

- C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

- A. Employ skilled workmen for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
- C. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- D. Prior to final completion, or Owner occupancy, Contractor shall conduct an inspection of sight-exposed surfaces, and all work areas, to verify that the entire Work is clean.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Maintain at the site for the Owner one (1) record copy of:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change Orders and other Modifications to the Contract
 - 5. Engineer Field Orders or written instructions
 - 6. Approved Shop Drawings, Product Data and Samples
 - 7. Field test records

1.02 RELATED REQUIREMENTS

- A. Section 01340: Shop Drawings, Product Data, and Samples

1.03 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with CSI/CSC format.
- C. Maintain documents in a clean, dry legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for inspection by Engineer.

1.04 MARKING DEVICES

- A. Provide felt tip marking pens for recording information in the color code designated by Engineer.

1.05 RECORDING

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information concurrently with construction progress.
 - 1. Do not conceal any Work until required information is recorded.

1.06 SUBMITTAL

- A. At Contract closeout, deliver Record Documents to Engineer for the Owner.
- B. Accompany submittal with transmittal letter in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. Title and number of each Record Document
 - 5. Signature of Contractor or his authorized representative

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 02100
EROSION CONTROL

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 01050: Field Engineering
- B. Section 02221: Trenching, Backfilling, and Compacting
- C. Section 02485: Seeding

1.02 JOB CONDITIONS

- A. Excavation, trenching, backfilling, and grading operations to elevations as needed to meet the requirements shown on the Contract Documents, shall be done in such a manner as to cause the least amount of soil erosion and siltation.
- B. Appropriate management practices and control structures shall be in place prior to clearing of vegetation for necessary construction activities near streams, rivers, and lakes.
- C. Provisions required to maintain uninterrupted surface water flow shall be maintained during the work. Storm water flow in existing gutters, surface drains, and swales shall not be interrupted.
- D. The Engineer shall be notified of any unexpected subsurface or other unforeseen conditions. Work shall be discontinued until the Engineer provides notification to resume work.

1.03 PERMITS

- A. All conditions set forth in the Corps of Engineers 404 Permit , Tennessee Valley Authority 26A Permit (if applicable), and the Tennessee Department of Environment and Conservation Notice of Coverage (and Storm Water Pollution Prevention Plan (SWPPP)) shall be strictly adhered to. The Owner shall obtain the appropriate permit.
- B. The Contractor and his/her subcontractors will be required to sign the SWPPP and the Notice of Intent (NOI), thus binding them to the conditions outlined in the SWPPP and the Notice of Cover (NOC). The contractor shall be responsible for all fines and penalties arising from failure to adhere to the SWPPP, NOC, or proper erosion control practices.

PART 2 - PRODUCTS

2.01 PROTECTIVE MATERIALS

- A. Straw Bale Barriers
- B. Silt Fence and Stakes

- C. Sand Bags
- D. Stone Rip Rap
- E. Floating Boom
- F. Burlap
- G. Temporary Diversion Dike or Berm
- H. Diversion
- I. Temporary Sediment Trap
- J. Temporary Sediment Basin
- K. Check Dams
- L. Riprap
- M. Construction Road Stabilization
- N. Stream Crossings
- O. Permanent & Temporary Vegetation
- P. Storm Drain Inlet Protection
- Q. Culvert Inlet Protection

PART 3 - EXECUTION

3.01 PREPARATION

- A. Erosion and sediment control shall be in accordance with the Tennessee Water Quality Control Act of 1977, as amended, and the Federal Act PL 92-59.
- B. The Tennessee Department of Conservation Publication, Tennessee Erosion & Sediment Control Handbook, latest revision, shall be used as a guide for construction of projects that require erosion and sediment controls to protect adjoining property and waters of the state.

3.02 PERFORMANCE

- A. Whenever possible, a buffer strip of vegetation cover shall be kept adjacent to grading operations.
- B. Control measures shall be in place and functional before earth moving operations begin, and must be properly constructed and maintained during the construction period.
- C. Staked and entrenched straw bales or silt fence shall be installed along the base of all sloped cuts and fills, on the down hill sides of stockpiled soil, and along stream banks.
- D. All surface water flowing toward the construction area shall be diverted around the area as much as possible to reduce erosion potential by using beams, channels,

and/or sediment traps as necessary.

- E. Maintenance of erosion and sediment control methods shall be performed on a regular basis throughout the construction period and until a good vegetative cover is established over the entire disturbed area.
- F. A vegetation buffer strip shall be maintained between any stream and pipe trenching. Excavated material from the trench shall not be placed between the trench and stream.
- G. Trenches or pits shall be backfilled as soon as practicable to reduce erosion potential.
- H. Erosion control measures shall be removed when they have served their useful purpose. The disturbed soil shall be fine graded, top soiled, and planted with permanent vegetation as soon as the construction sequence allows to prevent further potential erosion and sedimentation. Any seeded areas which are eroded shall be reworked as soon as possible.

3.03 INSPECTION

- A. The erosion and sediment control measures shall protect adjacent properties, shall be in accordance with the Tennessee Erosion and Sediment Control Handbook and local ordinances, and shall be approved by the Engineer. All measures shall be sized and designed in accordance with the criteria specified in the handbook. All erosion control measures shall be placed prior to commencement of grading.
- B. Temporary measures shall be applied throughout the construction of the project to control erosion and to minimize siltation of drainage ditches, storm drains, and waterways. The Contractor, as a minimum, shall employ all erosion control measures indicated on the drawings and specified herein.
- C. Limit grading to areas of workable size so as to limit the duration of exposure of disturbed and unprotected area. All appropriate conservation practices should be applied in sequence of work. Disturbed areas that are to be left unfinished for more than 30 days shall be stabilized with seed and mulch, or any other necessary temporary or permanent measures.
- D. Protect stockpiling material with mulch, temporary vegetation, or sediment barrier at base. Slopes of stockpiled material shall not exceed 2 to 1.
- E. Stabilize all streets and parking areas, within 15 days of final grading, with base coarse-crushed stone.
- F. Allow no water to enter the storm drainage system prior to settlement or screening

of excess siltation.

- G. No more than 500 feet of trench shall be open at any one time.
- H. Synthetic filter fabric fencing shall be used for sediment control when land disturbing activities are within 25 feet of a live creek or stream.
- I. No excavated material shall be placed in streambeds.
- J. On disturbed short, steep slopes, where erosion hazard is high, or in vegetated channels or ditches, Contractor shall provide soil stabilization blankets and matting as directed by Owner or Engineer.

3.04 FAILURE TO EXECUTE

- A. In the event the Contractor repeatedly fails to satisfactorily control erosion or siltation, the Owner reserves the right to employ outside assistance or to use his own forces to provide the erosion and sediment control indicated and specified. The cost of such work, plus related engineering costs, will be deducted from monies due to the Contractor for other work.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 01050: Field Engineering
- B. Section 01090: Reference Standards
- C. Section 01410: Testing Laboratory Services
- D. Section 01720: Project Records Documents

1.02 JOB CONDITIONS

- A. Clear, grub, remove, and dispose of vegetation, rocks, and debris within the limits of the work except items to remain as designated on the drawings.
- B. Excavate, backfill, compact, and grade the site to the elevations shown on the drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.
- C. Existing utilities, poles, services lines, fences, structures, trees, shrubs, or other improvements encountered during the construction, whether above or below ground, shall be protected by the Contractor. Any item damaged or removed by the Contractor shall be repaired or replaced at the Contractor's expense to at least its original condition and to the satisfaction of the Owner. It shall be the Contractor's responsibility to locate any existing utilities in the path of construction.
- D. Notify the Engineer of any unexpected subsurface conditions. Discontinue work in area until the Engineer provides notification to resume work.

1.03 QUALITY ASSURANCE

- A. All work included in this section shall conform to the minimum standards of the local codes and authorities having jurisdiction over the project area.
- B. Identify and mark location of all structures, utilities, vegetation, and other existing site features that are to remain.
- C. Provide barricades, coverings, or other type of protection necessary to prevent damage to existing improvements.
- D. Excavations for structures must conform to elevations and dimensions shown within

a tolerance of plus or minus 0.10 feet, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction required, and for inspection.

- E. Areas to receive topsoil must be graded to within not more than 0.10 feet +/- above or below the required subgrade elevations. Shape surface of areas under walks and pavement to not more than 0.10 feet +/- above or below the required subgrade elevation.

1.04 PROTECTION

- A. Protect living trees not marked for removal and outside the construction area. Treat cut or scarred surfaces of trees or shrubs with a paint prepared especially for tree surgery.
- B. Protect benchmarks and existing structures, roads, sidewalks, paving, and curbs against damage from vehicular or foot traffic.
- C. Maintain designated temporary roadways, walkways, and detours for vehicular and pedestrian traffic.
- D. It is mandatory that the contractor employ construction methods and techniques that will not cause unnecessary environmental impact. The contractor will enforce ecologically sound construction practices to ensure acceptance by the Owner and the public and minimal environmental impact and, comply with environmental laws and regulations.
- E. Any unreasonable environmental impacts or potential noncompliance issue as determined by the appropriate regulatory agency, shall be noted and rectified at the contractor's expense, to the satisfaction of the Owner and the appropriate regulatory agency.
- F. Care shall be taken to avoid oil or chemical spills while working in or near bodies of water. Oil and fuels near bodies of water where, they can reasonably be expected to discharge to watercourses, shall be diked so that the spill can be retained until cleaned up. Any spills will be reported immediately to the Owner and Engineer.
- G. Maintenance of equipment shall not cause damage to the area being cleared and grubbed. Equipment fluids shall not drip or be drained onto any surface area. If a release occurs, notify the Owner and Engineer, and the contractor shall remediate the affected area to the satisfaction of the Owner and appropriate regulatory agency.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Backfill and fill materials shall be free of clay, rock or gravel larger than 2" in any

- dimension, debris, waste, frozen materials, vegetable and other deleterious matter.
- B. Subbase material shall be a naturally or artificially graded mixture of crushed gravel or crushed stone.
 - C. Topsoil shall be friable clay loam surface soil found in a depth of not less than 4", free of subsoil, clay lumps, stones, and other objects over 2" in diameter and without weeds, roots or other objectionable material.

PART 3 - PRODUCTS

3.01 PREPARATION

- A. Maintain benchmarks, monuments, and other reference points. Re-establish if disturbed or destroyed at no cost to Owner.
- B. Provide a minimum of 72 hours notice to property owners whose property will potentially be disturbed.

3.02 CLEARING AND GRUBBING

- A. Clear rights-of-way, easements, borrow pit, and other stockpile areas of objectionable material to the ground surface except for trees and stumps.
- B. Cut trees and stumps outside the construction area marked for removal by the Engineer to within six (6") inches of the ground surface.
- C. Remove low hanging, unsound, or unsightly branches on trees or shrubs designated to remain. All branches shall be cut at the appropriate branch collars.
- D. Grub construction area of protruding obstructions except sound undisturbed stumps and roots six (6") inches or less above the ground which will be a minimum of five (5') feet below subgrade or embankment slope provided undercutting, topsoil stripping, or other corrective measures are not stipulated.
- E. Areas required for embankment construction, all stumps, roots, etc., shall be removed to a depth of minimum of five (5) feet below the existing ground surface.
- F. Herbicide use shall only be Environmental Protection Agency (EPA) approved materials and shall be applied in accordance with manufacturer recommendations. Use of herbicides must be approved by the Owner.
- G. Rights-of-way and easements will be completely clear within their total width.
- H. Grub borrow pit and stockpile areas of all objectionable material. Strip overburden over the material to be obtained in stockpile areas.
- I. Perform clearing and grubbing well in advance of construction or material removal

activities.

- J. Fences are to be maintained at all times. Under no circumstances is a fence to be let down or cut without prior arrangement with the property owner. If fences are damaged, the contractor shall repair and put the fence in first class condition entirely acceptable to the property owner. Repair work is to be accomplished at time of damage, or as soon thereafter as possible at the sole expense of the Contractor
- K. Wherever feasible, access to right-of-way and/or easement shall be through an existing gate (with agreement of the property owner). The gate shall be closed immediately after each passage. Any agreements with property owners shall be obtained in writing. Copies of agreements shall be provided to the Owner and Engineer prior to proceeding.

3.03 USE OF CHEMICALS AND SPRAYS

- A. All Right-of-Way/Easement spraying shall be performed by a certified and licensed applicator. Contractor shall be responsible for purchasing, storing, and furnishing chemicals to its crews. Engineer and Owner shall be consulted prior to any use of chemicals or sprays by Contractor.
- B. Spraying of right of way/easements may be done at various locations using suitable herbicides to control vegetation particular to that location. Detailed records of the applicator's name, property owner permission, date, location, amount and type of herbicide used shall be kept and copies furnished to the Owner and Engineer on a routine basis or upon completion of the job. Prior to commencement of any Work involving the application of chemicals, the Contractor shall thoroughly familiarize and inform himself of all local conditions and other factors which could or might affect chemical spraying.
- C. Unless otherwise specified by the Owner or Engineer, the Contractor shall mix and apply the chemicals in accordance with the recommendations of the manufacturer, and the following general specifications:
 - 1. For Foliage Application: This method shall be used only on brush over three (3) feet in average height during the active plant growth period, generally between May 1 and September 1. Chemical mixture shall be applied to completely wet the entire leaf, stem and trunk surface of each plant.
 - 2. For Basal Application: This method shall be used on brush of any size at any season of the year. Chemical mixture shall be applied to completely wet the entire surface of the stem or trunk from the root crown up the stem eighteen (18) inches, with emphasis on completely wetting the root crown.
 - 3. For Stump Application: This method shall be used on all new stumps at any season of the year. Stumps shall be sprayed as soon as practical, but always on the same day that the cutting is performed. Chemical mixture shall be applied in sufficient volume to completely wet the sapwood, bark area, root crown and any exposed roots.

- D. No spraying shall be done within thirty (30) minutes after fog, dew, or rain events sufficiently heavy to cause runoff.
- E. Contractor shall not spray any portion of a Right-of-Way or Easement where damages to crops, orchards, or ornamental plants may result from chemical drift.
- F. Owner or Engineer will have the right to specify when and where chemical application and/or chemical spraying will be used in rural areas or otherwise.
- G. Contractor's use of chemicals in connection with the Work shall be in strict compliance with all federal and state laws, rules and regulations which from time to time govern the use of chemicals, including but not limited to the Tennessee Hazardous Chemical Right to Know How (T.C.A. Section 5032001,et seq.), the Tennessee Hazardous Substance Act (T.C.A. Section 6827101,et seq.), the Tennessee Application of Pesticides Act of 1978 (T.C.A. Section 6221101,et seq.), the Federal Insecticide, Fungicide and Rodenticide Act (7 U.S.C. Section 136, et seq.), and the Federal Hazard Communications Standard (29 CFR 1910.1200). By undertaking to perform any part of the Work in which chemicals are used, the Contractor certifies that Contractor is familiar with, has complied with, and at all times will comply with all requirements (including but not limited to those relating to training and the giving and posting of all required notices) under all of the foregoing laws, rules and regulations and further, the Contractor shall indemnify and hold harmless the Owner and Engineer against any liability, claim, demand, cause of action of every kind and description, damage, losses and expenses, including attorney's fees through appeals, arising or resulting from the Contractor's noncompliance with or violation of any of the foregoing laws, rules or regulations.
- H. Contractor shall be solely responsible for the accurate recording and submission of all forms required by the applicable regulatory agencies and other governing authorities in connection with the use of chemicals.
- I. Chemical spills shall be immediately cleaned up in a manner consistent with label restrictions, Federal and State regulations, and acceptable environmental procedures mandated by law, as well as, notify the Owner and Engineer. Any and all notifications to proper authorities in connection with such spills shall be made by the Contractor. Each crew responsible for chemical applications shall be supplied with a suitable spill response kit for cleaning up and neutralizing spills of chemicals, all at the sole expense of the Contractor. Contractor shall insure that its employees are trained in the proper techniques for spill response, and are supplied with the necessary personal protective equipment required to perform spill mitigation duties.
- J. Contractor shall at all times be solely responsible for the continuous safeguarding of its workforce, including compliance with all applicable Federal, State, and

local laws, together with its responsibilities for training its employees in the proper methods and use of personal protective equipment required for handling chemicals used in connection with this Work.

3.04 BACKFILLING AND SURFACE PREPARATION

- A. Backfill and compact all depressions resulting from clearing and grubbing with suitable materials.
 - 1. Backfill embankment areas to natural ground elevation.
 - 2. Backfill excavation areas below finished subgrade to finish subgrade.
- B. Perform backfilling a satisfactory distance ahead of construction operations.
- C. Prepare areas designated on the drawings to receive erosion control matting to smooth surfaces that have been shaped, fertilized, and seeded.
- D. All depressions/holes remaining after clearing and grubbing shall be backfilled and tamped as directed by the Engineer. In areas to be immediately excavated, the Engineer may direct that the holes may not be backfilled.
- E. The entire area will be repaired to prevent ponding of water and to provide drainage.
- F. All disturbed areas shall be restored in accordance with Section 02260 Finish Grading and Section 02485 Seeding

3.05 FILL

- A. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break up sloped surfaces steeper than 4:1 so that fill material will bond with existing surface.
- B. Place backfill and fill materials in layers not more than 8" in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.

3.06 GRADING

- A. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grade areas adjacent to building lines to drain away from structures and to prevent

ponding. Finish surfaces to be free from irregular surface changes.

- C. Grade surface of fill under building slabs smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades to within a tolerance of 1/4" when tested with a 10 ft. straightedge.
- D. Ditches shall be cut accurately to the cross section and grades indicated on the drawings or as directed by the Engineer. All roots, stumps and other foreign matter shall be cut below the finished surface of the ditch and backfilled to the true section and grade.

3.06 COMPACTION

- A. For structures, building slabs and steps, the top 12" of subgrade and each layer of backfill or fill material must be compacted to 95% maximum density for cohesionless soils, and to 90% maximum density for cohesive soil material.
- B. For streets, parking areas, and walks, the top 6" of subgrade and each layer of backfill or fill material must be compacted to 95% maximum density for cohesionless soils, and to 90% maximum density for cohesive soil material.
- C. Areas to be landscaped or to remain unimproved should not be compacted, and heavy equipment should not be allowed to pass over these areas except to spread topsoil at the completion of construction.

3.07 DEBRIS REMOVAL

- A. Promptly remove cleared debris from site.
- B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.
- C. Under no circumstances are brush, trees, and debris to be buried within the property, right-of-way, easements, borrow pit, and other stockpile areas.

3.08 CLEAN-UP

- A. Upon acceptance of the Work, the Contractor shall reinstate the Project areas affected by the operations.
- B. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of excavating or other equipment and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and at the sole expense of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.
- C. Protect newly graded areas from traffic and erosion, and keep free of trash and debris.

- D. Remove waste materials, including unacceptable excavated material, trash and debris, from the project vicinity and dispose of it in a legal manner.

3.09 MEASUREMENT AND PAYMENT

- A. Measurement of clearing and grubbing area will not be made unless it is identified as a Unit Price Item on the Bid Form.
- B. Payment for clearing and grubbing shown on the drawings or specified herein shall be included in the work with which they are associated.
- C. Clearing and grubbing will be considered subsidiary to the subsequent bid item unless a specific bid item is provided in the proposal. All work performed in clearing and grubbing areas not so designated on the Plans or in the Special Provisions, will not be paid for directly but shall be considered subsidiary work pertaining to the various bid items.
- D. Payment will not be made for unauthorized work.
- E. If a specific bid item is included in the bid proposal, all work performed will be paid for at the unit price bid for clearing and grubbing or as a lump sum price according to the bid proposal. Price shall include full compensation for furnishing all labor, materials, equipment, tools, supplies, and incidentals necessary to complete the work.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 01050: Field Engineering
- B. Section 01150: Measurement and Payment
- C. Section 01530: Barriers
- D. Section 01570: Traffic Regulations
- E. Section 01720: Project Record Documents
- F. Section 02100: Erosion Control
- G. Section 02260: Finish Grading
- H. Section 02485: Seeding

1.02 JOB CONDITIONS

- A. Provide for uninterrupted surface water flow during the work. Provide means whereby storm water can be uninterrupted in existing gutters and surface drains, or temporary drains.
- B. All pipe shall be installed in a dry trench. No extra compensation shall be allowed for trench dewatering.
- C. Immediately notify the Engineer of any unexpected subsurface or other unforeseen conditions. Discontinue work in area until Engineer provides notification to resume work.
- D. Existing utilities, poles, service lines, fences, structures, trees, shrubs, or other improvements encountered during the construction, whether above or below ground, shall be protected by the Contractor. Any item damaged or removed by the Contractor shall be repaired or replaced at the Contractor's expense to at least its original condition and to the satisfaction of the Owner. It shall be the Contractor's responsibility to locate any existing utilities in the path of construction.
- E. Adjacent structures which may be damaged by excavation work shall be underpinned or supported by other means.
- F. Excavations shall be protected by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave in or loose dirt from falling into excavation.

1.03 PERMITS

- A. Permits shall be obtained from authorities having jurisdiction prior to any

explosives being brought to the site. The Contractor shall be responsible for providing such insurance that is required to hold the Owner harmless from any claims that may arise due to blasting operations at the site. The minimum insurance requirement will be that which is outlined in the General Conditions.

- B. All conditions set forth in the Corps of Engineers 404 Permit and Tennessee Valley Authority 26A Permit (if applicable) shall be strictly adhered to. The Owner shall obtain the appropriate permit.

1.04 QUALITY ASSURANCE

- A. Adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the work in this section shall be used.
- B. Equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner shall be used.

PART 2 - PRODUCTS

2.01 SANITARY SEWERS

A. BEDDING MATERIAL

- 1. Angular gravel, crushed gravel, or crushed limestone meeting the following gradation requirements set forth in ASTM 33 shall be used:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
1"	100
3/4"	90 - 100
1/2"	20 - 55
3/8"	0 - 15
#4	0 - 5

- 2. Shall be used for bedding, haunching, and initial backfill of PVC pipe. (See Detail 1 at end of this section).
- 3. Shall be used for bedding and haunching of Ductile Iron Pipe.
- 4. Frozen materials shall not be used.

B. BACKFILL MATERIALS

- 1. Material excavated from the trench, free from large stones, clods, debris, or frozen lumps shall be used:
 - a. For final backfill of PVC pipe.
 - b. For initial and final backfill of Ductile Iron Pipe.

C. CRUSHED STONE BACKFILL MATERIAL: UNDER ROADS OR AREAS TO BE PAVED

- 1. Shall be used for final backfill for all pipe under roads and in areas indicated as future roads on the drawings.

2. Material shall be approved by the Engineer.

2.02 WATER LINES

A. BEDDING MATERIALS

1. Angular gravel, crushed gravel, or crushed limestone, meeting the following gradation requirements set forth in ASTM 33:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
1"	100
3/4"	90 - 100
1/2"	20 - 55
3/8"	0 - 15
#4	0 - 5

2. Material excavated from the trench, free from large stones (any dimension greater than two (2") inches), clods, debris, or frozen lumps shall be used.
3. Borrow materials previously approved by the Engineer may be used for backfill material if suitable material is not available from trench.
4. Frozen materials shall not be used.

B. CRUSHED STONE MATERIAL SHALL BE USED AS FOLLOWS:

1. On road crossings where open cut crossings are made, crushed stone shall be used for bedding, haunching, and backfill. (See Typical Details at back of Project Manual).
2. In areas where rock excavation is required for installation of pipe, crushed stone shall be used for bedding, haunching, and initial backfill.
3. In other areas as directed by the Owner or Engineer and not otherwise required by the Contract Documents, crushed stone shall be replaced at a cost per ton previously agreed by the Owner and Contractor. The quantity of excavation work anticipated to be placed with crushed stone shall be mutually agreed to by the Contractor and the Engineer before excavation.

2.03 UNSUITABLE MATERIALS

- A. Wherever muck, soft clay or other material unsuitable for foundations, pipe beds, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. If suitable material is not encountered at a reasonable depth, the Engineer shall instruct the Contractor as to the limits of removal and procedure for stabilization
- B. The material removed shall be disposed of in a manner acceptable to the Engineer.
- C. Refill the areas excavated for this reason with TDOT Size No. 3 crushed stone up to the level of the lines, grades or cross sections shown on the Drawings. The top 6 inches of this refill shall be TDOT Size No. 67

crushed stone for bedding.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Line and grade for trench shall be established.
- B. Location of all underground utilities, existing and proposed shall be located.
- C. Location of existing sewer laterals, manholes and service connections shall be located prior to commencement of trenching.
- D. Location of existing water services, meters, and appurtenances shall be located prior to commencement of trenching.

3.02 PERFORMANCE

- A. All earthwork and trenching operations shall comply with the requirements of OSHA Construction Standards for the construction industry (29 CFR part 1926).
- B. Unless otherwise shown on the drawings or required by the specifications or authorized by the Engineer, all work shall be done in open, vertical trenches. Any sheeting driven below the level of the top of the pipe shall not be disturbed or removed. The responsibility for assessing the need for sheeting and analyzing the stresses induced shall be the total responsibility of the Contractor.
 - 1. Trench sheeting left in place shall be backfilled to a level of twelve (12") inches above the top of the pipe. It shall then be cut off and the upper portion removed.
 - 2. Sheeting for structures shall be left in place until backfill has been brought to a level of twelve (12") inches above the top of the bottom footing. It shall then be cut off and removed.
- C. Clearing, including removal of surfacing and pavement, shall be done as necessary to carry on the construction in the proper manner. Material shall be removed only to minimum width necessary to allow adequate construction area. Concrete and asphalt shall be saw cut.
- D. Trenches shall be excavated to such depth as required by the drawings. Trenches for water lines shall be excavated to such depth as required to provide a minimum of thirty (30") inches cover in all directions from the pipe wall, unless otherwise indicated. Maximum width of the trench at and below the top of the pipe shall not exceed the following widths.

PIPE SIZE	MAXIMUM WIDTH
6"	2' 6"
8"	2' 6"
10"	2' 6"
12"	2' 8"
15"	2' 10"

18"	3' 0"
21"	3' 3"
24"	3' 6"

- E. If rock is encountered in the trench, it shall be excavated in a manner approved by the Owner and as specified below:
1. No separate payment for trench rock excavation will be made. Trench excavation shall be considered unclassified.
 2. Trench shall be undercut one (') foot where rock is in the trench and backfilled with crushed stone.
 3. Drilling and blasting operations shall be conducted with due regard for the safety of persons and property in the vicinity and in strict conformity with requirements of all ordinances, laws, and regulations governing blasting and the use of explosives. Rock excavation near existing pipelines or other structures shall be conducted with the utmost of care to avoid damage.
 4. All drilling, blasting, and use of explosives shall be in strict accordance with OSHA standards for the construction industry (29 CFR part 1926).
- F. Excavated material suitable for backfilling shall be stockpiled no closer than two (2') feet from the edge of the trench and shall not obstruct crosswalks, sidewalks, or street intersections, and shall not cause unreasonable interference with travel on the streets by occupants of adjacent property. Gutters and other drainage facilities shall not be obstructed. Free access shall also be maintained to fire hydrants, mailboxes, sewer and water manholes, gas meters, or other municipal facilities.
- G. Cut the banks of trenches 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: $[(1.33 \times D) + (2 \times 10 \text{ inches})]$, where "D" represents the internal diameter of the pipe in inches.
- H. When approved in writing by the Engineer, 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.
- I. Any cut made in excess of the formula $[(1.33 \times \text{Dia. in Inches}) + (2 \times 10 \text{ inches})]$ shall be at the expense of the Contractor and may be cause for the Engineer to require that stronger pipe or a higher class of bedding be used at no cost to the Owner.
- J. For rigid pipe, shape the bottom of all trenches to provide uniform bearing for the bottom of the pipe barrel.

- K. For plastic sewer lines, provide a minimum of 6 inches of TDOT Size No. 67 crushed stone for bedding.
- L. Excavate bell holes for bell and spigot pipe at proper intervals so that the barrel of the pipe will rest for its entire length upon the trench bottom. Bell holes shall be large enough to permit proper pipe jointing. Do not excavate bell holes more than 2 joints ahead of pipe laying.
- M. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where the Engineer deems necessary to maintain vehicular or pedestrian traffic.
- N. In all cases where materials are deposited along open trenches, place them so that in the event of rain or surcharge loading from such deposits no damage will result to the work or to adjacent property.

3.03 STRUCTURE EXCAVATION

- A. Structure excavation 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 Drawings.
- B. Cut excavation without rounded corners. Allow no rock projections into the neat lines of the structures.
- C. Structure excavation may be performed with non-vertical banks except beneath pavements or adjoining existing improvements.
- D. No earth backfilling will be permitted under structures. Should the Contractor excavate below the elevations shown or specified, he shall, at his own expense, fill the void with either concrete or granular material approved by the Engineer.
- E. Maintain excavation free from standing water.
- F. Request Engineer approval of excavation prior to structure construction/installation.

3.04 BEDDING, HAUNCHING, AND BACKFILLING

- A. Pipe shall be installed as shown on the drawings.
- B. Bedding shall be shaped and compacted to 60 percent relative density, ASTM

D2049, to provide uniform bearing of the pipe. Bell holes shall be excavated to allow for unobstructed assembly of the joint. Bell holes shall be made as small as practical. After the joint has been made, bell holes shall be filled with bedding material.

- C. After pipe is jointed and aligned, haunching material shall be installed and compacted to 60 percent relative density, ASTM D2049. Ensure material is worked under the haunch of the pipe to provide adequate side support. Precautions shall be taken to prevent movement of the pipe during placement and compaction of haunching material.
- D. Initial backfill shall be hand placed and compacted to provide cover over the pipe as detailed. Pipe shall be protected from large particles of backfill material.
- E. Balance of backfill shall be placed by a method which will not damage or displace the pipe, nor cause bridging action in the trench. Backfill material shall be compacted with earthmoving equipment as material is placed so that excessive settlement of the trench material will not occur. Material shall be neatly mounded over the trench. Trench and settled areas shall be maintained as they occur. Finish grade shall be completed to eliminate uneven areas.
- F. Where pavement is to be placed over the backfilled trench as indicated on the drawings, the backfill shall be crushed stone under the full trench depth. Under future roads, compaction will be required up to within one (1') foot of existing grade with remaining one (1') foot backfill as per paragraph 3.03. E above.

3.05 CREEK AND DITCH CROSSINGS

- A. Construct pipe encasement as shown on typical details. Concrete shall be placed in the dry. Concrete: ASTM C94, 2500 psi, at twenty-eight (28) days.
- B. Construction methods that will minimize siltation and erosion shall be utilized.
- C. All backfill shall be granular material as specified for embedment material or crusher run stone.
- D. Clean up, grading, seeding, and other restoration work shall begin immediately and exposed areas shall not remain unprotected for more than seven (7) days.

3.06 TEST FOR DISPLACEMENT OF SEWERS

- A. A check of sewer pipe shall be made to determine whether displacement has occurred after the trench has been backfilled to above the pipe and has been compacted as specified.
- B. A light shall be flashed between manholes or between locations of manholes with a flash light or sun reflecting mirror.
- C. If the pipe line shows poor alignment, displaced pipes, or any other defects, defects shall be corrected to the specified conditions at no additional cost to the Owner.

3.07 TESTING OF BACKFILL

- A. A testing laboratory or the Owner shall verify compaction of the bedding and haunching material after placement and compaction.

END OF SECTION

SECTION 02225

HIGHWAY CROSSING

PART 1 - GENERAL

1.01 GENERAL

- A. All pipelines crossing highways, streets, and elsewhere if shown on the plans, shall be in a casing pipe installed by open cut or bored and jacked as called for on the plans.
- B. Where open cut is permitted, not more than one half of the traveled way shall be closed to traffic at any one time.
- C. Crossing permits or permission will be obtained by the Owner, and he shall cooperate closely with the appropriate road system owner during the construction of the crossings.

PART 2 - PRODUCTS

2.01 CARRIER PIPE

- A. Carrier pipes and joints shall be of accepted material and construction as provided in these specifications. Joints for carrier line pipe operating under pressure shall be push-on restraining gasket type. The pipe shall be laid with sufficient slack (no tension) in the line or with an expansion joint near the point of crossing.

2.02 CASING PIPE

- A. Casing pipes and joints shall be of leakproof construction and conform to the following.

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE	
Normal Thickness Inches	Normal Diameter Inches
0.188	Under 14
0.219	14 & 16
0.250	18
0.281	20
0.312	22
0.344	24
0.375	26
0.406	28 & 30
0.438	32
0.469	34 & 36
0.500	38, 40 & 42

Steel pipe shall have a minimum yield strength of 35,000 psi.

- B. Casing pipe may have a bituminous coating, applied cold, which shall be Koppers Company, Inc., bitumastic No. 50, Reilly Ca No 5, Barrett Coal Tar Paint No. 34 YB, or approved equal. The coating shall be applied in accordance with the manufacturer's direction. The coating shall be thinned only when permitted by the Engineer and then with not more than 5 percent of an approved solvent. The consistency of the coating shall be such that it can be applied easily with a brush or spray in one (1) coat to a coverage not greater than 70 square feet per gallon on smooth metal. One (1) coat approximately 1/32-inch thick on a plate suspended vertically shall show no appreciable flowing or sagging while still wet. The material shall dry to a firm film within twenty-four (24) hours at 75 degrees F to 80 degrees F, at a spreading rate of 70 square feet per gallon.
- C. When casing is installed without benefit of a protective coating, the wall thickness shown above shall be increased at the nearest standard size, which is a minimum of 0.063 inches greater than the thickness shown except for diameters under 12-3/4 inches.
- D. Cast iron pipe may be used for casing provided the method of installation is by open trench. Cast iron pipe shall conform to American Standard's Association Specification A21. The pipe shall be of the mechanical joint type or plain end pipe with compression type couplings. The strength of cast iron pipe to sustain external loads shall be computed in accordance with ASA A21.1 "Manual for the Computation of Strength and Thickness of Cast Iron Pipe".
- E. The inside diameter of the casing pipe shall be at least two (2") inches greater than the largest outside diameter of the carrier pipe, joints, or couplings for carrier pipe less than six (6") inches in diameter; and at least four (4") inches greater for carrier pipe, unless otherwise sized on the drawings or specified in the Bid Proposal. It shall, in all cases, be great enough to allow the carrier pipe to be removed subsequently without disturbing the casing pipe or roadway.

2.03 CARRIER PIPE BLOCKING

- A. The carrier pipe shall be blocked inside the casing pipe to support the load of the carrier pipe and its contents throughout the barrel section of the pipe; with no load carried by the bell or coupling section.
- B. The carrier pipe blocking shall support the carrier pipe in the approximate center of the casing pipe with minimum clearance between the blocking and the casing pipe to prevent lateral or vertical movement of the carrier pipe.
- C. The carrier pipe blocking shall be either fabricated steel split blocks or fabricated steel and polyethylene blocks specifically designed for the purpose. Carrier pipe blocking shall provide support at three (3) points around the circumference of the carrier pipe, and shall be spaced as follows:
 - 1. Fabricated blocking shall be three (3) per eighteen (18') foot joint of pipe four (4') feet from each end of the eighteen (18') foot length of pipe and at the center of each length.

2. Blocking/spacers shall be designed for use with restrained joint pipe.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Casing pipe shall be installed as to prevent leakage of any substance from the casing throughout its length, except at ends. Casing shall be installed as to prevent the formation of a waterway under the roadway with an even bearing throughout its length, and shall slope to one end. Installation by open trench methods shall comply with Department of Highways Specifications covering "Installation of Pipe Culverts".
- B. Where the ends of the casing are below ground, they shall be suitably protected against the entrance of foreign material, but shall not be tightly sealed.
- C. Where the ends of the casing are at or above ground surface and above high water level, they may be left open, provided drainage is afforded in such a manner that leakage will be conducted away from roadway or structures.

END OF SECTION

SECTION 02260
FINISH GRADING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 02221: Trenching, Backfilling, and Compacting

1.02 SITE COMPACTION TESTING

- A. Testing of compacted fill materials shall be performed by an independent testing laboratory appointed and paid for in accordance with Section 01410.
- B. When work of this section or portions of work are completed, notify the testing laboratory to perform density tests. Do not proceed with additional portions of work until results have been verified.
- C. If, during progress work, tests indicate that compacted materials do not meet specified requirements, remove defective work, replace, and retest at no cost to Owner.

1.03 SAMPLES

- A. Submit minimum ten (10 lb.) pound samples of each type of excavated fill material to be used. Forward samples to testing laboratory, packed tightly in containers to prevent contamination.
- B. If recent test results are available for fill materials to be used, disregard sample submission and submit such test results to the testing laboratory for approval. Such test results are to clearly indicate types of materials and composition, hardness, compactability, and suitability for proposed usage.

1.04 PROTECTION

- A. Prevent damage to existing fencing, trees, landscaping, natural features, benchmarks, pavement, utility lines, and structures. Correct damage at no cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil: Friable loam free from subsoil, roots, grass, excessive amount of weeds, stones and foreign matter; acidity range (pH) of 5.5 to 17.5; containing a minimum of four (4%) percent and a maximum of twenty-five (25%) percent organic matter. Use topsoil stockpiled on site if conforming to these requirements.

PART 3 - EXECUTION

3.01 SUB-SOIL PREPARATION

- A. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, and etc., in excess of three (3") inches in size. Remove sub-soil which has been contaminated with petroleum products.
- B. Cut out areas, to sub-grade elevation, which has been contaminated with petroleum products.
- C. Bring sub-soil to required levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- D. Slope grade away from building minimum two (2") inches in ten (10') feet unless indicated otherwise on drawings.
- E. Cultivate sub-grade to a depth of three (3") inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted sub-soil.
- F. Compact sub-soil to the following:
 - 1. Under Topsoil: 85 percent modified Proctor, ASTM D1557.
 - 2. Under Streets, Drives, and Parking Areas: 95 percent modified Proctor ASTM D1557.
 - 3. Under Walks: 85 percent modified Proctor, ASTM D1557.

3.02 PLACING TOPSOIL

- A. Place topsoil in areas where seeding and planting is to be performed. Place to the following minimum depths, up to finished grade elevations.
 - 1. Six (6") inches for seeded areas.
 - 2. Twenty-four (24") inches for shrub beds.
- B. Use topsoil in relatively dry state. Place during dry weather.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of sub-grades.
- D. Remove stone, roots, grass, weeds, debris, and other foreign material while spreading.
- E. Manually spread topsoil around trees, plants, and buildings to prevent damage which may be caused by grading equipment.
- F. Lightly compact placed topsoil.

3.03 SURPLUS MATERIAL

- A. Remove surplus sub-soil and topsoil from site.

- B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 02485

SEEDING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 01310: Construction Schedules
- B. Section 01560: Temporary Controls
- C. Section 01700: Contract Closeout
- D. Section 02100: Erosion Control
- E. Section 02260: Finish Grading

1.02 QUALITY ASSURANCE

- A. Seeds shall meet the requirements of the Official Seed Analysis of North America.
- B. Contractor shall provide sod where applicable for exotic grasses such as, Zoysia, Bermuda etc. The contractor and field representative shall meet with the property owner to discuss re-establishing the disturbed areas.
- C. Sod shall meet the requirements of the local producer members of Turfgrass Producers International, (TPI). TPI should be consulted on all sodding projects to gain information related to “micro-climates” and other localized conditions that could affect selection, installation and overall satisfaction with a newly sodded area.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed in original containers showing analysis of seed mixture, percentage or purse seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Every shipment of sod shall be accompanied by an invoice or sales slip indicating whether the material is of a single variety, a blend or a mixture, species, and the quality grade of the shipment.

PART 2 - PRODUCTS

2.01 FERTILIZER

- A. Commercial type, 10-20-10 grade, granular type.
- B. Sod type, 16-16-16 grade, granular type.

- C. All fertilizers shall be uniform in composition, free flowing and suitable for application with approved equipment. Fertilizers shall be delivered to the site fully labeled, according to applicable fertilizer laws and shall bear the name, trade name or trademark, and warranty of the producer or manufacturer.

2.02 SEEDS

- A. Vegetation and re-vegetation of lawn type areas where scheduled maintenance and up keep are desired and will be necessary to preserve the quality and appearance of the mature ground cover.
1. Type "A" mixtures of the following:
 - (a) Type "A-1" mixture as required to match existing vegetation
 - (b) Type "A-2" Mixture of turf type tall fescue and rye consisting of: 60% turf type tall fescue -(30% certified Rebel II)(30% certified Titan) 40% turf type perennial -Rye (Palmer)
 2. Purity: 98 percent
 3. Germination: 90 percent
 4. Weed Seed: Less than 0.5 percent
- B. General vegetation and re-vegetation of pipeline trenches, tank and pump station sites, pastures, and roadway slopes where minimum maintenance and up keep are required.
1. Type "B" mixtures of the following:
 - (a) Type B-1, non-seasonal, mixture-KY-31 tall fescue - 50%, annual rye - 50%
 - (b) Type B-2, seasonal, shall consist of the following;

TIME OF YEAR	TYPE	_% (BY WEIGHT)
February-May	KY-31 Tall Fescue	80%
	English Rye	5%
	Korean Lespedeza	15%
June-September	KY-31 Tall Fescue	55
	English Rye	20
	Korean Lespedeza	15
	German Millet	10
October-January	KY-31 Tall Fescue	70
	English Rye	20
	White Clover	10
	Purity	90
	Germination	90
	Weed Seed	less than 1%
	Phyter Tall Fescue (Fungus free) shall be used in all pasture applications, with Ky-31 Tall Fescue used in other applications	

- C. Vegetation and re-vegetation of slopes greater than 3:1 or as may be otherwise specified elsewhere in the contract documents where superior soil protection, erosion prevention, and minimum maintenance and upkeep are required.
 - 1. Type "C": Mixture of the following mixture:
 - (a) Type C-1, same as Type "B"
 - (b) Type C-2, preferred for slopes of 2:1 and greater, shall consist of the following:
 - Crown Vetch: 25%
 - Ky-31 Tall Fescue: 70%
 - English Rye: 5%
 - 2. Purity: 90%
 - 3. Germination: 90%
 - 4. Weed Seed: Less than 1.0 percent
 - 5. Type C-2 shall be applied with use of a TDOT approved soil inoculant to stimulate reproduction at the rate specified by the manufacturer of the produce selected.
 - 6. Phyter Tall Fescue (Fungus Free) shall be used in all pasture applications, with KY-31 tall Fescue used in other applications.

2.03 MULCH

- A. Non-toxic to vegetation and to the germination of seed, free from noxious seeds and weed seeds, and fresh.
 - 1. Hand or machine placement - Wheat, rye, or oat straw, air dried.
 - 2. Hydro-placement - wheat, rye or oat straw; shredded newspaper or peanut hulls, or other as approved by the Engineer.
- B. Asphalt Emulsion: SS-1.

2.04 SOD

- A. Sod shall be of good quality, free of weeds, disease, and insects and of good color and density
- B. Thickness of Cut: Sod shall be machine cut at a uniform soil thickness of 0.60 inch, plus or minus 0.25 inch, at the time of cutting. Measurement for thickness shall exclude top growth and thatch.
- C. Pad Size: Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus 0.5 inch (15 mm) on width and plus or minus five percent on length. Broken pads and torn or uneven ends will not be acceptable.
- D. Strength of Turf Sod Sections: Standard size sections of sod shall be strong enough that it can be picked up and handled without damage.

- E. Moisture Content: Sod shall not be harvested or transplanted when its moisture content (excessively dry or wet) may adversely affect its survival.
- F. Time Limitations: Sod shall be harvested, delivered and installed/transplanted within a period of 24 hours, unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected and approved by the field representative prior to its installation.
- G. Delivery and Off-Loading: Sod shall be delivered to the site specified in this contract and off-loaded using equipment furnished by the sod supply contractor. Palletized or large-roll sod shall be off-loaded at the location(s) designated for this purpose at the installation site.

2.04 LIME

- A. Agricultural ground limestone, minimum eighty (80%) percent passing No. 8 sieve, with a minimum 80 percent calcium carbonate equivalent.
- B. One (1) or both percentages greater than eighty (80) so that multiplication of the percent passing No. 8 sieve by the percent of calcium carbonate equivalent will be at least 0.72.

2.05 APPLICATION RATES

- A. Fertilizer: Ten (10 lb.) pounds per 1,000 sq. ft.
- B. Seeds:
 - 1. Type A 5.0 lbs/1000 sq. ft.
 - 2. Type B 5.5 lbs/1000 sq. ft.
 - 3. Type C 6.0 lbs/1000 sq. ft.
- C. Mulch: Two (2") inch thickness, loose measure.
- D. Asphalt Emulsion: 100 gallons per ton mulch.
- E. Lime: 75 lbs/1,000 sq. ft.

PART 3 - EXECUTION

3.01 PREPARATION

- A. When soil is in a tillable condition, cultivate to a depth of four (4") inches, reducing soil particles to a size no larger than two (2") inches for Type "B" and "C" seeding and one (1") inch for type "A" seeding.
- B. Assure seed bed is level and free of weeds, clods, stones, root, sticks, rivulets, gullies, crusting, and caking.
- C. Slopes greater than twenty (20%) percent shall be "raked" or "tracked" to produce horizontal grades following the surface contours to assist establishment of vegetation cover and reduce wash-off before germination.
- D. Preparation of areas designated for type "C" grassing. Disturbed area shall be:

1. Brought to general contours three (3") inches below finished grades and prepared in accordance with 3.01, A and B.
 2. The surface shall be tightened by "tracking" using a single pass of a D-6 class track machine with a minimum of eighty (80%) percent pad depth, on earth tracks traveling vertically up and down the slope.
 3. Top soil shall be placed to a uniform depth at four (4") inches over the area to bring the site up to finished grade elevations.
 4. Should seeding methods other than hydro-seeding be approved by the Engineer, lime and fertilizer shall be placed at this time.
 5. The surface shall be tightened by "tracking" using a final single pass of a D-6 class track machine with a minimum of eighty (80%) percent pad depth, on earth tracks traveling vertically up and down the slope. Care should be taken to establish and protect a uniform "tracking" pattern over the entire surface to assist the establishment of vegetation cover and reduce wash-off before germination.
 6. Areas that cannot be "tracked" as outlined in 3.01 - C-5 above shall be hand raked to establish horizontal lines following the surface contours.
- E. Preparation for disturbed areas for sod replacement shall be:
1. Brought to general contours to a point equivalent to the thickness of the cut below finished grades and prepared in accordance with 3.01, A and B.
 2. Moistening the Soil: During periods of higher than optimal temperature for the species being specified, and after all unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to installation of the sod.
 3. Starter Strip: The first row of sod shall be laid in a straight line, with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the pieces are not stretched or overlapped and that all joints are butted tightly to prevent voids that would cause air drying of the roots.
 4. Sloping Surfaces: On 3:1 or greater slopes, traditional size (1 sq yd / 1 sq m) sod shall be laid across the angle of the slope (perpendicular), with staggered joints and secured by tamping, pegging, stapling or other approved methods of temporarily securing each piece. Large-roll sod shall be laid in the direction of the slope, with temporary securing being at the discretion of the field representative.
 5. Swales and Intermittent Waterways: The installation of sod within drainage ways or intermittent waterways shall be determined after considering maximum channel velocities for storms of a designated intensity. Traditional size sod shall be laid perpendicular to the direction of flow and pegged to resist washout during the establishment period, while large-roll pieces shall be laid in the direction of the flow, with temporary securing being at the discretion of the field representative.

6. Watering and Rolling: The installation contractor shall water the sod immediately after transplanting to prevent drying. As sodding is completed in any one section, the entire area shall be lightly rolled. It shall then be thoroughly watered to a depth sufficient to ensure the underside of the new sod pad and soil immediately below the pad are thoroughly wet. The general contractor shall be responsible for having adequate water available at the site prior to and during installation.

3.02 FERTILIZING AND LIMING

- A. Fertilizer and lime placed mechanically shall be applied separately and mixed into the top two (2") inches of soil. Apply within forty-eight (48) hours of seeding.

3.03 MULCHING AND SEEDING

- A. Seed: Apply over the prepared area using methods that will produce a uniform application to the entire area.
- B. Mulch:
 1. Apply mulch uniformly over the area after seeding.
 2. Application shall be undertaken in a manner as to minimize bald and tightly clumped spots in the mulch that will adversely effect the seed germination and growth.
 3. Mulch shall be tacked with SS-1 or other methods as approved by the Engineer to hold mulch in place until development of the vegetation cover.
- C. Hydroseeding: Apply complete mix of fertilizer, lime, seed, and mulch uniformly over the entire area to produce a final application free of bald or weak spots and of the rates specified herein.

3.04 MAINTENANCE PERIOD

- A. Maintenance Period: Until final acceptance.

3.05 MAINTENANCE

- A. Maintain surfaces; supply additional topsoil and re-seed/sod where necessary, including areas affected by erosion.
- B. Water the entire area to ensure uniform seed germination, establish sod root system and re-water regularly to keep surface of soil damp and promote proper growth.
- C. Apply water slowly so that surface of soil will not puddle and crust.
- D. The contractor shall supply adequate water to the site. The single-most important factor in the successful rooting of newly installed sod/seeding is adequate, regular watering. Watering should begin immediately after installation. The amount of water required will vary depending upon season, weather, temperature, wind, slope, and sod/seed variety. The contractor shall ensure adequate water supply and application.

1. First Week: The contractor shall provide all labor and arrange for all watering necessary for rooting of the sod/seed. Soil on sod pads shall be kept moist at all times. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least four (4) inches. Watering should be done during the heat of the day to prevent wilting.
2. Second and Subsequent Weeks: The contractor shall water the sod/seed as required by the manufacturer to maintain adequate moisture in the upper four (4) inches of soil, necessary for the promotion of deep root growth.

3.06 ACCEPTANCE

- A. Seeded/Sodded areas will be accepted at end of maintenance period when seeded/sodded areas are properly established and otherwise acceptable.

END OF SECTION

SECTION 02540

SEWER FLOW CONTROL AND BYPASS PUMPING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Sewer flow control required to perform sewer line replacement, television inspection, sewer line testing, and sewer line sealing. Flow control is required for all sewer line replacements and when sewer line flow is greater than one-third of the pipe diameter when inspecting pipe.

1.02 RELATED DOCUMENTS

- A. Section 01570: Traffic Regulations
- B. Section 01710: Cleaning
- C. Section 02722: Gravity Sanitary Sewers, Force Main and Appurtenances

1.03 SUBMITTALS

- A. A Flow Control Plan shall be submitted a minimum of forty-eight (48) hours prior to controlling flow. The Plan shall include, at a minimum:
 - 1. Estimate of peak flow.
 - 2. Detailed procedure for handling peak estimated flow.
 - 3. Schedule.
 - 4. Listing and informational drawings of proposed equipment including plugs, bypass pump(s), hoses, including sizes, capacities, power requirements, and material types.
 - 5. Plan for notifying sewer customers.
 - 6. Operation plan.
 - 7. Emergency procedures.
- B. Owner and Engineer will review the plan and either approve or comment on its contents. Contractor shall address comments and satisfy Owner and Engineer that the plan is sound and, that it will adequately address both low flows and peak flows within the portion of the collection system being affected by the work.

1.04 JOB CONDITIONS

- A. Notify the Engineer immediately if unusual or unexpected conditions are encountered. Discontinue Work until Engineer provides notification to resume Work.
- B. All Work in streets and roadways shall be conducted in strict accordance with provisions of Section 01570.
- C. Contractor shall plan the Work and arrange the Work schedules to minimize the length of the time sewer service is interrupted.

1.05 QUALITY ASSURANCE

- A. Adequate numbers of skilled workman who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specific requirements and the methods needed for proper performance of the Work in this section shall be provided and used to complete the work. Equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner shall be provided and used to complete the Work.
- B. Contractor shall provide an adequate on-the-job supervisor of all Work and workmen to assure the Work meets all requirements of the Contract.

PART 2 - PRODUCTS

2.01 FLOW CONTROL SYSTEMS

- A. Provide adequate capacity and sized equipment to handle estimated flows. Equipment shall be capable of handling a minimum of 150 percent of the estimated peak flow.
- B. Plugs shall include connections for pressure gauges and air hoses and, shall include flow through capability. For pipe sizes less than twenty-four (24") inches, plugs shall be mechanical type with rubber gaskets or, shall be pneumatic type with rubber boots. For pipe sizes twenty-four (24") inches or greater, plugs shall be two piece inflatable bag stoppers.
- C. Discharge piping shall be HDPE or DIP and shall be leak free, with butt-fused (HDPE) or rubber gasketed (DIP) joints. Discharge piping may be reused on subsequent placements if approved by the Owner.
- D. Flexible discharge piping may be used for low pressure flow control and low flow conditions, as determined by the Contractor. Flexible discharge hoses may not be used for controlling flow from sewer pipe sizes in excess of ten (10") inches.
- E. Bypass pumps shall be fully automatic self-priming units. Pumps shall be designed to handle a minimum of three (3") inch diameter solid and shall be capable for running dry for long periods of time without pump/ motor failure. Engines shall be low noise type (max ninety (90) decibels at fifty (50') feet). Provide one stand-by pump of each type utilized for the work.

PART 3 – EXECUTION

3.01 GENERAL

- A. Secure approval of "Traffic Control Plan" prior to working in roadways.
- B. Install barriers, signs and other devices to identify and protect the work site and all adjacent areas.
- C. Notify all properties that will or potentially have sewer service disruptions due to the planned work activities.
- D. Notify Owner a minimum of forty-eight (48) hours prior to implementing system.

- E. Operate and maintain the system seven (7) days per week and twenty-four (24) hours per day, no exceptions.
- F. Eliminate all flow from sewer line sections where point repairs, service connections, manhole construction, pipe replacement or rehabilitation are to occur.
- G. Remove flow control equipment and accessories after work is completed and pipe section is placed back into service, with approval of the Owner.

3.02 PLUGGING AND BLOCKING

- A. A sewer line plug shall be inserted into the lines upstream of the line section being worked. Secondary plugs are required where pipe diameters exceed ten (10") inches.
- B. Plugs shall be so designed that all or any portion of the sewage can be released. During TV inspection, testing and sealing operations, flow shall be reduced to within the limits specified above.
- C. After the Work has been completed, flow shall be restored to normal in controlled, gradual manner such that downstream surcharging is prevented.
- D. Temporary plugs shall be removed at the end of each day if the downstream pipe sections are capable of handling the restored flow.

3.03 PUMPING AND BYPASSING

- A. When pumping and bypassing is required the Contractor shall supply the pumps, conduits, and other equipment to divert the flow of sewage around the line section in which Work is to be performed.
- B. Bypass pumping shall be performed in a manner that will not damage public or private property or, create a nuisance.
- C. Provide a minimum of 72 hours notice to customers whose sanitary sewer service will potential be interrupted.
- D. **Dumping sewage on private or public property in any form or fashion is strictly prohibited.**
- E. Contractor is responsible for all power requirements for bypass pumps and standby units.
- F. Service for disconnected sewer service connections shall be maintained in a manner approved by the Owner.

3.04 FLOW CONTROL PRECAUTIONS

- A. 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.

- B. Contractor is solely responsible for any damage to public or private property and any claims resulting from the damage, which are a result of a failure of the flow control system.
- C. Precautions must also be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

3.05 QUALITY CONTROL AND MAINTENANCE OF SYSTEMS

- A. General:
 - 1. Contractor shall perform pressure and leakage tests of the system using clean water prior to bypass operations. Tests shall be performed at a minimum of 1.5 times the maximum working pressure of the system.
 - 2. Pressure and leakage tests shall be witnessed by the Owner.
- B. Inspection and Maintenance:
 - 1. Contractor shall inspect bypass system a minimum of every two (2) hours to insure that it is operating correctly.
 - 2. Contractor shall insure that the system is properly maintained and, that an operator is on hand at all times when pumping operations are occurring.
- C. Cleaning:
 - 1. Prior to tearing down and moving the system to a different location, all sewage within the system must be flushed to an existing operable sanitary sewer main.
 - 2. Areas disturbed by the operation must be cleaned and restored, including pavements, to a condition as good as better than prior to the operation taking place.

3.06 ADDITIONAL RESPONSIBILITIES OF THE CONTRACTOR

- 1. In the event of any Contractor-related overflow or interruption/backup of customer service, the Contractor shall immediately notify the Engineer and Owner. The Contractor shall contain and eliminate the overflow/interruption.
- 2. The Contractor shall be responsible for any fines levied by others, reimbursement of any agency incurred costs, damage, cleanup, restoration of flow and any disruption of service costs to customers as a result of the Contractor's work. This in addition to any and all costs incurred by the customer.
- 3. The Contractor shall respect the rights of property owners, and not enter upon private property without obtaining permission from the owner of the property.
- 4. For manholes located in easements of private property, the Contractor shall provide the residents with 24-hour advanced notice for easement access prior to entering the property, unless the resident provides immediate permission.

3.07 CLEAN-UP

- A. Clean-up and final completion of Work.
 - 1. Upon acceptance of the Work, the Contractor shall reinstate the Project areas affected by the operations.
 - 2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of bypass pumping equipment, excavating or other equipment and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and the sole cost of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.

END OF SECTION

SECTION 02610

PAVING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 02260: Finish Grading

1.02 REFERENCE STANDARDS

- A. Tennessee Department of Transportation (TDOT) Standard Specification for Road and Bridge Construction (latest edition).
- B. American Association of State Highway and Transportation Officials.
- C. Federal Specifications - FS TT-P-115

1.03 QUALITY ASSURANCE

- A. The Owner will employ a Testing Laboratory to evaluate the materials delivered to and placed at the project site.
- B. Certificates of material compliance, signed by the material supplier and Contractor may be submitted in lieu of material testing when acceptable to the Engineer.

1.04 JOB CONDITIONS

- A. Do not apply prime and tack coats when temperature is below 50 degrees F or when base is wet. Apply asphalt concrete paving only when temperature is above 40 degrees F and when base is dry.
- B. The work shall be in conformity with the lines, grades, notes, and cross sections shown on the drawings or as directed by the Engineer.
- C. All suitable materials removed from the excavation shall be used as far as

PART 2 - PRODUCTS

2.01 MINERAL AGGREGATE BASE

- A. The crushed stone shall meet all the requirements of the TDOT Standard Specification Section 903.05 for aggregate for mineral aggregate base and surface courses.

- B. The mineral aggregate shall be crushed stone, crushed or uncrushed gravel and shall be of hard durable particles or fragments of stone, slag, gravel, and other finely divided mineral matter. Material shall be free of silt and clay.
- C. The mineral aggregate base shall be Class A.
- D. At the contractor's request, the Engineer will consider deviation from the specification but only if the request is made prior to approval of the job mix formula and at least ten (10) days prior to beginning of construction.

2.02 ASPHALT BINDER COURSE

- A. The asphalt binder course shall consist of coarse aggregate and sand, stone screenings or a combination of sand and stone screenings, uniformly mixed with asphalt cement and shall be laid upon the prepared subgrade to finished thickness of three (3") inches.
- B. The asphalt binder course shall conform to TDOT Standard Specification Section 307 Grading B.

2.03 ASPHALTIC CONCRETE SURFACE COURSE

- A. The asphaltic concrete surface course shall conform to TDOT Standard Specification Section 411 Grading E, and shall be laid in reasonably close conformity to the lines, grades, and typical sections shown on the Plans.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Paver must examine the areas and conditions under which paving is to be installed.
- B. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the work.
- C. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the paver.

3.02 SUBGRADES

- A. Each six (6") inch layer of subgrade shall be compacted to a density of not less than ninety-five (95%) percent and an average of ninety-seven (97%) percent of the maximum density as determined by the AASHTO Method T180.
- B. After the subgrade has been prepared it shall be kept free from ruts, depressions, and any damage resulting from the hauling or handling of tools and equipment.

3.03 MINERAL AGGREGATE BASE COURSE

- A. Mineral aggregate base shall be placed in accordance with TDOT Standard Specification Section 303.
- B. Base material shall be dumped on the end of the preceding spread without dumping or hauling directly on the subgrade.
- C. Equipment for spreading and grading shall be as specified in the Standard Specifications.
- D. After the spreading is completed, the entire surface shall be scarified and then shaped to produce the required grade and cross section after compaction. Water shall be required to obtain the specified density.
- E. Compaction shall be by rolling with a combination of steel wheel and rubber tied rollers until an average density of ninety-eight (98%) percent of the maximum density is reached as tested under AASHTO method T180. Apply to minimum compact thickness of six (6") inches.
- F. Tests will be paid for by the Owner and retests paid for by the Contractor.

3.04 ASPHALT BASE BINDER COURSE

- A. Equipment and construction requirements including surface preparation, mixing, spreading, finishing, and compaction shall be as prescribed in the appropriate sections of the TDOT Standard Specifications.
- B. Base binder shall be bituminous plant mix base, hot mix asphalt spread with appropriate power propelled, self contained bituminous paver.
- C. Construction shall include a black base binder course compacted to minimum thickness of three (3") inches and placed on a prepared mineral aggregate base.

3.05 ASPHALTIC CONCRETE SURFACE COURSE

- A. Asphaltic concrete surface course shall consist of constructing a 1-1/2 inch surface course on the prepared base course in accordance with these specifications and in conformity with specified tolerance with lines, grades, and typical cross sections shown on the drawings. Do not begin paving work until such conditions have been corrected and are ready to receive paving.
- B. Place asphaltic concrete mixture at not less than 225 degrees F, spread and strike off. Place inaccessible and small areas by hand.
- C. Follow TDOT Standard Specifications for general construction of the surface course as applicable to this project.

- D. Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course.
- E. Begin rolling when asphaltic concrete mixture will bear roller weight without excessive displacement.
- F. Repair surface defects with hot asphaltic concrete material as rolling progresses.
- G. Cut out and patch defective areas and roll to blend with adjacent satisfactory paving.
- H. Continue rolling until maximum density is attained and roller marks are eliminated.
- I. Protect paving from damage and vehicular traffic until asphaltic concrete mixture has cooled and attained its maximum degree of hardness.

3.06 PAVING TOLERANCES

- A. In place compacted asphaltic concrete paving will not be acceptable if exceeding the following tolerances:
 - 1. Thickness of base course - Not more than 1/2 inch plus or minus.
 - 2. Thickness of surface course - Not more than 1/4 inch plus or minus.
 - 3. Base course surface smoothness - Not more than 1/4 inch when measured with a ten (10') foot straightedge.
 - 4. Wearing course surface smoothness - Not more than 3/16 inch when measured with a ten (10') foot straightedge.

END OF SECTION

SECTION 02722

SANITARY SEWERS, FORCE MAINS AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnishing and installation of sanitary sewerage systems.

1.02 RELATED DOCUMENTS

- A. Section 01530: Barriers
- B. Section 01560: Temporary Controls
- C. Section 01570: Traffic Regulations
- D. Section 01710: Cleaning
- E. Section 02100: Erosion Control
- F. Section 02221: Trenching, Backfilling and Compacting
- G. Section 02730: Manhole Repair and Rehabilitation
- H. Section 02750: Sewer Reconstruction by Slip-Lining Method
- I. Section 02760: Sewer Reconstruction by Pipe-Bursting Method
- J. Section 02790: Sewer Line Cleaning and Closed Circuit TV Inspection

1.03 SUBMITTALS

- A. Submittals shall be submitted as specified in Section 01340, promptly and in accordance with approved schedule, in such a sequence that no delay to the work, or to the work of other Contractors is caused.
- B. Product data shall be submitted as required.
- C. Submit certification signed by manufacturer and Contractor that pipe, fittings, manholes, castings, and appurtenances meet specification requirements.
- D. Submit six (6) copies of required documents.

1.04 QUALITY ASSURANCE

- A. The Contractor shall install and test lines, fittings, valves and appurtenances in accordance with regulations issued by the Tennessee Department of Environment and Conservation and the Owner.

- B. The Contractor shall disinfect all potable water lines, fittings, valves and appurtenances in accordance with regulations issued by the Tennessee Department of Environment and Conservation.
- C. Adequate numbers of skilled workmen, who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section shall be used.
- D. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner.
- E. PVC piping shall be stored to protect from long term exposure to direct sun light and shall be stacked in suitable support systems to prevent buckling and deformation.
- F. Immediately prior to lowering pipe or fittings into the trench, each length of pipe and each component shall have the interior and mating surfaces cleaned of all dirt and foreign material.
- G. Carefully examine each pipe and fitting for cracks and other defects while suspended above the trench immediately before installation.

1.05 REFERENCES

- A. ASTM A48 - Gray Iron Casting
- B. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and sewer pipe
- C. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings
- D. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- E. ASTM C478 - Pre-Cast Reinforced Concrete Manhole Sections
- F. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- G. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures
- H. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- I. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- J. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

- K. AWWA C111 - Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
- L. AWWA C151 - Ductile-Iron Pipe Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- M. ASTM D-1248 - High Density Polyethylene Pipe
- N. National Precast Concrete Association: Quality Control Manual for Precast Concrete Plants.
- O. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Product Delivery, Storage and handling shall be in strict accordance with the manufacturer's recommendations using the best available methods to prevent damage to materials and components.
- B. PVC piping shall be stored to protect from long term exposure to direct sun light and shall be stacked in suitable support systems to prevent buckling and deformation.
- C. Protect ductile iron pipe from damage to coating and lining.

1.07 JOB CONDITIONS

- A. All Work in streets and roadways shall be conducted in strict accordance with provisions of Section 01570.
- B. Whenever pipe laying is not actively in progress, open ends of all installed pipe and fittings shall be fitted with a watertight plug.
- C. Separation of Sewers and Water Mains:
 - 1. Parallel Installation of Sewers and Water Mains
 - a. Whenever possible the sewer shall be installed at least ten (10') foot horizontally from water mains, the distance measured from edge to edge.
 - b. If local conditions prevent a horizontal separation of ten (10') foot, the sewer shall be installed in a separate trench so that the top of the sewer pipe is at least eighteen (18") inches below the bottom of the water main.
 - c. If neither of these conditions can be met the sewer shall be constructed of push-on or mechanical joint ductile-iron pipe, and the pipe pressure tested to assure water tightness prior to backfilling.

2. Crossing of Sewers and Water Mains:
 - a. Whenever possible the sewer main shall be installed below the water main so that the minimum distance between the outside of the sewer pipe and the outside of the water pipe is at least eighteen (18") inches. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - b. If local conditions prevent this separation, the sewer shall be constructed of push-on or mechanical joint ductile-iron pipe, and the pipe pressure tested to assure water-tightness prior to backfilling.
 - c. Where the water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.
- D. Sewage flow must be maintained in the existing sewers. Whenever pipe laying progresses to a point where this flow must be interrupted, the Contractor shall plug a manhole upstream of the construction and provide pump bypassing to a downstream manhole in accordance with Section 02540. All downstream pipes, manholes and appurtenances must be tested and determined to be acceptable to the Owner and the Engineer to receive sewage flow. Bypassing of raw sewage to the surface will not be permitted. Contractor shall notify the Owner, his field representative and/or other appropriate authorities and receive written remission prior to proceeding with bypassing. When working in areas where interruption of sewer flow may occur, the Contractor shall have at the site the necessary pumps, lines and all other equipment in readiness to provide pump bypassing.
- E. Contractor shall plan his Work and arrange his Work schedules, to minimize the length of time sewer service is interrupted.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE AND FITTINGS FOR GRAVITY SEWERS

- A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.
- B. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM D-3034 and have a Standard Dimension Ratio (SDR) of 35.
- C. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.
- D. All PVC gravity sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, ASTM D-3034, and NSF approval seal.

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. Pipe:
 - 1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 (AWWA C-110).
 - 2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).
 - 3. Where the pipe is shown as "Protecto 401 lined", the pipe will be lined with a ceramic epoxy lining meeting the following:
 - a. 40-mil dry film thickness lining manufactured under the name of Protecto 401.
 - b. Line interior of bell and exterior of spigot in joint sealing areas with 6 to 10 mils of specified lining.
 - c. Surface preparation: SP10 near white blast.
 - d. Pinhole detection: 2,500 volts minimum over 100 percent of lined surfaces.
 - 4. A minimum of 1 mil thick bituminous coating on the outside surface.
 - 5. Clearly mark with manufacturer's name, D.I. or Ductile, weight, class or nominal thickness, and casting period.
 - 6. Unless otherwise specified or shown on the Contract Documents, ductile iron pipe shall be pressure class 350.
- B. Fittings
 - 1. Fittings 4"-24": Pressure rated at 350 psi.
 - 2. Fittings 30"-36: Pressure rated at 250 psi.
 - 3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111).
 - 4. If specified, ceramic epoxy lining per 2.02 (3) above.
 - 5. Sewer Tee-Wye fittings shall conform to AWWA C 110

2.03 POLYVINYL CHLORIDE PIPE FOR PRESSURE SEWERS

- A. Polyvinyl Chloride Pipe (PVC), for pressure sewers: AWWA C-900 PC 235/C-905, PR 200. All pipe shall meet a minimum of 200 psi working pressure rating, and shall be marked with the manufacturer's name, nominal diameter, DR, and pressure rating.
 - 1. Fittings: Shall be Ductile-Iron (Protecto 401 Lined) as specified above.
 - 2. Joints: Shall be push-on with gaskets recommended by the manufacturer for the specific application.

2.04 AIR/VACUUM VALVES

- A. Air/Vacuum Valves shall be ARI D-025 with reinforced nylon body, all stainless steel internal parts, NPT or flanged connection, with complete flushing package.

2.05 ECCENTRIC PLUG VALVES

- A. Plug valves shall be as manufactured by Pratt or DeZurik.
- B. Plug valves shall be mechanical joint type for buried application and flanged for interior application.

- C. Body shall be cast iron plastic coated, with nickel seat.
- D. Plug shall be cast iron with resilient coating to resist corrosion and damage.
- E. Extension shafts for pedestal operators shall be stainless steel.

2.06 DETECTION TAPE

- A. Detection tape shall be required for all PVC piping installed on the Project.
- B. The tape shall consist of a minimum thickness of 0.5 mils solid aluminum foil core running the full length and width.
- C. The aluminum foil core shall be encased in a protective, high visibility, color coded, inert plastic jacket that is impervious to alkalis, acids, and solvents normally found in soil. The foil is to be visible on the unprinted side.
- D. The tape's minimum overall thickness shall be 5.5 mils, its minimum tensile strength shall be 5000 psi, and its minimum weight is shall 2.5 pounds per inch of width per 1000 feet of length. Width shall be three (3") inches.
- E. The tapes used shall be of the following colors: Blue for potable water line; red for sewer line; green for non-potable water line.
- F. The tape shall have the following printed on it in one (1") inch letters.

"CAUTION - _____ * BURIED BELOW."*

*Example only, wording to be appropriate for line type.

- G. Tape shall be placed directly over the pipe between one (1") foot and three (3") feet below finished grade and at least one (1") foot above the top of the pipe.
- H. A different color tape shall be used for each pipe carrying a different substance.

2.07 THRUST BLOCKS

- A. Concrete for thrust blocks shall met the requirements of Section 03300 and shall be placed in accordance with the Typical Details.

2.08 SUPPORTS, ANCHORS AND SEALS

- A. Supports, anchors and seals shall be furnished and installed in accordance with the plans.

2.09 CONCRETE MATERIALS

- A. Standard Cement Concrete mix, with a minimum twenty-eight (28) day compressive strength of 2500 psi.

2.10 CASTING FOR FRAME AND COVERS

- A. Gray iron, Class 30 unless otherwise specified, meeting AASHTO M-108.

- B. Cleaned and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.
- C. Rings and covers for use on watertight manholes shall be machined smooth uniform bearing that will provide a watertight seal.
- D. Frame and cover shall be capable of supporting 16,000 pounds wheel load, combined weight shall be as shown in the Project Details.
- E. Cover shall have concealed pickhole.
- F. The words SANITARY SEWER shall be cast into the cover.
- G. Horizontal and vertical mating surfaces shall be machined.
- H. Frame and cover shall provide a minimum of twenty-four (24") inches clear opening.
- I. The clear opening in the frame casting shall not be less than 24 inches, and the cover shall weigh not more than 180 pounds.
- J. Castings shall be heavy duty type, Vulcan Foundry No. V-1380 or equal.
- K. Watertight castings shall conform to the above specifications, but shall be furnished with a neoprene O-Ring gasket and countersunk stainless steel bolts to form a watertight seal between the cover and the frame. Vulcan Foundry No. V-2380 or equal.

2.11 PRECAST MANHOLES

- A. AASHTO M-199 SR or ASTM C-478.
- B. Openings shall be provided for the required number and size pipes and shall be marked to insure installation at proper locations.
- C. Lift loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars are not allowed.
- D. Flexible Joint Sealant Roping and Sealant Sheets shall be butyl rubber based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1.2% volatile matter and suitable for application temperatures between 10 and 100 degrees F. Material shall be RV-30 as manufactured by RuVan Inc. (or approved equal) with a minimum cross section of 1¼ inches for roping and sheets with minimum dimensions of 1/8 inch by six (6") inches.

- E. Epoxy Gels for interior patching of wall penetrations when used as approved by the Engineer shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.
- F. Precast Component Fabrication and Manufacture shall be as described in the following paragraph:
 - 1. Precast Manufacturing shall be in conformance with ASTM C478. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable. Exterior slab surfaces shall have a float finish. Small surface holes, normal color variations, normal form joint marks, and minor depressions, chips and spalls will be tolerated. Dimensional tolerances shall be those set forth in the appropriate References and specified below.
 - 2. Joint Surfaces between Bases, Risers and Cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C361. The maximum slope of the vertical surface shall be 2 degrees. The maximum annular space at the base of the joint shall be 0.10". The minimum height of the joint shall be four (4") inches.
 - 3. Lift Inserts and Holes shall be sized for a precision fit with the lift devices, shall comply with OSHA 1926.704, and shall not penetrate through the manhole wall.
 - 4. Step Holes: Step holes shall be cast or drilled in the Bases, Risers and cones to provide a uniform step spacing of sixteen (16") inches. Cast step holes shall be tapered to match the taper of the steps.
- G. Precast Base Sections shall be cast monolithically without construction joints or with an approved galvanized or PVC waterstop in the cold joint between the base slab and the walls. The bottom step in base sections shall be a maximum of twenty-six (26") inches from the top of the base slab. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness.
- H. Precast Riser Sections shall have a minimum lay length of sixteen (16") inches.
- I. Precast Concentric and Eccentric Cone Sections shall have an inside diameter at the top of twenty-six (26") inches. The width of the top ledge shall be no less than the wall thickness required for the cone section. Concentric cones shall be used only for Shallow Manholes.
- J. Precast Transition Cone Sections shall provide an eccentric transition from sixty (60") inch and larger manholes to forty-eight (48") inch diameter risers, cones and flat slab top sections. The minimum slope angle for the cone wall shall be 45 degrees.

- K. Precast Transition Top Sections shall provide an eccentric transition from sixty (60") inch and larger manholes to forty-eight (48") inch diameter risers, cones and flat slab top sections. Transition Top sections shall be furnished with vents as shown on the manhole details. The maximum amount of fill over the transition top section shall be twenty (20') feet. Transition Tops shall not be used in areas subject to vehicle traffic.
- L. Precast Flat Slab Top Sections shall have an inside diameter at the top of twenty-six (26") inches and shall be designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops shall be sized to fit within the manhole ID and the top and bottom surfaces.
- M. Precast Grade Rings shall be used to adjust ring and covers to finished grade. No more than 11 vertical inches of grade rings will be allowed per manhole. Grade Rings shall conform to ASTM C478 and shall be no less than four (4") inches in height.
- N. Precast Inverts shall meet the following requirements.
 - 1. Pipe openings shall provide clearance for pipe projecting a minimum of two (2") inch inside the manhole. The height of the transition from the pipe opening to the invert trough shall be equal to $\frac{1}{2}$ of the Opening ID minus Pipe ID, plus or minus $\frac{1}{4}$ ". The crown of small I.D. pipe shall be no lower than the crown of the outlet pipe. When the fall between the inlet and the outlet holes is greater than four (4") inch, the inlet end of the trough shall be below the inlet pipe invert and aligned horizontally within one (1") inch.
 - 2. Invert Troughs shall be formed and finished to provide a consistent slope from the pipe outlet to the inlets up to four (4") inches. The minimum fall shall be one (1") inch. The minimum outside bending radius from influent to effluent shall be 1.5 times the pipe I.D. A one-half inch ($\frac{1}{2}$ ") radius shall be provided at the intersection of 2 or more channels. The minimum concrete thickness from the bottom of the trough to the bottom of the base shall be seven (7") inches.
 - 3. Invert Benches shall have a float finish with a uniform 2- $\frac{1}{2}$ " slope, plus or minus one (1"), from the high point at the manhole wall to the low point at invert trough. A $\frac{1}{4}$ " radius shall be provided at the edge of the bench and trough.
 - 4. Depressions, high spots, voids, chips, or fractured over $\frac{1}{4}$ inch in diameter or depth shall be filled with a sand cement paste and finished to a texture reasonably consistent with that of the formed surface.
- O. Precast Components and grade rings shall be sealed around the external perimeter as follows:
 - 1. External Seals shall consist of a polyethylene backed flat butyl rubber sheet no less than $\frac{1}{8}$ " thick and 6" wide applied to the outside perimeter

- of the joint. Material to be RV-40-PW (or approved equal) as manufactured by RuVan, Inc.
2. Internal Seals shall consist of a plastic backed butyl rubber rope no less than fourteen (14') feet long and having a cross-sectional area no less than the annular space times the height of the joint or 1¼ inches, whichever is greater.
- P. Lifting devices for handling Precast Components shall be provided by the Precast Manufacturer and shall comply with OSHA Standard 1926.704.
- Q. New manholes "wet-cast" shall have a waterproof admixture added during the batching process as manufactured by Xypex (C-1000R) or approved equal.
- R. Coatings
1. The exterior surface of all new "dry-cast" manholes shall be coated with a minimum of one (1) coat of specified material. The coating shall be applied by the manhole manufacturer, and applied and cured in strict accordance with the coating manufacturer's requirements
 2. Coating and sealing material shall be:
 - DRYCON Water proofing/sealer (grey in color) as manufactured by IPA Systems, Inc.
 - PRECO Waterproofing/sealer (grey in color) as manufactured by FOSROC PRECO Industries, Ltd.
 3. Coating is not required for manholes, which are manufactured utilizing the "wet-cast" method.
- S. All precast components shall be manufactured at a plant certified by the National Pre-cast Concrete Association's Plant Certification Program prior to and during the production of products for this project.

2.12 MANHOLE STEPS

- A. Steps shall be provided in Bases, Risers, Cones, Transition Cones, and Transition Top sections aligned vertically on sixteen (16") inch centers. Steps shall be secured to the wall with a compression fit in tapered holes or cast in place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½" diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be 2000 lbs. minimum when tested according to ASTM C497.

2.13 PIPE ENTRANCE COUPLINGS FOR MANHOLES

- A. Pipe to Manhole Connectors shall conform to ASTM C923, and to ASTM C-425 for Pipe Diameters twelve (12") inches and smaller. The location of the pipe connectors shall vary from the location shown on the Project Plans no more than ½ inch vertically and 5 degrees horizontally. Provide for control of the OD to within the tolerances of the connector on flexible pipes larger than twelve (12) inches.

- B. Rigid cement or synthetic type grouts are not acceptable as a seal between the manhole and entry pipe.
- C. The manhole entrance coupling with the entry pipe shall be fitted with either a Neoprene Boot insert, "A-Loc" or approved equal.
- D. Other specially designed flexible products such as "KOR-N-SEAL" may be approved for use in adding a pipe entrance to an installed manhole and for other uses where available and where materials meet the requirements of ASTM C-425.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install barriers, signs and other devices to identify and protect areas the construction site and all adjacent areas.
- B. Protect and maintain all benchmarks and other survey points.
- C. Protect and maintain all pipe, manholes and other material and equipment not scheduled for replacement, and/or all pipe and equipment scheduled for operation during the construction period of the new components. Repair or replacement of all damaged items shall be at the Contractors expense.
- D. Prior to laying pipe, prepare a suitable bedding according to Section 02221.
- E. Before placing pipe in the trench, field inspect for cracks or other defect; remove defective pipe from the construction site.
- F. The interior of each joint of the pipe shall be cleaned to remove all undesirable material.
- G. Prepare and clean the spigot and the bell end of the pipe and remove undesirable material from the gasket and gasket recess.
- H. Establish line and grade for pipe and appurtenances. Verify location and elevation of other utilities and manholes for gravity sewers.

3.02 INSTALLATION OF GRAVITY SANITARY SEWERS

- A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
 - 1. Where laser equipment is used, provide offset hubs at every manhole location for purposes of checking grade between sections.
 - 2. Set offset hubs at such distance from centerline of excavation as is suitable for the excavating method and machinery used.
- B. Lay pipe progressively up grade, with bell upstream, in such a manner as to form

close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer's specifications.

- C. Bed each pipe section and provide Check Dams in accordance with Section 02221.
- D. Unless otherwise specified, provide all gravity sewer lines with a minimum of four (4') feet of cover in roadways and 2-1/2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used.
- E. Do not allow walking on complete pipelines until backfill has been placed to a depth of at least six (6") inches above the crown of the pipe.
- F. Keep the interior of the pipe free of all unsuitable material, and upon completion of a section between any two manholes it shall be possible to view a complete circle of light when looking through the pipe.
- G. When pipe laying ceases, close the open ends of the pipe with a suitable plug to prevent the entrance of foreign materials.
- H. Couplings and adapters used for joining dissimilar gravity pipe materials, for repairing and rejoining sections of gravity sewer, and for connecting the first full joint of pipe to a short stub through a manhole wall shall meet the requirements of ASTM C-425. (See Project Details).
- I. All couplings and adapters for gravity sewer pipe shall be of rubber, plastic and metallic materials that will not react chemically or biologically with municipal wastewaters or aggressive elements in the soil and conform to ASTM - 425, Section 5.

3.03 INSTALLATION: TEE-WYE FITTINGS AND CLEANOUTS FOR SERVICE CONNECTIONS

- A. Use in-line factory made Tee-Wye fittings for all service connections.
- B. Install service connections on sanitary sewer mains for each service connection in accordance with the plans.
- C. All service laterals shall be 6" to property line and/or edge of easement installed at minimum of 1% slope, unless field verified by the engineer. A 6" x 4" increaser bushing (eccentric) as manufactured by Plastic Trends (part number 32642), or approved equal, installed after the cleanout shall be used for single family residential connection.
- D. The service lateral shall be terminated at the end of cleanout with a plug.
- E. Service laterals that originate on the sewer main shall be of the same material as the main at that location on the main. Ductile Iron service laterals shall be Class

350.

- F. The service lateral shall not protrude into the sewer main.
- G. Service lateral cleanouts shall be a 2-way cleanout as manufactured by Plastic Trends (G 1006), or approved equal, and extend 3' above finished grade to mark sewer service connections until building connection is made.
- H. Any sanitary sewer services which are over 12 feet in depth shall require water line and/or mechanical joint quality pipe.
- I. Reconnect existing service connections, including those that are intended to serve unoccupied or abandoned buildings or vacant lots, unless directed otherwise by the Owner or Engineer.
- J. Crushed stone bedding and haunching shall be placed in accordance with the Project Details.
- K. Initial and final backfill and surface restoration shall be completed as referenced and specified in Section 02221 and other appropriate sections.
- L. Contractor shall install tracer wire along the service line to the cleanout location.
- M. Contractor shall provide service Tee-Wye locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream), invert of the sewer main at Tee-Wye location and depth of cleanout in a tabular form.

3.04 INSTALLATION: SEWER MANHOLES - GENERAL

- A. Unless otherwise specified, all manholes shall have inside diameter of not less than forty-eight (48 inches and a vertical wall height of not less than 2.5 feet.
- B. The clear opening into the manhole shall be not less than twenty-four (24") inches.
- C. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the base of the ring.
- D. Backfill manholes in the same manner as specified for pipelines.

3.05 INSTALLATION: STANDARD PRECAST CONCRETE MANHOLES

- A. Manhole shall be installed in accordance with ASTM C-478.
- B. Excavate to the required depth and remove materials, that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending a minimum of six (6") inch beyond the manhole base.

- C. When wet or unconsolidated material occurs or when over excavation of the base occurs, provide a subbase with a minimum of twelve (12") inch of Class I, granular material, well compacted with mechanical tamping equipment.
- D. Set base plumb and level, aligning manhole invert with pipe invert.
- E. Secure Pipe Connectors to Pipe according to the Connector Manufacturer instructions. When pipe stub outs are installed, provide restraint from vertical and longitudinal movements before backfill.
- F. Inlets and outlets from each manhole shall be finished smooth and flush with the sides of manholes walls so as not to obstruct the flow of liquid through the manhole.
- G. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against base of spigot. Leave protective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side, not top to bottom and remove protective wrapper.
- H. Set risers and cones so that steps align, taking particular care to clean, prepare and seal joints.
- I. After joining manhole sections and setting adjustment rings, apply the butyl sealant sheet around the outside perimeter of the joint as shown in the Project Details.
- J. Lift Holes leaving less than two (2") inches of wall thickness shall be plugged from the outside using a sand cement mortar, then covered with butyl sealant sheet. Should Lift Holes penetrate the wall they shall be additionally sealed with an interior application of an epoxy gel $\frac{3}{4}$ " thick extending two (2") inch beyond the penetration.
- K. Perform the final finishing to the manhole interior by filling all chips or fractures greater than $\frac{1}{2}$ inches in length, width or depth and depressions more than $\frac{1}{4}$ inch deep in inverts with an approval hydraulic cement. Do not fill the joints between the precast concrete sections with cementitious material. Clean the interior of the manhole, removing all dirt, spills, or other foreign matter.

3.06 INSTALLATION: MANHOLE RINGS AND COVERS

- A. Grout and anchor manhole rings and covers in place with butyl sealant rope and sheets and bolts in accordance with the Project Details.
- B. The bearing surfaces between cast rings and covers shall be machined, fitted together, and match marked to prevent rocking.

- C. All casting shall be of the types, dimensions, and weights as shown in the Project Details and shall be free of faults, cracks, blow-holes, or other defects.
- D. Set the manhole frames to the required elevation using no more than 11" of precast concrete grade rings, sealing all joints between cone, adjusting rings, and manhole frame.
- E. Standard manholes frames set above grade and all water tight frames shall be held in place by four (4) threaded anchors. Anchors shall consist of:
 - 1. Four (4) $\frac{3}{4}$ inch diameter by eight (8") inch long stainless steel all-thread rod.
 - 2. Set all-thread rod into $\frac{3}{4}$ inch holes 6 inches deep into the precast manhole with approved two (2) component epoxy anchor bolt setting compound.
 - 3. Secure ring with stainless steel washers and nuts after setting compound has cured.

3.07 INSTALLATION: DROP MANHOLE ASSEMBLIES

- A. Drop manhole assemblies shall be constructed as outlined in the Project Details and on the Contract Documents.
- B. The material used in the drop pipe construction shall be Protecto 401 lined Ductile Iron Pipe and Class B concrete.
- C. Inside drop bowl assembly shall be installed with stainless steel fasteners in accordance with the manufacture's recommendations.
- D. Abandonment of existing outside drop assembly shall be incidental to the cost of the inside drop assembly the abandonment procedure shall be as follows:
 - 1. Remove flow from subject line segment by plugging, by-pass pumping, or other methods approved by owner and engineer.
 - 2. Plug existing incoming sanitary sewer (lower pipe) from inside manhole with concrete or grout plug.
 - 3. Fill existing vertical outside drop pipe to within 6" of top with crushed stone.
 - 4. Cap off remaining 6" of existing drop pipe with concrete or grout plug. Provide smooth finish to match invert of existing incoming sanitary sewer.
- E. For inside drop assembly installations where incoming sanitary sewer is being lined, contractor to extend liner pipe a maximum of 2 inches into manhole and cut a "V" shaped notch at bottom edge of incoming pipe in accordance with drop bowl manufacturer's recommendations.

3.08 FIELD TEST - INITIAL PROOF TESTING OF SANITARY SEWERS

- A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the necessary delay of final acceptance.
- B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness, and leakage.

- C. In the event that four (4) or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.
- D. The basis for grade, alignment and cleanliness testing will be visual inspection. Leakage testing will be by means of low pressure air or exfiltration or infiltration as deemed acceptable by the Engineer.
- E. Proof test flexible pipeline installation for deflection by pulling a "go, no-go" test mandrel through the line after the initial backfill is complete to avoid unnecessary dig-ups.

3.09 FIELD TEST - FINAL GRAVITY SEWER TESTING

- A. Before the Work is accepted and before any house services are connected, a final testing procedure is to be followed.
- B. Perform a visual inspection when groundwater levels are above the pipeline if possible. All visible leaks shall be repaired.
- C. The standard leak test for all gravity sewers shall be a low pressure air exfiltration test. Other exfiltration tests, if approved by the Engineer, will be conducted in accordance with ASTM C-828 or latest revision.
- D. If flexible pipe is used, pull an approved go-no go deflection mandrel of 95/100 pipe diameter through all reaches of gravity sewer main. This test shall be conducted no sooner than twenty-four (24) hours after completion of backfilling of the tested reach. No sections will be accepted that exhibits a deflection of more than five (5%) percent.
- E. After the low pressure air and mandrel tests are successfully completed and, house services are connected to the new sewer (in the case of a replacement or rehabilitated line), a post Closed Circuit Television (CCTV) shall be performed of the sewer line per specification section 02790 and the information provided to the OWNER for review prior to contract closeout.

3.10 LOW PRESSURE AIR EXFILTRATION TEST - GRAVITY SEWERS

- A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 4.0 to 3.0 PSIG.
- B. Times for mixed pipe sized of varying lengths should be calculated as described in ASTM, C828-76T using formula $t = K d/q$ ($q = .0020$).
- C. Lengths of sections under test shall not exceed 500 linear feet.
- D. Gravity sewer line testing shall include service laterals.
- E. The following items are for one (1) pipe size only:

SPECIFICATION TABLE
(MIN:SEC) REQUIRED WHEN TESTING ONE PIPE DIAMETER ONLY

DIA. (IN)	4	6	8	10	12	15	18	21	24	27	38	33	36	39	42
TEST SECT. (FT)															
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	8:05
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	16:10
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	19:50
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35			
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20				20:25	19:58	23:06
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30			13:24	16:32	17:09	23:49	23:57	27:43
175	0:31	1:09	2:03	3:13	4:37	7:05			12:06	15:19	18:54	20:01	27:13	27:57	32:20
200	0:35	1:19	2:21	3:40	5:17			10:25	13:36	17:13	21:16	22:52	30:37	31:56	36:58
225	0:40	1:29	2:38	4:08	5:40		8:31	11:35	15:07	19:08	23:38	25:44	34:01	35:56	41:35
250	0:44	1:39	2:56	4:35			9:24	12:44	16:38	21:03	25:59	28:35	37:25	39:56	46:12
275	0:48	1:49	3:14	4:43		8:16	10:12	13:53	18:09	22:58	28:21	31:27	40:49	43:55	50:49
300	0:53	1:59	3:31		6:03	9:27	11:54	16:12	21:10	26:47	33:05	34:16	47:38	47:55	55:26
350	1:02	2:19	3:47		6:48	10:38	13:36	18:31	24:12	30:37	37:48	40:01	54:26	55:54	64:41
400	1:10	2:38			7:34	11:49	15:19	20:50	27:13	34:27	42:32	45:44	61:14	63:53	73:55
450	1:19	2:50		5:14	8:19	13:00	17:01	23:09	30:14	38:16	47:15	51:27	68:02	71:52	83:10
500	1:28			5:45	9:04	14:11	18:43	25:28	33:16	42:06	51:59	57:10	74:51	49:51	92:24
550	1:37		4:02	6:17	9:50	15:21	20:25	27:47	36:17	45:56	56:42	62:53	81:39	87:50	101:38
600	1:46	2:50	4:22	6:48			22:07	30:06	39:19	49:45	61:26	68:36	88:27	95:49	110:53
650	1:54											74:19		103:48	120:07

3.11 FIELD TEST - PRECAST MANHOLES

- A. Manholes shall be physically and vacuum tested to assure compliance with the Contract Documents and the desired workmanship of the finished work has been achieved.
- B. Manhole Vacuum Test:
 1. Backfill shall be placed around the base of the manhole to a depth of one (1) foot over the top of the sewer pipe before the vacuum test is performed.
 2. The maximum vacuum applied to a manhole shall be twelve (12") inches of mercury (Hg).
 3. All manholes shall be subject to a vacuum test of a minimum of ten (10") inches Hg prior to acceptance by the Owner. The test shall be considered acceptable if the vacuum drops no more than one (1") inch within the time specified in the following table:

Manhole I.D. (inches)	48	60	72	84	96	120
Test Time for up to 8 feet in depth (seconds)	60	70	80	90	100	120
Additional Test Time for each 4 Foot Added Depth (Seconds)	10	15	20	30	40	60

4. Testing Sequence:
 - a. All manholes shall be physically and vacuum tested. Manholes failing the test shall be repaired by the Contractor, and retested.
 - b. Manholes failing the vacuum test two (2) times may, at the discretion of the Owner, be allowed to be hydrostatically tested by an exfiltration test for acceptance.
 - c. The OWNER may require complete replacement of any manhole failing three (3) leak tests. Replacement shall be at no cost to the OWNER.
5. The CONTRACTOR shall furnish all necessary equipment and personal to conduct the tests in the presence of the ENGINEER.
6. Costs for testing shall be included within and incidental to the Contract Unit Price for manhole construction or rehabilitating.
7. Repairing, retesting, pressure grouting and/or replacement of defective manholes shall be at the sole expense and responsibility of the CONTRACTOR, and shall be pursued in a timely manner to prevent disruption to the Project and/or sewer services.
8. Manholes moved, disturbed, displaced and/or damaged in any way during the finishing and/or backfilling operation subsequent to successful testing shall be retested for acceptance as specified above, at the CONTRACTOR's expense.

3.12 INSTALLATION OF PRESSURE PIPE

- A. Trenching and backfill for yard and under slab piping shall meet the requirements of Section 02221.
- B. During pipe installation Contractor shall take every precaution to prevent foreign material from entering the pipe or fittings. The Contractor shall place a heavy, tightly woven canvas bag over each end of joint of pipe before lowering it into the trench.
- C. Jointing procedures, including cleaning of ends of pipe, and lubrication shall be in accordance with the manufacturer's recommendations. All push-joint and/or mechanical joint pipe shall be laid with the bells pointing in the direction of laying.
- D. Field cutting of pipe shall be done according to the manufacturer's recommendations. Cut end shall be smooth and at right angles to the axis of the pipe. Field cuts shall be filed or trimmed to resemble the spigot end of the pipe as manufactured. Depth marks shall be placed on the pipe to assure pipe is inserted to the full depth when joint is

made.

- E. Thrust blocking shall be provided at all bends (of 11-1/4 degrees or greater) and tees and valves. Blocking shall be poured against undisturbed earth, be a minimum of twelve (12") inches thick, and constructed so that the pipe and fitting joints will be accessible for repairs. Install as shown in the Typical Details.
- F. All yard valves shall be installed plumb and true in a workmanlike manner.

3.13 PRESSURE SEWER TESTING

- A. Tests are to be conducted on lengths between valves or plugs and in no case on more than 3000 linear feet of pipe in any one (1) section.
- B. After the pipe has been laid, it shall be subjected to a hydrostatic pressure of 200 psi, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.
- C. The duration of each pressure test shall be at least two (2) hours when joints are exposed and four (4) hours where any joints in the line are covered or backfilled. The pressure shall not drop more than 5 psi during the test period.
- D. Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connection to the line. The pump, pipe connection, all necessary apparatus, and the gauges for the test, all taps into the pipe, and all necessary personnel for conducting the tests shall be furnished by the contractor and approved by the Engineer.
- E. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least seven (7) days have elapsed after the concrete reaction backing was installed.
- F. Before applying the specified test pressure, all air shall be expelled from the pipe. If release valves are not available at high points, the Contractor shall, at his own expense, make the necessary taps at points of highest elevation before the test is made and provide corporation stops to seal the taps after the test has been completed.
- G. All exposed pipes, fittings, and joints will be carefully examined during the pressure test. Leaking joints shall be disassembled, cleaned, and reassembled and/or defective material replaced until all leakage is stopped.
- H. Any cracked or defective pipe or fittings discovered in consequence of this pressure test, shall be removed and replaced with sound material, and the test shall be repeated until satisfactory results are obtained.
- I. A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

- J. The Contractor shall furnish the pump, pipe, connections, gauges, measuring devices, and all other necessary apparatus and shall furnish all necessary assistance to conduct the test.
- K. The duration of each leakage test shall equal the duration of the pressure test. No pipe will be accepted until the leakage during the test period is less than 0.67 gallons per 1000 feet of pipe under test.
- L. If any test discloses leakage greater than the allowance, the Contractor shall, at his own expense, locate and repair defects until the leakage is within the specified allowance. Following repairs, the line shall be retested.
- M. Any visible leaks at exposed joints or leaks evident at the surface where joints are covered shall be repaired by rejoining regardless of the total leakage shown by any test.
- N. The water required for testing shall be furnished by the Contractor and may be purchased from the local water purveyor through a fire hydrant meter. The Contractor shall be required to obtain and pay for the use of the hydrant meter.

END OF SECTION

SECTION 02722

SANITARY SEWERS, FORCE MAINS AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnishing and installation of sanitary sewerage systems.

1.02 RELATED DOCUMENTS

- A. Section 01530: Barriers
- B. Section 01560: Temporary Controls
- C. Section 01570: Traffic Regulations
- D. Section 01710: Cleaning
- E. Section 02100: Erosion Control
- F. Section 02221: Trenching, Backfilling and Compacting
- G. Section 02730: Manhole Repair and Rehabilitation
- H. Section 02750: Sewer Reconstruction by Slip-Lining Method
- I. Section 02760: Sewer Reconstruction by Pipe-Bursting Method
- J. Section 02790: Sewer Line Cleaning and Closed Circuit TV Inspection

1.03 SUBMITTALS

- A. Submittals shall be submitted as specified in Section 01340, promptly and in accordance with approved schedule, in such a sequence that no delay to the work, or to the work of other Contractors is caused.
- B. Product data shall be submitted as required.
- C. Submit certification signed by manufacturer and Contractor that pipe, fittings, manholes, castings, and appurtenances meet specification requirements.
- D. Submit six (6) copies of required documents.

1.04 QUALITY ASSURANCE

- A. The Contractor shall install and test lines, fittings, valves and appurtenances in accordance with regulations issued by the Tennessee Department of Environment and Conservation and the Owner.

- B. The Contractor shall disinfect all potable water lines, fittings, valves and appurtenances in accordance with regulations issued by the Tennessee Department of Environment and Conservation.
- C. Adequate numbers of skilled workmen, who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section shall be used.
- D. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner.
- E. PVC piping shall be stored to protect from long term exposure to direct sun light and shall be stacked in suitable support systems to prevent buckling and deformation.
- F. Immediately prior to lowering pipe or fittings into the trench, each length of pipe and each component shall have the interior and mating surfaces cleaned of all dirt and foreign material.
- G. Carefully examine each pipe and fitting for cracks and other defects while suspended above the trench immediately before installation.

1.05 REFERENCES

- A. ASTM A48 - Gray Iron Casting
- B. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and sewer pipe
- C. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings
- D. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- E. ASTM C478 - Pre-Cast Reinforced Concrete Manhole Sections
- F. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- G. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures
- H. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- I. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- J. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

- K. AWWA C111 - Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
- L. AWWA C151 - Ductile-Iron Pipe Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- M. ASTM D-1248 - High Density Polyethylene Pipe
- N. National Precast Concrete Association: Quality Control Manual for Precast Concrete Plants.
- O. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Product Delivery, Storage and handling shall be in strict accordance with the manufacturer's recommendations using the best available methods to prevent damage to materials and components.
- B. PVC piping shall be stored to protect from long term exposure to direct sun light and shall be stacked in suitable support systems to prevent buckling and deformation.
- C. Protect ductile iron pipe from damage to coating and lining.

1.07 JOB CONDITIONS

- A. All Work in streets and roadways shall be conducted in strict accordance with provisions of Section 01570.
- B. Whenever pipe laying is not actively in progress, open ends of all installed pipe and fittings shall be fitted with a watertight plug.
- C. Separation of Sewers and Water Mains:
 - 1. Parallel Installation of Sewers and Water Mains
 - a. Whenever possible the sewer shall be installed at least ten (10') foot horizontally from water mains, the distance measured from edge to edge.
 - b. If local conditions prevent a horizontal separation of ten (10') foot, the sewer shall be installed in a separate trench so that the top of the sewer pipe is at least eighteen (18") inches below the bottom of the water main.
 - c. If neither of these conditions can be met the sewer shall be constructed of push-on or mechanical joint ductile-iron pipe, and the pipe pressure tested to assure water tightness prior to backfilling.

2. Crossing of Sewers and Water Mains:
 - a. Whenever possible the sewer main shall be installed below the water main so that the minimum distance between the outside of the sewer pipe and the outside of the water pipe is at least eighteen (18") inches. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - b. If local conditions prevent this separation, the sewer shall be constructed of push-on or mechanical joint ductile-iron pipe, and the pipe pressure tested to assure water-tightness prior to backfilling.
 - c. Where the water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.
- D. Sewage flow must be maintained in the existing sewers. Whenever pipe laying progresses to a point where this flow must be interrupted, the Contractor shall plug a manhole upstream of the construction and provide pump bypassing to a downstream manhole in accordance with Section 02540. All downstream pipes, manholes and appurtenances must be tested and determined to be acceptable to the Owner and the Engineer to receive sewage flow. Bypassing of raw sewage to the surface will not be permitted. Contractor shall notify the Owner, his field representative and/or other appropriate authorities and receive written remission prior to proceeding with bypassing. When working in areas where interruption of sewer flow may occur, the Contractor shall have at the site the necessary pumps, lines and all other equipment in readiness to provide pump bypassing.
- E. Contractor shall plan his Work and arrange his Work schedules, to minimize the length of time sewer service is interrupted.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE AND FITTINGS FOR GRAVITY SEWERS

- A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.
- B. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM D-3034 and have a Standard Dimension Ratio (SDR) of 35.
- C. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.
- D. All PVC gravity sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, ASTM D-3034, and NSF approval seal.

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. Pipe:
 - 1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 (AWWA C-110).
 - 2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).
 - 3. Where the pipe is shown as "Protecto 401 lined", the pipe will be lined with a ceramic epoxy lining meeting the following:
 - a. 40-mil dry film thickness lining manufactured under the name of Protecto 401.
 - b. Line interior of bell and exterior of spigot in joint sealing areas with 6 to 10 mils of specified lining.
 - c. Surface preparation: SP10 near white blast.
 - d. Pinhole detection: 2,500 volts minimum over 100 percent of lined surfaces.
 - 4. A minimum of 1 mil thick bituminous coating on the outside surface.
 - 5. Clearly mark with manufacturer's name, D.I. or Ductile, weight, class or nominal thickness, and casting period.
 - 6. Unless otherwise specified or shown on the Contract Documents, ductile iron pipe shall be pressure class 350.
- B. Fittings
 - 1. Fittings 4"-24": Pressure rated at 350 psi.
 - 2. Fittings 30"-36: Pressure rated at 250 psi.
 - 3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111).
 - 4. If specified, ceramic epoxy lining per 2.02 (3) above.
 - 5. Sewer Tee-Wye fittings shall conform to AWWA C 110

2.03 POLYVINYL CHLORIDE PIPE FOR PRESSURE SEWERS

- A. Polyvinyl Chloride Pipe (PVC), for pressure sewers: AWWA C-900 PC 235/C-905, PR 200. All pipe shall meet a minimum of 200 psi working pressure rating, and shall be marked with the manufacturer's name, nominal diameter, DR, and pressure rating.
 - 1. Fittings: Shall be Ductile-Iron (Protecto 401 Lined) as specified above.
 - 2. Joints: Shall be push-on with gaskets recommended by the manufacturer for the specific application.

2.04 AIR/VACUUM VALVES

- A. Air/Vacuum Valves shall be ARI D-025 with reinforced nylon body, all stainless steel internal parts, NPT or flanged connection, with complete flushing package.

2.05 ECCENTRIC PLUG VALVES

- A. Plug valves shall be as manufactured by Pratt or DeZurik.
- B. Plug valves shall be mechanical joint type for buried application and flanged for interior application.
- C. Body shall be cast iron plastic coated, with nickel seat.

- D. Plug shall be cast iron with resilient coating to resist corrosion and damage.
- E. Extension shafts for pedestal operators shall be stainless steel.

2.06 DETECTION TAPE

- A. Detection tape shall be required for all PVC piping installed on the Project.
- B. The tape shall consist of a minimum thickness of 0.5 mils solid aluminum foil core running the full length and width.
- C. The aluminum foil core shall be encased in a protective, high visibility, color coded, inert plastic jacket that is impervious to alkalis, acids, and solvents normally found in soil. The foil is to be visible on the unprinted side.
- D. The tape's minimum overall thickness shall be 5.5 mils, its minimum tensile strength shall be 5000 psi, and its minimum weight is shall 2.5 pounds per inch of width per 1000 feet of length. Width shall be three (3") inches.
- E. The tapes used shall be of the following colors: Blue for potable water line; red for sewer line; green for non-potable water line.
- F. The tape shall have the following printed on it in one (1") inch letters.

"CAUTION - _____ * BURIED BELOW."*

*Example only, wording to be appropriate for line type.

- G. Tape shall be placed directly over the pipe between one (1") foot and three (3") feet below finished grade and at least one (1") foot above the top of the pipe.
- H. A different color tape shall be used for each pipe carrying a different substance.

2.07 THRUST BLOCKS

- A. Concrete for thrust blocks shall met the requirements of Section 03300 and shall be placed in accordance with the Typical Details.

2.08 SUPPORTS, ANCHORS AND SEALS

- A. Supports, anchors and seals shall be furnished and installed in accordance with the plans.

2.09 CONCRETE MATERIALS

- A. Standard Cement Concrete mix, with a minimum twenty-eight (28) day compressive strength of 2500 psi.

2.10 CASTING FOR FRAME AND COVERS

- A. Gray iron, Class 30 unless otherwise specified, meeting AASHTO M-108.

- B. Cleaned and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.
- C. Rings and covers for use on watertight manholes shall be machined smooth uniform bearing that will provide a watertight sea.
- D. Frame and cover shall be capable of supporting 16,000 pounds wheel load, combined weight shall be as shown in the Project Details.
- E. Cover shall have concealed pickhole.
- F. The words SANITARY SEWER shall be cast into the cover.
- G. Horizontal and vertical mating surfaces shall be machined.
- H. Frame and cover shall provide a minimum of twenty-four (24") inches clear opening.
- I. The clear opening in the frame casting shall not be less than 24 inches, and the cover shall weigh not more than 180 pounds.
- J. Castings shall be heavy duty type, Vulcan Foundry No. V-1380 or equal.
- K. Watertight castings shall conform to the above specifications, but shall be furnished with a neoprene O-Ring gasket and countersunk stainless steel bolts to form a watertight seal between the cover and the frame. Vulcan Foundry No. V-2380 or equal.

2.11 PRECAST MANHOLES

- A. AASHTO M-199 SR or ASTM C-478.
- B. Openings shall be provided for the required number and size pipes and shall be marked to insure installation at proper locations.
- C. Lift loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars are not allowed.
- D. Flexible Joint Sealant Roping and Sealant Sheets shall be butyl rubber based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1.2% volatile matter and suitable for application temperatures between 10 and 100 degrees F. Material shall be RV-30 as manufactured by RuVan Inc. (or approved equal) with a minimum cross section of 1¼ inches for roping and sheets with minimum dimensions of 1/8 inch by six (6") inches.

- E. Epoxy Gels for interior patching of wall penetrations when used as approved by the Engineer shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.
- F. Precast Component Fabrication and Manufacture shall be as described in the following paragraph:
 - 1. Precast Manufacturing shall be in conformance with ASTM C478. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable. Exterior slab surfaces shall have a float finish. Small surface holes, normal color variations, normal form joint marks, and minor depressions, chips and spalls will be tolerated. Dimensional tolerances shall be those set forth in the appropriate References and specified below.
 - 2. Joint Surfaces between Bases, Risers and Cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C361. The maximum slope of the vertical surface shall be 2 degrees. The maximum annular space at the base of the joint shall be 0.10". The minimum height of the joint shall be four (4") inches.
 - 3. Lift Inserts and Holes shall be sized for a precision fit with the lift devices, shall comply with OSHA 1926.704, and shall not penetrate through the manhole wall.
 - 4. Step Holes: Step holes shall be cast or drilled in the Bases, Risers and cones to provide a uniform step spacing of sixteen (16") inches. Cast step holes shall be tapered to match the taper of the steps.
- G. Precast Base Sections shall be cast monolithically without construction joints or with an approved galvanized or PVC waterstop in the cold joint between the base slab and the walls. The bottom step in base sections shall be a maximum of twenty-six (26") inches from the top of the base slab. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness.
- H. Precast Riser Sections shall have a minimum lay length of sixteen (16") inches.
- I. Precast Concentric and Eccentric Cone Sections shall have an inside diameter at the top of twenty-six (26") inches. The width of the top ledge shall be no less than the wall thickness required for the cone section. Concentric cones shall be used only for Shallow Manholes.
- J. Precast Transition Cone Sections shall provide an eccentric transition from sixty (60") inch and larger manholes to forty-eight (48") inch diameter risers, cones and flat slab top sections. The minimum slope angle for the cone wall shall be 45 degrees.

- K. Precast Transition Top Sections shall provide an eccentric transition from sixty (60") inch and larger manholes to forty-eight (48") inch diameter risers, cones and flat slab top sections. Transition Top sections shall be furnished with vents as shown on the manhole details. The maximum amount of fill over the transition top section shall be twenty (20') feet. Transition Tops shall not be used in areas subject to vehicle traffic.
- L. Precast Flat Slab Top Sections shall have an inside diameter at the top of twenty-six (26") inches and shall be designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops shall be sized to fit within the manhole ID and the top and bottom surfaces.
- M. Precast Grade Rings shall be used to adjust ring and covers to finished grade. No more than 11 vertical inches of grade rings will be allowed per manhole. Grade Rings shall conform to ASTM C478 and shall be no less than four (4") inches in height.
- N. Precast Inverts shall meet the following requirements.
1. Pipe openings shall provide clearance for pipe projecting a minimum of two (2") inch inside the manhole. The height of the transition from the pipe opening to the invert trough shall be equal to $\frac{1}{2}$ of the Opening ID minus Pipe ID, plus or minus $\frac{1}{4}$ ". The crown of small I.D. pipe shall be no lower than the crown of the outlet pipe. When the fall between the inlet and the outlet holes is greater than four (4") inch, the inlet end of the trough shall be below the inlet pipe invert and aligned horizontally within one (1") inch.
 2. Invert Troughs shall be formed and finished to provide a consistent slope from the pipe outlet to the inlets up to four (4") inches. The minimum fall shall be one (1") inch. The minimum outside bending radius from influent to effluent shall be 1.5 times the pipe I.D. A one-half inch ($\frac{1}{2}$ ") radius shall be provided at the intersection of 2 or more channels. The minimum concrete thickness from the bottom of the trough to the bottom of the base shall be seven (7") inches.
 3. Invert Benches shall have a float finish with a uniform 2- $\frac{1}{2}$ " slope, plus or minus one (1"), from the high point at the manhole wall to the low point at invert trough. A $\frac{1}{4}$ " radius shall be provided at the edge of the bench and trough.
 4. Depressions, high spots, voids, chips, or fractured over $\frac{1}{4}$ inch in diameter or depth shall be filled with a sand cement paste and finished to a texture reasonably consistent with that of the formed surface.
- O. Precast Components and grade rings shall be sealed around the external perimeter as follows:
1. External Seals shall consist of a polyethylene backed flat butyl rubber sheet no less than $\frac{1}{8}$ " thick and 6" wide applied to the outside perimeter of the joint. Material to be RV-40-PW (or approved equal) as manufactured by RuVan, Inc.

2. Internal Seals shall consist of a plastic backed butyl rubber rope no less than fourteen (14') feet long and having a cross-sectional area no less than the annular space times the height of the joint or 1¼ inches, whichever is greater.
- P. Lifting devices for handling Precast Components shall be provided by the Precast Manufacturer and shall comply with OSHA Standard 1926.704.
- Q. New manholes "wet-cast" shall have a waterproof admixture added during the batching process as manufactured by Xypex (C-1000R) or approved equal.
- R. Coatings
1. The exterior surface of all new "dry-cast" manholes shall be coated with a minimum of one (1) coat of specified material. The coating shall be applied by the manhole manufacturer, and applied and cured in strict accordance with the coating manufacturer's requirements
 2. Coating and sealing material shall be:
 - DRYCON Water proofing/sealer (grey in color) as manufactured by IPA Systems, Inc.
 - PRECO Waterproofing/sealer (grey in color) as manufactured by FOSROC PRECO Industries, Ltd.
 3. Coating is not required for manholes, which are manufactured utilizing the "wet-cast" method.
- S. All precast components shall be manufactured at a plant certified by the National Pre-cast Concrete Association's Plant Certification Program prior to and during the production of products for this project.

2.12 MANHOLE STEPS

- A. Steps shall be provided in Bases, Risers, Cones, Transition Cones, and Transition Top sections aligned vertically on sixteen (16") inch centers. Steps shall be secured to the wall with a compression fit in tapered holes or cast in place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½" diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be 2000 lbs. minimum when tested according to ASTM C497.

2.13 PIPE ENTRANCE COUPLINGS FOR MANHOLES

- A. Pipe to Manhole Connectors shall conform to ASTM C923, and to ASTM C-425 for Pipe Diameters twelve (12") inches and smaller. The location of the pipe connectors shall vary from the location shown on the Project Plans no more than ½ inch vertically and 5 degrees horizontally. Provide for control of the OD to within the tolerances of the connector on flexible pipes larger than twelve (12) inches.

- B. Rigid cement or synthetic type grouts are not acceptable as a seal between the manhole and entry pipe.
- C. The manhole entrance coupling with the entry pipe shall be fitted with either a Neoprene Boot insert, "A-Loc" or approved equal.
- D. Other specially designed flexible products such as "KOR-N-SEAL" may be approved for use in adding a pipe entrance to an installed manhole and for other uses where available and where materials meet the requirements of ASTM C-425.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install barriers, signs and other devices to identify and protect areas the construction site and all adjacent areas.
- B. Protect and maintain all benchmarks and other survey points.
- C. Protect and maintain all pipe, manholes and other material and equipment not scheduled for replacement, and/or all pipe and equipment scheduled for operation during the construction period of the new components. Repair or replacement of all damaged items shall be at the Contractors expense.
- D. Prior to laying pipe, prepare a suitable bedding according to Section 02221.
- E. Before placing pipe in the trench, field inspect for cracks or other defect; remove defective pipe from the construction site.
- F. The interior of each joint of the pipe shall be cleaned to remove all undesirable material.
- G. Prepare and clean the spigot and the bell end of the pipe and remove undesirable material from the gasket and gasket recess.
- H. Establish line and grade for pipe and appurtenances. Verify location and elevation of other utilities and manholes for gravity sewers.

3.02 INSTALLATION OF GRAVITY SANITARY SEWERS

- A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
 - 1. Where laser equipment is used, provide offset hubs at every manhole location for purposes of checking grade between sections.
 - 2. Set offset hubs at such distance from centerline of excavation as is suitable for the excavating method and machinery used.
- B. Lay pipe progressively up grade, with bell upstream, in such a manner as to form close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer's specifications.

- C. Bed each pipe section and provide Check Dams in accordance with Section 02221.
- D. Unless otherwise specified, provide all gravity sewer lines with a minimum of four (4') feet of cover in roadways and 2-1/2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used.
- E. Do not allow walking on complete pipelines until backfill has been placed to a depth of at least six (6") inches above the crown of the pipe.
- F. Keep the interior of the pipe free of all unsuitable material, and upon completion of a section between any two manholes it shall be possible to view a complete circle of light when looking through the pipe.
- G. When pipe laying ceases, close the open ends of the pipe with a suitable plug to prevent the entrance of foreign materials.
- H. Couplings and adapters used for joining dissimilar gravity pipe materials, for repairing and rejoining sections of gravity sewer, and for connecting the first full joint of pipe to a short stub through a manhole wall shall meet the requirements of ASTM C-425. (See Project Details).
- I. All couplings and adapters for gravity sewer pipe shall be of rubber, plastic and metallic materials that will not react chemically or biologically with municipal wastewaters or aggressive elements in the soil and conform to ASTM - 425, Section 5.

3.03 INSTALLATION: TEE-WYE FITTINGS AND CLEANOUTS FOR SERVICE CONNECTIONS

- A. Use in-line factory made Tee-Wye fittings for all service connections.
- B. Install service connections on sanitary sewer mains for each service connection in accordance with the plans.
- C. All service laterals shall be 6" to property line and/or edge of easement installed at minimum of 1% slope, unless field verified by the engineer. A 6" x 4" increaser bushing (eccentric) as manufactured by Plastic Trends (part number 32642), or approved equal, installed after the cleanout shall be used for single family residential connection.
- D. The service lateral shall be terminated at the end of cleanout with a plug.
- E. Service laterals that originate on the sewer main shall be of the same material as the main at that location on the main. Ductile Iron service laterals shall be Class 350.
- F. The service lateral shall not protrude into the sewer main.

- G. Service lateral cleanouts shall be a 2-way cleanout as manufactured by Plastic Trends (G 1006), or approved equal, and extend 3' above finished grade to mark sewer service connections until building connection is made.
- H. Any sanitary sewer services which are over 12 feet in depth shall require water line and/or mechanical joint quality pipe.
- I. Reconnect existing service connections, including those that are intended to serve unoccupied or abandoned buildings or vacant lots, unless directed otherwise by the Owner or Engineer.
- J. Crushed stone bedding and haunching shall be placed in accordance with the Project Details.
- K. Initial and final backfill and surface restoration shall be completed as referenced and specified in Section 02221 and other appropriate sections.
- L. Contractor shall install tracer wire along the service line to the cleanout location.
- M. Contractor shall provide service Tee-Wye locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream), invert of the sewer main at Tee-Wye location and depth of cleanout in a tabular form.

3.04 INSTALLATION: SEWER MANHOLES - GENERAL

- A. Unless otherwise specified, all manholes shall have inside diameter of not less than forty-eight (48 inches and a vertical wall height of not less than 2.5 feet.
- B. The clear opening into the manhole shall be not less than twenty-four (24") inches.
- C. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the base of the ring.
- D. Backfill manholes in the same manner as specified for pipelines.

3.05 INSTALLATION: STANDARD PRECAST CONCRETE MANHOLES

- A. Manhole shall be installed in accordance with ASTM C-478.
- B. Excavate to the required depth and remove materials, that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending a minimum of six (6") inch beyond the manhole base.

- C. When wet or unconsolidated material occurs or when over excavation of the base occurs, provide a subbase with a minimum of twelve (12") inch of Class I, granular material, well compacted with mechanical tamping equipment.
- D. Set base plumb and level, aligning manhole invert with pipe invert.
- E. Secure Pipe Connectors to Pipe according to the Connector Manufacturer instructions. When pipe stub outs are installed, provide restraint from vertical and longitudinal movements before backfill.
- F. Inlets and outlets from each manhole shall be finished smooth and flush with the sides of manholes walls so as not to obstruct the flow of liquid through the manhole.
- G. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against base of spigot. Leave protective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side, not top to bottom and remove protective wrapper.
- H. Set risers and cones so that steps align, taking particular care to clean, prepare and seal joints.
- I. After joining manhole sections and setting adjustment rings, apply the butyl sealant sheet around the outside perimeter of the joint as shown in the Project Details.
- J. Lift Holes leaving less than two (2") inches of wall thickness shall be plugged from the outside using a sand cement mortar, then covered with butyl sealant sheet. Should Lift Holes penetrate the wall they shall be additionally sealed with an interior application of an epoxy gel $\frac{3}{4}$ " thick extending two (2") inch beyond the penetration.
- K. Perform the final finishing to the manhole interior by filling all chips or fractures greater than $\frac{1}{2}$ inches in length, width or depth and depressions more than $\frac{1}{4}$ inch deep in inverts with an approval hydraulic cement. Do not fill the joints between the precast concrete sections with cementitious material. Clean the interior of the manhole, removing all dirt, spills, or other foreign matter.

3.06 INSTALLATION: MANHOLE RINGS AND COVERS

- A. Grout and anchor manhole rings and covers in place with butyl sealant rope and sheets and bolts in accordance with the Project Details.
- B. The bearing surfaces between cast rings and covers shall be machined, fitted together, and match marked to prevent rocking.
- C. All casting shall be of the types, dimensions, and weights as shown in the Project Details and shall be free of faults, cracks, blow-holes, or other defects.

- D. Set the manhole frames to the required elevation using no more than 11" of precast concrete grade rings, sealing all joints between cone, adjusting rings, and manhole frame.
- E. Standard manholes frames set above grade and all water tight frames shall be held in place by four (4) threaded anchors. Anchors shall consist of:
 - 1. Four (4) $\frac{3}{4}$ inch diameter by eight (8") inch long stainless steel all-thread rod.
 - 2. Set all-thread rod into $\frac{3}{4}$ inch holes 6 inches deep into the precast manhole with approved two (2) component epoxy anchor bolt setting compound.
 - 3. Secure ring with stainless steel washers and nuts after setting compound has cured.

3.07 INSTALLATION: DROP MANHOLE ASSEMBLIES

- A. Drop manhole assemblies shall be constructed as outlined in the Project Details and on the Contract Documents.
- B. The material used in the drop pipe construction shall be Protecto 401 lined Ductile Iron Pipe and Class B concrete.
- C. Inside drop bowl assembly shall be installed with stainless steel fasteners in accordance with the manufacture's recommendations.
- D. Abandonment of existing outside drop assembly shall be incidental to the cost of the inside drop assembly the abandonment procedure shall be as follows:
 - 1. Remove flow from subject line segment by plugging, by-pass pumping, or other methods approved by owner and engineer.
 - 2. Plug existing incoming sanitary sewer (lower pipe) from inside manhole with concrete or grout plug.
 - 3. Fill existing vertical outside drop pipe to within 6" of top with crushed stone.
 - 4. Cap off remaining 6" of existing drop pipe with concrete or grout plug. Provide smooth finish to match invert of existing incoming sanitary sewer.
- E. For inside drop assembly installations where incoming sanitary sewer is being lined, contractor to extend liner pipe a maximum of 2 inches into manhole and cut a "V" shaped notch at bottom edge of incoming pipe in accordance with drop bowl manufacturer's recommendations.

3.08 FIELD TEST - INITIAL PROOF TESTING OF SANITARY SEWERS

- A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the necessary delay of final acceptance.
- B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness, and leakage.
- C. In the event that four (4) or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.

- D. The basis for grade, alignment and cleanliness testing will be visual inspection. Leakage testing will be by means of low pressure air or exfiltration or infiltration as deemed acceptable by the Engineer.
- E. Proof test flexible pipeline installation for deflection by pulling a "go, no-go" test mandrel through the line after the initial backfill is complete to avoid unnecessary dig-ups.

3.09 FIELD TEST - FINAL GRAVITY SEWER TESTING

- A. Before the Work is accepted and before any house services are connected, a final testing procedure is to be followed.
- B. Perform a visual inspection when groundwater levels are above the pipeline if possible. All visible leaks shall be repaired.
- C. The standard leak test for all gravity sewers shall be a low pressure air exfiltration test. Other exfiltration tests, if approved by the Engineer, will be conducted in accordance with ASTM C-828 or latest revision.
- D. If flexible pipe is used, pull an approved go-no go deflection mandrel of 95/100 pipe diameter through all reaches of gravity sewer main. This test shall be conducted no sooner than twenty-four (24) hours after completion of backfilling of the tested reach. No sections will be accepted that exhibits a deflection of more than five (5%) percent.
- E. After the low pressure air and mandrel tests are successfully completed and, house services are connected to the new sewer (in the case of a replacement or rehabilitated line), a post Closed Circuit Television (CCTV) shall be performed of the sewer line per specification section 02790 and the information provided to the OWNER for review prior to contract closeout.

3.10 LOW PRESSURE AIR EXFILTRATION TEST - GRAVITY SEWERS

- A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 4.0 to 3.0 PSIG.
- B. Times for mixed pipe sized of varying lengths should be calculated as described in ASTM, C828-76T using formula $t = K d/q$ ($q = .0020$).
- C. Lengths of sections under test shall not exceed 500 linear feet.
- D. Gravity sewer line testing shall include service laterals.
- E. The following items are for one (1) pipe size only:

SPECIFICATION TABLE
(MIN:SEC) REQUIRED WHEN TESTING ONE PIPE DIAMETER ONLY

DIA. (IN)	4	6	8	10	12	15	18	21	24	27	38	33	36	39	42
TEST SECT. (FT)															
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	8:05
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	16:10
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	19:50
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35			
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20				20:25	19:58	23:06
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30			13:24	16:32	17:09	23:49	23:57	27:43
175	0:31	1:09	2:03	3:13	4:37	7:05			12:06	15:19	18:54	20:01	27:13	27:57	32:20
200	0:35	1:19	2:21	3:40	5:17			10:25	13:36	17:13	21:16	22:52	30:37	31:56	36:58
225	0:40	1:29	2:38	4:08	5:40		8:31	11:35	15:07	19:08	23:38	25:44	34:01	35:56	41:35
250	0:44	1:39	2:56	4:35			9:24	12:44	16:38	21:03	25:59	28:35	37:25	39:56	46:12
275	0:48	1:49	3:14	4:43		8:16	10:12	13:53	18:09	22:58	28:21	31:27	40:49	43:55	50:49
300	0:53	1:59	3:31		6:03	9:27	11:54	16:12	21:10	26:47	33:05	34:16	47:38	47:55	55:26
350	1:02	2:19	3:47		6:48	10:38	13:36	18:31	24:12	30:37	37:48	40:01	54:26	55:54	64:41
400	1:10	2:38			7:34	11:49	15:19	20:50	27:13	34:27	42:32	45:44	61:14	63:53	73:55
450	1:19	2:50		5:14	8:19	13:00	17:01	23:09	30:14	38:16	47:15	51:27	68:02	71:52	83:10
500	1:28			5:45	9:04	14:11	18:43	25:28	33:16	42:06	51:59	57:10	74:51	49:51	92:24
550	1:37		4:02	6:17	9:50	15:21	20:25	27:47	36:17	45:56	56:42	62:53	81:39	87:50	101:38
600	1:46	2:50	4:22	6:48			22:07	30:06	39:19	49:45	61:26	68:36	88:27	95:49	110:53
650	1:54											74:19		103:48	120:07

3.11 FIELD TEST - PRECAST MANHOLES

- A. Manholes shall be physically and vacuum tested to assure compliance with the Contract Documents and the desired workmanship of the finished work has been achieved.
- B. Manhole Vacuum Test:
 1. Backfill shall be placed around the base of the manhole to a depth of one (1) foot over the top of the sewer pipe before the vacuum test is performed.
 2. The maximum vacuum applied to a manhole shall be twelve (12") inches of mercury (Hg).
 3. All manholes shall be subject to a vacuum test of a minimum of ten (10") inches Hg prior to acceptance by the Owner. The test shall be considered acceptable if the vacuum drops no more than one (1") inch within the time specified in the following table:

Manhole I.D. (inches)	48	60	72	84	96	120
Test Time for up to 8 feet in depth (seconds)	60	70	80	90	100	120
Additional Test Time for each 4 Foot Added Depth (Seconds)	10	15	20	30	40	60

4. Testing Sequence:
 - a. All manholes shall be physically and vacuum tested. Manholes failing the test shall be repaired by the Contractor, and retested.
 - b. Manholes failing the vacuum test two (2) times may, at the discretion of the Owner, be allow to be hydrostatically tested by an exfiltration test for acceptance.
 - c. The OWNER may require complete replacement of any manhole failing three (3) leak tests. Replacement shall be at no cost to the OWNER.
5. The CONTRACTOR shall furnish all necessary equipment and personal to conduct the tests in the presence of the ENGINEER.
6. Costs for testing shall be included within and incidental to the Contract Unit Price for manhole construction or rehabilitating.
7. Repairing, retesting, pressure grouting and/or replacement of defective manholes shall be at the sole expense and responsibility of the CONTRACTOR, and shall be pursued in a timely manner to prevent disruption to the Project and/or sewer services.
8. Manholes moved, disturbed, displaced and/or damaged in any way during the finishing and/or backfilling operation subsequent to successful testing shall be retested for acceptance as specified above, at the CONTRACTOR's expense.

3.12 INSTALLATION OF PRESSURE PIPE

- A. Trenching and backfill for yard and under slab piping shall meet the requirements of Section 02221.
- B. During pipe installation Contractor shall take every precaution to prevent foreign material from entering the pipe or fittings. The Contractor shall place a heavy, tightly woven canvas bag over each end of joint of pipe before lowering it into the trench.
- C. Jointing procedures, including cleaning of ends of pipe, and lubrication shall be in accordance with the manufacturer's recommendations. All push-joint and/or mechanical joint pipe shall be laid with the bells pointing in the direction of laying.
- D. Field cutting of pipe shall be done according to the manufacturer's recommendations. Cut end shall be smooth and at right angles to the axis of the pipe. Field cuts shall be filed or trimmed to resemble the spigot end of the pipe as manufactured. Depth marks shall be placed on the pipe to assure pipe is inserted to the full depth when joint is made.

- E. Thrust blocking shall be provided at all bends (of 11-1/4 degrees or greater) and tees and valves. Blocking shall be poured against undisturbed earth, be a minimum of twelve (12") inches thick, and constructed so that the pipe and fitting joints will be accessible for repairs. Install as shown in the Typical Details.
- F. All yard valves shall be installed plumb and true in a workmanlike manner.

3.13 PRESSURE SEWER TESTING

- A. Tests are to be conducted on lengths between valves or plugs and in no case on more than 3000 linear feet of pipe in any one (1) section.
- B. After the pipe has been laid, it shall be subjected to a hydrostatic pressure of 200 psi, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.
- C. The duration of each pressure test shall be at least two (2) hours when joints are exposed and four (4) hours where any joints in the line are covered or backfilled. The pressure shall not drop more than 5 psi during the test period.
- D. Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connection to the line. The pump, pipe connection, all necessary apparatus, and the gauges for the test, all taps into the pipe, and all necessary personnel for conducting the tests shall be furnished by the contractor and approved by the Engineer.
- E. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least seven (7) days have elapsed after the concrete reaction backing was installed.
- F. Before applying the specified test pressure, all air shall be expelled from the pipe. If release valves are not available at high points, the Contractor shall, at his own expense, make the necessary taps at points of highest elevation before the test is made and provide corporation stops to seal the taps after the test has been completed.
- G. All exposed pipes, fittings, and joints will be carefully examined during the pressure test. Leaking joints shall be disassembled, cleaned, and reassembled and/or defective material replaced until all leakage is stopped.
- H. Any cracked or defective pipe or fittings discovered in consequence of this pressure test, shall be removed and replaced with sound material, and the test shall be repeated until satisfactory results are obtained.
- I. A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

- J. The Contractor shall furnish the pump, pipe, connections, gauges, measuring devices, and all other necessary apparatus and shall furnish all necessary assistance to conduct the test.
- K. The duration of each leakage test shall equal the duration of the pressure test. No pipe will be accepted until the leakage during the test period is less than 0.67 gallons per 1000 feet of pipe under test.
- L. If any test discloses leakage greater than the allowance, the Contractor shall, at his own expense, locate and repair defects until the leakage is within the specified allowance. Following repairs, the line shall be retested.
- M. Any visible leaks at exposed joints or leaks evident at the surface where joints are covered shall be repaired by rejoining regardless of the total leakage shown by any test.
- N. The water required for testing shall be furnished by the Contractor and may be purchased from the local water purveyor through a fire hydrant meter. The Contractor shall be required to obtain and pay for the use of the hydrant meter.

END OF SECTION

SECTION 02730

MANHOLE REPAIR AND REHABILITATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Section 01530: Barriers
- B. Section 01560: Temporary Controls
- C. Section 01570: Traffic Regulations
- D. Section 01710: Cleaning
- E. Section 02722: Sanitary Sewers, Force Mains, and Appurtenances

1.02 SUBMITTALS

- A. Contractor shall supply a listing of all materials proposed for use under this Section including copies of the manufacturer's descriptive literature.
- B. Submit six (6) copies of the required documents in accordance with Section 01340.

1.03 JOB CONDITIONS

- A. Immediately notify the Engineer of any unexpected or unusual conditions. Discontinue work until Engineer provides notification to resume Work.
- B. All Work in streets and roadways shall be conducted in strict accordance with provisions of Section 01570.
- C. By-pass pumping of sewage will be allowed only as provided in the Project Work Schedule, and submitted and approved. Further, the Owner must approve any bypass pumping proposed by the Contractor.

1.04 QUALITY ASSURANCE

- A. Adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specific requirements and the methods needed for the proper performance of the Work in this section shall be provided and used to complete the Work.
- B. Equipment adequate in size, capacity, and numbers to accomplish the Work in a timely manner shall be provided and used to complete the Work.
- C. Contractor shall provide adequate on-the-job supervision of all Work and workmen to insure that the Work meets all requirements of the Contract.

1.05 PATENTS AND LICENSES

- A. The Contractor shall warrant and hold harmless the Owner and Engineer against all claims for Patent and/or Licensing infringements and any loss thereof.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Only materials listed below and/or those approved by the Engineer a minimum of seven (7) calendar days prior to the BID opening will be accepted for use on this Project.
- B. All materials and supplies shall be prepared, applied, and cured in strict accordance with the manufacturer's requirements and specifications.

2.02 REPAIR AND REHABILITATION MATERIALS

- A. Leak Stopping and Plugging Material - Type "A"
 - 1. Foam type chemical grout, "Scotch-Seal 5600", as manufactured by the 3-M Company.
 - 2. DRYCON-OCTOPLUG as manufactured by IPA Systems, Inc.
 - 3. THOROC PLUG as manufactured by CHEM REX Industries Ltd.
 - 4. QUAD-PLUG as manufactured by Quadex, Inc.
 - 5. STRONG PLUG as manufactured by Strong Seal Systems
- B. Plugging, Smoothing and Filling Material - Type "B"
 - 1. OCTOCRETE as manufactured by IPA Systems, Inc.
 - 2. HYPERFORM as manufactured by Quadex, Inc.
 - 3. QSR as manufactured by Strong Company, Inc.
- C. Coating and Sealing Materials - Type "C"
 - 1. PRECO Waterproofing/Sealer (Grey and White) as manufactured by FOSROC PRECO Industries, Ltd.
 - 2. DRYCON Waterproofing/Sealer (Grey and White) as manufactured by IPA Systems, Inc.
- D. Lining Material - Type "M"
 - 1. MATERIALS:
 - A. QM-1S Restore as manufactured by Quadex, Inc.
 - B. MS-2A as manufactured by Strong Company, Inc.
 - 2. CHARACTERISTICS: The cured system shall conform to minimum physical standards as follows:

<u>CURED LINER</u>	<u>STANDARD</u>	<u>28 DAY</u>
Compressive Strength	ASTM C-109	>9,000 psi
Flexural Strength	ASTM C-321	>1,400 psi
Bond Strength	ASTMC-882	>2,000 psi
Density	ASTM	>130 pcf.

- E. Coating and Sealing Materials - Type "E"
1. AQUATAPOXY Coating "A-6" as manufactured by American Chemical Corporation.
 2. Structure Guard Epoxy as manufactured by QUADDEX, Inc.
 3. Color to be white or other manufacturer's standard colors, to be selected by the Owner.

2.03 CLEANING MATERIALS

- A. A "Clean" water for high-pressure washing.
- B. Standard Masonry Cleaning Muriatic Acid Solution for chemical cleaning.

2.04 FLEXIBLE JOINT SEALANTS

- A. Flexible joint sealants for setting and sealing top frames to manholes shall be butyl rubber based material conforming to federal specification SS-S210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of one (1%) percent volatile matter and suitable for application temperatures between 10 and 100 degrees F.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Remove manhole casting if scheduled for repair or replacement, or if it is loose and requires resetting to seal and pass the vacuum test.
- B. Inspect manholes before beginning high-pressure wash to identify scope of work, to confirm actual depth for payment purposes, and to confirm rehabilitation category.
- C. Clean all interior surfaces by hand and with high-pressure "clean" water to remove all loose, deteriorated, and/or foreign materials.
- D. Wash all interior surfaces with approved solution of muriatic or hydrochloric acid.
- E. Repeat Step C.
- F. Chipping of smaller cracks and loose material may be necessary to provide proper placement and bonding of plugging materials.

- G. Controlled diversion or by-pass pumping of the sewage flow around the manhole being serviced shall be incorporated if required to accomplish a satisfactory rehabilitation.
- H. Construction Photographs
 - 1. Digital photographs in JPEG format shall be made of the pre-construction and post-construction conditions of the manholes scheduled for rehabilitation. Each photograph shall identify the manhole number, approximate location, manhole diameter, manhole depth and number, sizes, and locations (horizontal and vertical) of pipes connected to the manhole. All photographs shall have sufficient detail of the interior of each manhole to reveal conditions of existing defects and rehabilitated features.
 - 2. JPEG images shall be captured at a minimum resolution of 640x480 pixels.
 - 3. A hard drive or DVD(s) containing the photo files shall be submitted to the Engineer.

3.02 MAJOR MANHOLE REHABILITATION

- A. Major Manhole Rehabilitation shall include complete restoration of manholes in fair to poor condition. Manhole condition and vertical footage quantity shall be agreed upon by the field representative before proceeding with repairs.
- B. Manhole restoration shall consist of:
 - 1. Correct all visible leaks by use of approved Type "A" material, drilling and pressure grouting (approved grout only), or other approved methods.
 - 2. Repair, reshape, or replace invert area.
 - 3. Depressions, holes, and very rough areas shall be filled and smoothed with approved Type "B" material to provide a surface leveled to a maximum of 1/2 inch roughness.
 - 4. Type "C" Rehabilitation System
 - a. Brick and concrete block manholes shall, at a minimum, be coated with two (2) layers of Type "B" material to a minimum thickness of 1/4 inch or greater to meet the requirements of 3.02 - C - 3 above.
 - b. One (1) coat of Type "B" material shall be applied to all pre-cast manholes to a minimum finished thickness of 1/2 inch with no surface irregularities greater than 1/4 inch.
 - c. Interior Type "B" and "C" coatings may be applied by "Brushing" or approved "Spraying" methods.
 - d. Coat interior surface with one (1) coat of approved white Type "C" coating material and allow minimum curing time and proper curing conditions.
 - e. Apply second (2nd) layer of approved grey Type "C" coating materials within allowable time to assure proper bond and curing.

- f. Allow recommended final curing time and provide recommended curing conditions.
 - g. Re-set or replace frame and cover as specified.
 - h. Cast Iron Frames shall be set in a bed of Butyl rubber flexible joint sealant, and secured with anchors as specified and shown in the Project Details.
- 5. Type "M" Rehabilitation Systems
 - a. The lining system may be applied to damp, but not wet surfaces.
 - b. The lining shall be applied by approved appropriate spray and finishing techniques to the interior manhole surfaces by trained/experienced technicians.
 - c. The liner placement shall be in strict accordance with equipment and procedures approved prior to beginning the Work.
 - d. The finished liner thickness(es) shall be in accordance with the calculated required thickness(es) to a tolerance of minus 1/8th inches to plus 2/8th inches.
 - e. Replaced existing or new manhole frame and cover shall be completed prior to placement of the liner to allow the liner to be applied continuously over the frame up to the lid seat.

3.03 MINOR MANHOLE REHABILITATION

- A. Minor Manhole Rehabilitation shall include complete restoration of manholes rated in good to moderate condition. Manhole condition and vertical footage quantity shall be agreed upon by the field representative before proceeding with repair.
- B. Manhole restoration shall consist of:
 - 1. Correct all visible leaks by use of approved Type "A" material, drilling and pressure grouting (approved grout only), or other approved methods.
 - 2. Repair, reshape, or replace invert area.
 - 3. Depressions, holes, and very rough areas shall be filled and smoothed with approved Type "B" material to provide a surface leveled to a maximum of 1/2 inch roughness.
 - 4. Type "C" Rehabilitation System
 - a. Brick and concrete block manholes shall, at a minimum be coated with two (2) layers of Type "B" material to a minimum thickness of 1/4 inch or greater to meet the requirements of 3.03 - C - 3.
 - b. One (1) coat of Type "B" material shall be applied to all pre-cast manholes to a minimum finished thickness of 1/2 inch with no surface irregularities greater than 1/4 inch.
 - c. Interior Type "B" and "C" coatings may be applied by "Brushing" or approved "Spraying" methods.

- d. Coat interior surface with one (1) coat of approved white Type "C" coating material and allow minimum curing time and proper curing conditions.
 - e. Apply second (2nd) layer of approved grey Type "C" coating materials within allowable time to assure proper bond and curing.
 - f. Allow recommended final curing time and provide recommended curing conditions.
 - g. Re-set or replace frame and cover as specified.
 - h. Cast Iron Frames shall be set in a bed of Butyl rubber flexible joint sealant, and secured with anchors as specified and shown in the Project Details.
5. Type "M" Rehabilitation Systems
- a. The lining system may be applied to damp, but not wet surfaces.
 - b. The lining shall be applied by approved appropriate spray and finishing techniques to the interior manhole surfaces by trained/experienced technicians.
 - c. The liner placement shall be in strict accordance with equipment and procedures approved prior to beginning the Work.
 - d. The finished liner thickness(es) shall be in accordance with the calculated required thickness(es) to a tolerance of minus 1/8th inch to plus 2/8th inch.
 - e. Replaced existing or new manhole frame and cover shall be completed prior to placement of the liner to allow the liner to be applied continuously over the frame up to the lid seat.

3.04 TESTING

- A. Manholes shall be physically, and vacuum or hydrostatically tested to assure compliance with the Contract Specification and the desired workmanship of the finished rehab has been achieved.
- B. Manhole Vacuum Test:
 - 1. All manholes shall be physically inspected, and all visible defects repaired before reinspection.
 - 2. All manholes shall be subjected to a vacuum test of a minimum of ten (10") inches of mercury (Hg) prior to acceptance by the OWNER. The test shall be considered acceptable if the vacuum remains at nine (9") inches of Hg or higher after the following times:

Manhole I.D. (inches)	48	60	72	84	96	120
Test Time for up to 8 feet in depth (seconds)	60	70	80	90	100	120
Additional Test Time for each 4 Foot Added Depth (Seconds)	10	15	20	30	40	60

- C. Exfiltration Test:
 - 1. Manholes shall be subjected to an exfiltration test for a minimum of ten (10) minutes. The test shall be considered a success if the water level in the manhole (filled to the lid seat of the frame) remains within one (1) inch of the starting level for the specified time of ten (10) minutes.
 - 2. The manhole shall be plugged and filled to the test level and for a period of fifteen (15) minutes prior to the test to presoak the manhole materials. The water level shall be returned to the specified level before beginning the test.
- D. Testing Sequence:
 - 1. All manholes shall be physically inspected and vacuum tested. Manholes failing the test shall be repaired by the Contractor, and retested.
 - 2. Manholes failing the vacuum test two (2) times may, at the discretion of the Owner, be allowed to be hydrostatically tested by an exfiltration test for acceptance.
 - 3. The OWNER may require complete replacement of any manhole failing three (3) leak tests. Replacement shall be at no cost to the OWNER.
- E. The CONTRACTOR shall furnish all necessary equipment and personnel to conduct the tests in the presence of the ENGINEER.
- F. Costs for all testings shall be included within and incidental to the Contract Unit Price for manhole repair and rehabilitation.
- G. Repairing, retesting, pressure grouting, and/or replacement of defective manholes shall be at the sole cost and responsibility of the Contractor, and shall be pursued in a timely manner to prevent disruption to the Project and/or sewer services.
- H. Manholes moved, displaced, and/or damaged in any way during the finishing and/or backfilling operation subsequent to successful testing shall be retested for acceptance as specified above, at the sole cost of the Contractor.

3.05 CLEAN-UP AND WARRANTY

- A. Clean-up and final completion of Work.
 - 1. Upon acceptance of the installation Work and testing, the Contractor shall reinstate the Project areas affected by the operations.
 - 2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of rehabilitation, cleaning, excavating or other equipment and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and at the the sole expense of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.

B. Warranty

1. During the warranty period, which shall be defined as twelve (12) calendar months after acceptance by the Owner, any defects which will affect the integrity or strength of the manhole shall be repaired at the Contractor's expense, in a manner mutually agreed to by the Owner and the Contractor.

END OF SECTION

SECTION 02740

SEWER REHABILITATION BY CURED-IN-PLACE METHOD

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Rehabilitation of sewer lines by installation of an inverted tube resin-impregnated liner that is cured-in-place by thermal processors.
- B. The finished pipe shall be continuous from manhole to manhole and be formed to the original conduit.

1.2 RELATED DOCUMENTS

- A. Section 01010: Summary of Work
- B. Section 01150: Measurement and Payment
- C. Section 01310: Construction Schedules
- D. Section 01340: Shop Drawings, Product Data and Samples
- E. Section 01530: Barriers
- F. Section 01560: Temporary Controls
- G. Section 01570: Traffic Regulations
- H. Section 01710: Cleaning
- I. Section 02540: Sewer Flow Control and Bypass Pumping
- J. Section 02722: Sanitary Sewers, Force Mains and Appurtenances
- K. Section 02790: Sewer Line Cleaning and Closed-Circuit Television Inspection

1.3 SUBMITTALS

- A. Submit certified product data for:
 - 1. Resins
 - 2. Liner components
 - 3. Liner assembly
- B. Submit six (6) copies of required documents in accordance with Section 01340.
- C. Submit six (6) copies of the proposed construction schedules within fourteen (14) calendar days of the Notice to Proceed.
- D. Submit four (4) copies of required documents in accordance with Section 02540.

- E. Submit testing and inspection data as outlined in this Section.

1.4 REFERENCES

- A. ASTM F1216 -Standard Practice for CIPP.
- B. ASTM 638M -Tensile Strength Testing
- C. ASTM D790 -Flexure Testing
- D. ASTM D2412 -Parallel Plates Load Testing
- E. ASTM D543 -Chemical Sewer, chemical Resistance
- F. ASTM C581 -Chemical Resistance

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Liner shall be ordered and fabricated specifically for each pipeline reach as each is installed.
- B. Resin shall be impregnated into the liner after fabrication in a continuous process, and immediately loaded on a transport vehicle designed to provide adequate temperature and other conditions suitable to prevent chemical activity of the resin.
- C. The completed resin impregnated liner shall be transported, without delay, directly to the job site.
- D. The installation procedures shall begin in a timely manner upon arrival of the liner at the job site to prevent chemical action of the resin prior to installation and in-place curing.

1.6 JOB CONDITIONS

- A. Conduct all activities in strict accordance with the approval construction schedules, or request an amended schedule a minimum of fourteen (14) **days** prior to the proposed change(s).
- B. Immediately notify the Engineer of any unexpected or unforeseen conditions that arise during the course of the work. Work may be discontinued, with the direction and/or concurrence of the Engineer until such time as the condition can be evaluated and work is allowed to proceed.
- C. Pre-Inversion Cleaning: The Contractor shall rewash and clean the existing sewer pipe immediately before the pre-inversion television (TV) inspection, in accordance with Section 02790.
- D. Pre-Inversion Television (TV) Inspection: It shall be the responsibility of the Contractor to video (TV) inspect the sewer pipe immediately before the installation of the resin impregnated tube, to insure that the pipe is clean and pipe conditions have not changed.

- E. Video with a detailed written log shall be prepared and reviewed concurrently by the Contractor, Owner and/or the Engineer's representative on the project.
- F. A "GO" decision or "NO-GO" decision will be made at the conclusion of the review, with the following results:
 - 1. "GO" decision: Contractor shall proceed with by-pass pumping and installation of the pipe liner.
 - 2. "NO-GO" decision: Contractor shall dismantle the equipment and relocate to the next area of work identified on the Project Schedules, with compensation for the work performed in accordance with Sections 01010 and 01150.
- G. Diversion Pumping: The Contractor shall provide for continuous sewage flow around the section or sections of pipe designated for the inversion process in accordance with Section 02540.
- H. Line Obstructions: If Pre-Inversion video (TV) inspection reveals an obstruction in the existing pipe that cannot be removed by conventional sewer cleaning equipment, (such as heavy solids, dropped joints, protruding service connections or collapsed pipe) which will prevent completion of the inversion process, then a Point Repair shall be made by the Contractor in accordance with provisions of relevant Sections in these Specifications, with the approval of the Engineer.
- I. After completion of liner installation and curing and reconnections of individual services, Contractor shall perform a post-video (TV) inspection in accordance with Section 02790, and prepare a narrated (TV) video with a detailed written log of the completed reach of sewer, including measured distances to each service location from the downstream manhole.
- J. Contractor shall provide copies, of original quality, of both sets of (TV) video and written logs to the Owner, with the cost being incidental to the Work.

1.7 QUALITY ASSURANCE

- A. Adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the Work in this section shall be used.
- B. Equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner shall be used.

1.8 PRE-QUALIFICATIONS

- A. Products and/or Contractors pre-qualified for furnishing and installing the elements of the Project specified in this Section are provided in Section 00100 "Instructions to Bidders".

PART 2 - PRODUCTS

2.1 LINER TUBE

- A. Tube: The liner tube material shall meet the requirements of ASTM F1216, Section 5.1.
- B. The liner tube shall be fabricated to a size that when installed will form to the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion.
- C. The outside layer of the liner tube (before inversion) shall be plastic coated with a transparent flexible material that is compatible with the resin system used. The plastic coating shall not be subject to delamination after cure of the liner tube.
- D. The liner tube shall contain no intermediate or encapsulated elastomeric layers. No materials shall be included in the tube that are subject to delamination in the cured liner tube.
- E. The wall color of the interior pipe surface of the liner tube after installation shall not be of a dark or non-reflective nature, which could inhibit proper closed circuit television inspection.
- F. The liner tube shall be designed in accordance with ASTM F1216, Appendix X1, with the following additional requirements:
 - 1. The liner tube design shall assume no bonding to the original pipe wall.
 - 2. The Cured-In-Place Liner thickness shall be calculated based on the following physical condition of the existing pipe:
 - a. All pipes shall be considered fully deteriorated.
 - b. All pipes shall be subjected to full soil load of 120 lbs./cu.ft., with applicable Live Load, and water table **one (1)** feet below the top of the ground.
 - c. All pipes should be considered to have a minimum of 2% Ovality in the circumference.
 - 3. Only conditions (2.a) and (2.c) may be changed (after TV report) for later case by case design calculations if required by the Engineer. The Engineer may also add and/or modify the conditions based on field information and other considerations.
 - 4. Based on above physical condition, the following shall be the **minimum** liner thickness, using standard resin and the Design Criteria and Values mentioned earlier in these Specification, (thickness shall be rounded to the next highest multiple of 1.5 mm after adding an allowance of 5% to the design thickness for resin migration). Bidders and Contractors shall also verify and agree with the table for correctness and, if disagreeing, must have any modifications approved by the "Owner" through an addendum before the bid date to be issued as information for all prospective bidders.

5. The thickness of the cured-in-place liner shall be within minus 5% and plus 10% of the designated thickness. Thicknesses greater than that specified shall not be allowed in order to minimize any reduction of hydraulic capacity of the sewer being rehabilitated. The installed thickness shall be accurately measured and certified by the Contractor.

<u>LINER THICKNESS</u>			
SEWER DIAMETER	PIPE INVERT DEPTH UP TO 10'	PIPE INVERT DEPTH 10' - 15'	PIPE INVERT DEPTH OVER 15'
6"	4.5mm	4.5mm	4.5mm
8"	6.0mm	6.0mm	6.0mm
10"	6.0mm	6.0mm	7.5mm
12"	6.0mm	7.5mm	9.0mm
15"	7.5mm	9.0mm	10.0mm
18"	9.0mm	12.0mm	13.5mm
21"	10.5mm	13.5mm	15.0mm
24"	12.0mm	15.0mm	16.5mm
30"	15.0mm	18.0mm	21.0mm
36"	16.5mm	21.0mm	24.0mm
42"	19.5mm	24.0mm	28.5mm
48"	22.5mm	28.5mm	33.0mm
54"	25.5mm	30.0mm	36.0mm

2.2 RESIN

- A. The liquid thermosetting resin used to impregnate the polyester felt tube shall produce a properly cured tube that will be resistant to abrasion and corrosion due to solids, grit, sand, acids, and gases such as hydrogen sulfide, methane, carbon monoxide and other compounds normally associated with municipal sewage. The resin shall have a heat deflection temperature greater than one-hundred (100°) degrees centigrade.
- B. Resin: The resin system shall meet the requirements of ASTM F1216, Section 5.2.
- C. Resin Impregnation: The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall.
- D. The resin system to be used shall be manufactured by an approved company(ies) selected by the "Cured-In-Place" process manufacturer.

- E. The bond between liner tube layers shall be at the minimum design strength and shall be uniform throughout the entire tube. All layers, after cure, must form one homogeneous structural pipe wall with no part of the tube left unsaturated by resin.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The preparation steps herein before and after specified shall be completed, unless approved otherwise by the Engineer.
- B. Prior to the commencement of the actual liner inversion process, the Contractor will plan his work after review of previous television inspection tapes and reports.
- C. Bypass pumping equipment shall be set up and tested in accordance with Section 02540.
- D. All point repairs must be satisfactorily completed, equipment and material mobilized.
- E. The Engineer shall be informed of any noted deviations from approved Work Schedules for liner installations prior to beginning work.
- F. Safety
 - 1. The Contractor shall carry out his operations in strict accordance with all applicable OSHA Standards.
 - 2. Particular attention is drawn to those safety requirements involving work on an elevated platform, entry into a confined space and chemical exposure.
 - 3. It shall be the Contractor's responsibility to familiarize all personnel at the job site with appropriate OSHA Standards and Regulations pertaining to all aspects of the Work.

3.2 INSTALLATION PROCEDURES

- A. EXISTING MANHOLE LINER ENTRY: For sanitary sewers with diameters large enough to prevent liner entry through the standard manhole frame and cover, the Contractor shall be responsible for removal and replacement of the existing manhole frame and cover and the top conical section as follows:
 - 1. Remove frame and cover.
 - 2. Excavate one (1') foot from the outside edge of the existing manhole to a minimum of six (6") inches below the seam between the top conical section and the section upon which the top conical section rests. Remove and dispose of materials that are unsuitable.
 - 3. Remove top conical manhole section.

4. Following completion of liner insertion activities, Contractor shall re-install top conical section in accordance with the applicable portions of Section 02722.
 5. Backfill manhole in accordance with Section 02221. All backfill material shall be approved by Engineer prior to placement.
 6. Re-install frame and cover in accordance with the applicable portions of Section 02722.
 7. Perform clean-up and surface restoration in accordance with Sections 01710, 02485, and 02610 (for paved areas).
 8. Should existing manhole and/or frame and cover be damaged during removal and re-installation procedures, repair or replacement of damaged components shall be at the Contractor's expense.
- B. WET OUT: The Contractor shall designate a location where the felt tube will be impregnated ("wet out") with resin using distribution rollers and vacuum, to thoroughly saturate the felt tube prior to its dispatch for installation. The Contractor shall inform the Engineer in advance, to inspect the materials and the wet out procedure. A catalyst system or additive(s) compatible with the resin and tube may be used in accordance with the manufacturer's recommendation and with the Engineer's approval.
- C. INSERTION: The resin impregnated tube shall be transported and kept in a refrigerated truck, until it is inserted through an existing manhole by means of an inversion or equal process, and the application of a water column sufficient to fully extend it to the next designated manhole or termination point. The tube end shall initially be turned inside out, and attached to a platform ring or standpipe or as approved. The inversion water column or steam pressure will be adjusted to sufficient height/pressure to cause the impregnated tube to invert from manhole to manhole, and hold the tube tight against the existing pipe wall. The inversion area/equipment shall be securely protected, barricaded, and proper signage installed in accordance with appropriate Sections of the Specifications.
- D. CURING: After the insertion is completed, the Contractor shall use a suitable heat source and water or steam recirculation system, capable of delivering the required hot water uniformly throughout the section, for a consistent cure of the resin. The curing temperature shall be recommended from calculations provided by the resin/catalyst system or the process manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge shall be placed between the impregnated tube and the invert of the original pipe at the upstream and downstream manholes to monitor the outside liner temperatures during the resin curing process. Initial cure may be considered completed when the exposed portions of the felt tube pipe have attained the designed hardness, and the remote sensing device indicates the design temperatures have been reached. Curing temperatures and duration shall be in strict compliance with submitted data and information.

- E. COOL DOWN: The Contractor shall cool the hardened pipe to a temperature below 100 degrees Fahrenheit, before relieving the water column or pressure. Cool water may be added to the water column while draining hot water from a small hole at the opposite end of the cured-in-place pipe, so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column to prevent a vacuum from developing, which could damage the newly installed pipe. Coupon samples shall be obtained for testing.
- F. FINISHED PIPE: The finished cured-in-place-liner shall be continuous over the entire length of the inversion run, and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes and delamination.

3.3 SEALING AT MANHOLES

- A. The cured-in-place liner shall make a water-tight seal at the manhole opening with no annular gaps. Under all circumstances, a half inch (½") diameter activated Oakum band soaked in Scotchseal 5600 or equal, shall be applied all around for an approved seal, unless approved otherwise.
- B. All large annular spaces shall be sealed by using activated Oakum soaked in Scotchseal 5600 or equal, and later covered with a cementitious epoxy fortified mortar.
- C. This procedure shall be completed before proceeding to the next manhole section.

3.4 SERVICE RE-INSTATEMENTS

- A. Provide a minimum of 72 hours notice to customers whose sanitary sewer service will potential be interrupted.
- B. In the event of any Contractor-related overflow or interruption/backup of customer service, the Contractor shall immediately notify the Engineer and Owner. The Contractor shall contain and eliminate the overflow/interruption.
- C. Contractor shall be responsible for any fines levied by others, reimbursement of any agency incurred costs, damage, cleanup, restoration of flow and any disruption of service costs to customers as a result of the Contractor's work. This is in addition to any and all costs incurred by the customer.
- D. All service re-instateMENTS shall be completed by use of specialized equipment designed to operate within the new liner pipe.
- E. Employ method and equipment that restore the service connection capacity to not less than 90 percent of its original capacity.
- F. Immediately open any missed connections and repair any holes drilled in error. Submit method(s) of repair to the Engineer for approval, which may require field or workshop demonstration.

- G. Reconnect existing service connections, including those that are intended to serve unoccupied or abandoned buildings or vacant lots, unless directed otherwise by the Owner or Engineer.
- H. Contractor shall provide service locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, and right or left side connection (looking upstream) in a tabular form.

3.5 MATERIALS TESTING AND CERTIFICATIONS

A. GENERAL

1. Results of testing shall be submitted in sets of six (6) copies of original quality within thirty (30) calendar days of the Notice-to-Proceed and/or at least thirty (30) calendar days prior to beginning work on the Project.
 2. Certified copies of all test reports on the properties of the selected resin, and later, on the liner coupons performed by, and/or for the Contractor, shall be submitted to the Engineer. Results of additional product testing, normally performed for "in-house quality control" and process improvement, shall also be provided to the Engineer, at no cost to the Owner.
 3. The Contractor shall inform the Engineer in writing of the Name and Designation of all in-house quality control tests and the sampling frequency of the tests on the resin and liner materials. The Engineer shall also have the right to require the testing to be done at designated liner locations within the scope of the Contract.
 4. The Owner may require that additional tests be performed on random samples, at no cost to the Contractor.
- B. Chemical Resistance: The finished liner tube shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. Samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that the liner tube samples with and without plastic coating meet these chemical testing requirements.
- C. Long-Term Reduction in Physical Properties: Long-term creep data in accordance with ASTM D2990 shall be submitted. Duration of creep testing shall be a minimum of 10,000 hours.
- D. Hydraulic Capacity: Calculations must support that the finished liner tube shall provide a minimum of 100% of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a mutually agreed upon roughness coefficient for the original pipe material. A typical roughness coefficient for the finished liner tube shall be as verified by third party test data.

- E. Field Samples: To verify past performance, the manufacturer shall submit a minimum of 15 test results from previous field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the physical properties specified in this Section have been achieved in previous field applications.
- F.
1. Contractor shall submit relevant information from the resin manufacturer, including specifications, characteristics and properties, as well as methods of application. This data shall be submitted to the Engineer for approval.
 2. A written certification that the resin material complies with the required application, along with curing temperature, and duration of the temperature (step cooking temperatures/hours at each and final stages) depending upon the sewer size and liner thickness, shall be supplied to the Engineer. A blanket letter will not be sufficient in cases of varying liner thicknesses and lengths, etc.
 3. The required information is necessary for the Engineer to verify that the curing is being accomplished in accordance with the approved plans and procedures, and allow checking in the field during installation.
- G. WET OUT:
1. The Engineer shall be informed in advance, for verification and inspection of the resin material at the "wet out" of the felt tube. The inspection shall be at the discretion of the Engineer, which shall not relieve the Contractor of his responsibilities. The inversion and heating schedule/plan shall be submitted at least 24 hours in advance. Heating shall continue uninterrupted until the desired temperature is achieved. Temperatures shall be measured and recorded at both ends by sensitive and accurate measuring devices, and the initials of the Engineer or his representative shall be obtained on the log.
 2. Copies of curing temperature/time log sheets, on approved format, shall be submitted to the Engineer in a timely manner after the curing is completed. This report shall be attached to the daily report. It shall be imperative that the Contractor strictly follow the process manufacturer's criteria, guidelines and recommendations. Any changes in guidelines after the contract date will require the owner and/or Engineer's written approval prior to implementing.
- H. External Hydrostatic Design: Acceptable third party testing and verification of enhancement factor, K, (equation 1 - ASTM F1216) shall be submitted.
- I. External Buckling Design: Where the liner tube is designed as a stand alone pipe, a fully deteriorated condition, acceptable third party testing and verification of design analysis techniques (ASTM F1216, Section X1.2.2) shall be submitted. This testing requirement can be accomplished with soil box testing, with approval of the Engineer.

3.6 FIELD TEST - FINAL CURED-IN-PLACE LINER TESTING

- A. Before the work is accepted and before any re-instatement of services is performed, a final testing procedure is to be followed.
- B. The standard leak test for all cured-in-place liners shall be a low pressure air exfiltration test. Other exfiltration tests, if approved by the Engineer, will be conducted in accordance with ASTM C-828 or latest revision.
- C. A visual inspection shall be performed when groundwater levels are above the pipeline, if possible. All visible leaks shall be repaired.

3.7 LOW PRESSURE AIR EXFILTRATION TEST – CURED-IN-PLACE LINERS

- A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 4.0 to 3.0 PSIG.
- B. Times for mixed pipe sized of varying lengths should be calculated as described in ASTM, C828-76T using formula $t = K d/q$ ($q = .0020$).
- C. Lengths of sections under test shall not exceed 500 linear feet.
- D. The following items are for one pipe size only:

AIR TEST TABLE
SPECIFICATION TABLE (MIN:SEC) REQUIRED
TESTING ONE PIPE DIAMETER ONLY
PIPE DIAMETER, INCHES

Length of Pipe Segment (FT)	4	6	8	10	12	15	18	21	24	27	38	33	36	39	42
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	8:05
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	16:10
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	19:50
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35			
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20				20:25	19:58	23:06
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30			13:24	16:32	17:09	23:49	23:57	27:43
175	0:31	1:09	2:03	3:13	4:37	7:05			12:06	15:19	18:54	20:01	27:13	27:57	32:20
200	0:35	1:19	2:21	3:40	5:17			10:25	13:36	17:13	21:16	22:52	30:37	31:56	36:58
225	0:40	1:29	2:38	4:08	5:40		8:31	11:35	15:07	19:08	23:38	25:44	34:01	35:56	41:35
250	0:44	1:39	2:56	4:35			9:24	12:44	16:38	21:03	25:59	28:35	37:25	39:56	46:12
275	0:48	1:49	3:14	4:43		8:16	10:12	13:53	18:09	22:58	28:21	31:27	40:49	43:55	50:49
300	0:53	1:59	3:31		6:03	9:27	11:54	16:12	21:10	26:47	33:05	34:16	47:38	47:55	55:26
350	1:02	2:19	3:47		6:48	10:38	13:36	18:31	24:12	30:37	37:48	40:01	54:26	55:54	64:41
400	1:10	2:38			7:34	11:49	15:19	20:50	27:13	34:27	42:32	45:44	61:14	63:53	73:55
450	1:19	2:50		5:14	8:19	13:00	17:01	23:09	30:14	38:16	47:15	51:27	68:02	71:52	83:10
500	1:28			5:45	9:04	14:11	18:43	25:28	33:16	42:06	51:59	57:10	74:51	49:51	92:24

3.8 FINAL TESTING AND INSPECTIONS

- A. Logs, TV tapes and results of final testing and inspections shall be submitted in sets of three (3) copies of original quality within five (5) days of the completion of the related work.
- B. Logs and results shall be available on the job site (or at a local field office) for all required tests and inspection as they are performed.
- C. For each inversion length designated by the Owner in the Contract Documents or Purchase Order, one finished liner tube sample shall be prepared using one of the following methods.
 - 1. The sample shall be cut from a section of cured liner tube at an intermediate manhole.
 - 2. At the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
- D. The finished liner tube samples shall be tested in accordance with ASTM F1216, Section 8.1.3.
- E. Leakage testing of the finished liner tube shall be accomplished during cure while under a positive head. This test does not preclude the requirement for the low pressure air test.
- F. Visual inspection of the finished liner tube shall be in accordance with ASTM F1216, Section 8.4.

3.9 CLEAN-UP AND WARRANTY

- A. Clean-up and final completion of Work.
 - 1. Upon acceptance of the installation Work and testing, the Contractor shall reinstate the Project areas affected by the operations.
 - 2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of TV, cleaning, boiler, steam or other trucks and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and at the sole expense of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.
 - 3. Correction of failed liner or liner deemed unacceptable, as identified in the post video (TV) inspection and/or test reports for structural values, thickness, etc. shall be repaired at no extra cost to the Owner. Method(s) of repair shall be approved by the Engineer, which may require field or workshop demonstration.

B. Warranty

1. During the warranty period, which shall be defined as twelve (12) calendar months after acceptance by the Owner, any defects which will affect the integrity or strength of the liner pipe or hydraulic capacity of the sewer shall be repaired at the Contractor's expense, in a manner mutually agreed to by the Owner and the Contractor.

END OF SECTION

SECTION 02741

SEWER SERVICE LATERAL REHABILITATION BY CURED-IN-PLACE METHOD

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Rehabilitation of sewer laterals by installation of an inverted tube resin-impregnated liner that is cured-in-place by thermal processors.
- B. The finished pipe shall be continuous from sanitary sewer main to a clean-out tee/wye and be formed to the original conduit.

1.2 RELATED DOCUMENTS

- A. Section 01010: Summary of Work
- B. Section 01150: Measurement and Payment
- C. Section 01300: Submittals
- F. Section 01560: Temporary Controls
- G. Section 01570: Traffic Control
- H. Section 01700: Cleaning

1.3 SUBMITTALS

- A. Submit certified product data for:
 - 1. Resins
 - 2. Liner components
 - 3. Liner assembly
- B. Submit six (6) copies of required documents in accordance with Section 01340.
- C. Submit six (6) copies of the proposed construction schedules within fourteen (14) calendar days of the Notice to Proceed.
- D. Submit testing and inspection data as outlined in this Section.

1.4 REFERENCES

- A. ASTM F2561-06 – Standard Practice for Rehabilitation of a Sewer Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-In-Place Liner
- B. ASTM F1216 -Standard Practice for CIPP
- C. ASTM 638M -Tensile Strength Testing
- D. ASTM D790 -Flexure Testing
- E. ASTM D2412 -Parallel Plates Load Testing

- F. ASTM D543 -Chemical Sewer, chemical Resistance
- G. ASTM C581 -Chemical Resistance

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Liner shall be ordered and fabricated specifically for each lateral reach as each is installed.
- B. Resin shall be impregnated into the liner after fabrication in a continuous process, and immediately loaded on a transport vehicle designed to provide adequate temperature and other conditions suitable to prevent chemical activity of the resin.
- C. The completed resin impregnated liner shall be transported, without delay, directly to the job site.
- D. The installation procedures shall begin in a timely manner upon arrival of the liner at the job site to prevent chemical action of the resin prior to installation and in-place curing.

1.6 JOB CONDITIONS

- A. Conduct all activities in strict accordance with the approval construction schedules, or request an amended schedule a minimum of fourteen (14) weeks prior to the proposed change(s).
- B. Immediately notify the Engineer of any unexpected or unforeseen conditions that arise during the course of the work. Work may be discontinued, with the direction and/or concurrence of the Engineer until such time as the condition can be evaluated and work be allowed to proceed.
- C. Pre-Inversion Cleaning: The Contractor shall rewash and clean the existing lateral pipe immediately before the pre-inversion Television (TV) inspection.
- D. Pre-Inversion Television (TV) Inspection: It shall be the responsibility of the Contractor to video (TV) inspect the lateral pipe immediately before the installation of the resin impregnated tube, to assure that the pipe is clean and pipe conditions have not changed.
- E. Video with a detailed written log shall be prepared and reviewed concurrently by the Contractor, Owner and/or the Engineer's representative on the project.
- F. A "GO" decision or "NO-GO" decision will be made at the conclusion of the review, with the following results:
 - 1. "GO" decision: Contractor shall proceed with by-pass pumping and installation of the pipe liner.
 - 2. "NO-GO" decision: Contractor shall dismantle the equipment and relocate to the next area of work identified on the Project Schedules, with compensation for the work performed in accordance with Sections 01010 and 01150.

- G. Diversion Pumping: The Contractor shall provide for continuous sewage flow around the section or sections of pipe designated for the inversion process, if required. The pump and bypass lines shall have adequate capacity and size to handle the flow as per provisions of relevant Sections in these Specifications.
- H. Line Obstructions: If Pre-Inversion video (TV) inspection reveals an obstruction in the existing pipe that cannot be removed by conventional sewer cleaning equipment, (such as heavy solids, dropped joints, protruding service connections or collapsed pipe which will prevent completion of the inversion process), then the lateral shall be replaced by dig-and-lay in accordance with provisions of relevant Sections in these Specifications with the approval of the Engineer.
- I. After completion of liner installation and curing, Contractor shall prepare a narrated (TV) video with a detailed written log of the completed reach of lateral, including measured distances from main to clean-out.
- J. Contractor shall provide copies of original quality, of both sets of (TV) video and written logs to the Owner, with the cost incidental to the Work.

1.7 QUALITY ASSURANCE

- A. Adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the Work in this section shall be used.
- B. Equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner shall be used.

1.8 PRE-QUALIFICATIONS

- A. Products and/or Contractors pre-qualified for furnishing and installing the elements of the Project specified in this Section are provided in Section 00100 "Instructions to Bidders".
- B. A qualified bidder for installing a mainline/lateral connection and lateral repair system shall use a Manufactured System that has a minimum of a five-year history of satisfactory performance. Bidders shall be prepared to submit a list of installation projects, numbers of connections sealed and lateral footage lined providing contact names, addresses, and telephone numbers for reference.

PART 2 - PRODUCTS

2.1 LINER TUBE

- A. The liner assembly shall be continuous in length and consist of one or more layers of absorbent textile material i.e. needle punched felt, circular knit or circular braid that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. The textile tube and sheet shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe segments, and flexibility to fit irregular pipe sections. The wet-out textile tube and sheet shall meet ASTM F 1216, 7.2 as applicable, and shall have a uniform thickness and 5% to 10% excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.
- B. The outside layer of the textile tube (before inversion) and interior of the textile sheet shall be coated with an impermeable, translucent flexible membrane. The textile sheet before insertion shall be permanently marked as a "Lateral Identification" correlating to the address of the building and the lateral pipe services. The sheet and tube shall be surrounded by a second impermeable, flexible translucent membrane (translucent bladder) that will contain the resin and facilitate vacuum impregnation while monitoring of the resin saturation during the resin impregnation (wet-out) procedure.
- C. The mainsheet and lateral tube shall be a one-piece assembly formed in the shape of a "T" or WYE. No intermediate or encapsulated elastomeric layers shall be in the textile that may cause de-lamination in the cured in-place pipe. The main sheet will be flat with one end overlapping the second end and sized accordingly to create a circular lining equal to the inner diameter of the main pipe. The lateral tube will be continuous in length and the wall thickness shall be uniform. The lateral tube will be capable of conforming to offset joints, bells, and disfigured pipe sections.
- D. Liner material and system shall be "T-Liner" as manufactured by LMK Enterprises, Inc. or approved equal.

2.2 RESIN

- A. The resin/liner system shall conform to ASTM D5813 Section 8.2.2 - 10,000-hour test.
- B. The resin shall be a corrosion resistant polyester, vinylester, epoxy or silicate resin and catalyst system that when properly cured within the composite liner assembly, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP, for this project.
- C. The resin shall produce CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216.

Table 1 CIPP INITIAL STRUCTURAL PROPERTIES

Property	ASTM Test	Minimum value_____	
		psi	(MPa)
Flexural Strength	D 790	4,500	(31)
Flexural Modulus	D 790	250,000	(1,724)

PART 3 - EXECUTION

3.1 PREPARATION

- A. The preparation steps herein before and after specified shall be completed, unless approved otherwise by the Engineer.
- B. Prior to the commencement of the actual liner inversion process, the Contractor will plan his work after review of previous television inspection and reports.
- C. The Engineer shall be informed of any noted deviations from approved Work Schedules for liner installations prior to beginning work.
- D. Safety
 - 1. The Contractor shall carry out his operations in strict accordance with all applicable OSHA Standards.
 - 2. Particular attention is drawn to those safety requirements involving work on an elevated platform, entry into a confined space and chemical exposure.
 - 3. It shall be the Contractor's responsibility to familiarize with appropriate OSHA Standard and Regulations pertaining to all aspects of the Work.

3.2 INSTALLATION PROCEDURES

- A. *Access Safety* – Prior to entering access areas such as manholes, an excavation pit, performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.
- B. *Cleaning and Inspection* – As per NASSCO Standards.
- C. *Accessing the Lateral* – A cleanout is required to be located on the exterior of the building. The cleanout fitting must be either TEE shaped or back to back WYE shaped where the lateral meets the cleanout riser pipe. The cleanout shall be located no less than within two (2) feet of the finished liner.
- D. *Plugging* – The upstream side of the cleanout shall be plugged during insertion and curing of the liner assembly ensuring no flows enter the pipe and no air, steam or odors will enter the building. When required, the main pipe flows will be by-passed. The pumping system shall be sized for normal to peak flow conditions. The upstream manhole shall be monitored at all times and an emergency deflating system will be incorporated so that the plugs may be removed at any time without requiring confined space entry.

- E. *Inspection of Pipelines* – The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots, and collapsed or crushed pipe sections. These conditions shall be noted. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.
- F. *Line Obstructions* – The existing service lateral shall be clear of obstructions that prevent the proper insertion and expansion of the lining system. Changes in pipe size shall be accommodated, if the lateral tube is sized according to the pipe diameter and condition. Obstructions may include dropped or offset joints of no more than 20% of inside pipe diameter.
- G. *Resin Impregnation* – The lateral tube and mainline sheet shall be encapsulated within the translucent bladder (liner/bladder assembly) shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe. No dry or unsaturated area in the mainline sheet or lateral tube shall be acceptable upon visual inspection.
- H. *Liner Insertion* – The lateral tube and inversion bladder will be inserted into the carrying device. The mainline liner and bladder shall be wrapped around the “T” launching device and held firmly by placing four (4) hydrophilic O-rings around the main liner. An adhesive sealant 300ml in volume is applied to the main/lateral interface and shall be applied as a two-inch (2”) wide band on the main liner. Both the launching and carrying device are pulled into the pipe using a cable winch. The pull is complete when the open port of the “T” launching device is aligned with the interface of the service connection and mainline pipe. The lateral tube is completely protected during the pull. The mainline liner is supported on a rigid “T” launcher that is elevated above the pipe invert through the use of a rotating skid system. The liner assembly shall not be contaminated or diluted by exposure to dirt, debris, or water during the pull.
- I. *Bladder* – The main bladder shall be inflated causing the main sheet to unwrap and expand, embedding the hydrophilic O-rings between the main liner and the main pipe as the main liner is pressed tight against the main pipe. The lateral tube is inverted by the action of the lateral bladder through the center of the main liner as it extends up into the lateral pipe to a termination point that shall be no less than 2-feet from the exterior cleanout. The Main/Lateral bladder assembly shall extend past all ends of the liner, as no cutting shall be required.

- J. *Curing* – After liner placement is complete; pressure is maintained pressing the liner firmly against the inner pipe wall. The liner is chemically cured at ambient temperatures or by a suitable heat source. The heating equipment shall be capable of delivering a mixture of steam and air throughout the liner bladder assembly to uniformly raise the temperature above the temperature required to cure the resin. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of the soil). The heat source temperatures shall be monitored and logged during the cure and cool down cycles. The manufacturer's recommended cure schedule shall be submitted.
- K. *CIPP Processing* – Curing shall be done without pressure interruption with air or a mixture of air and steam for the proper duration of time per the resin manufacturer's recommendations. When the heat source is removed and the temperature on both ends of the CIPP reaches 100 degrees Fahrenheit or less, the processing shall be finished

3.3 FINISH

- A. *The finished CIPP* – Shall be continuous over the entire length of the rehabilitated sewer service lateral and 16" of the main pipe (5" on either side of a 6" lateral or 6" on either side of a 4" lateral connection). The CIPP shall smooth with minimal wrinkling and increase flow rate. The CIPP shall be free of dry spots, lifts, and delaminated portions. The CIPP shall taper at each end providing a smooth transition for accommodating video equipment and maintaining proper flow in the mainline. After the work is completed, the installer will provide the owner with video footage documenting the repair and the visual markings identifying the sewer lateral address as completed work. The finished product must provide an airtight/watertight verifiable non-leaking connection between the main sewer and sewer service lateral.

3.4 MATERIALS TESTING AND CERTIFICATIONS

- A. GENERAL
 - 1. Results of testing shall be submitted in sets of six (6) copies of original quality within thirty (30) calendar days of the Notice-to-Proceed and/or at least thirty (30) calendar days prior to beginning work on the Project.
 - 2. Certified copies of all test reports on the properties of the selected resin, and later, on the liner coupons performed by, and/or for the Contractor, shall be submitted to the Engineer. Results of additional product testing(s), normally performed for "in-house quality control" and process improvement, shall also be provided to the Engineer, at no cost to the Owner.
 - 3. The Contractor shall inform the Engineer in writing, the Name and Designation of all in-house quality control tests and the sampling frequency of the tests on the resin and liner materials. The Engineer shall also have the right to require the testing to be done at designated liner locations within the scope of the Contract.

4. The Owner may require that additional tests be performed on random samples, at no cost to the Contractor.
- B. Chemical Resistance: The finished liner tube shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. Samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that the liner tube samples with and without plastic coating meet these chemical testing requirements.
- C. Hydraulic Capacity: Calculations must support that the finished liner tube shall have at least 100% of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the original pipe material. A typical roughness coefficient for the finished liner tube shall be as verified by third party test data.
- D. Field Samples: To verify past performance, the manufacturer shall submit a minimum of 15 test results from previous field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the physical properties specified in this Section have been achieved in previous field applications.
- E.
 1. Contractor shall submit relevant information from the resin manufacturer, including: specifications, characteristics and properties, as well as methods of application. This data shall be submitted to the Engineer for approval.
 2. A written certification that the resin material complies with the required application, along with curing temperature, and duration of the temperature (step cooking temperatures/hours at each and final stages) depending upon the sewer size and liner thickness, shall be supplied to the Engineer. A blanket letter will not be sufficient in cases of varying liner thicknesses and lengths, etc.
 3. The required information is necessary for the Engineer to verify that the curing is being accomplished in accordance with the approved plans and procedures, and allow checking in the field during installation.
- F. WET OUT:
 1. The Engineer shall be informed in advance, for verification and inspection of the resin material at the "wet out" of the felt tube. The inspection shall be at the discretion of the Engineer, which shall not relieve the Contractor of his responsibilities. The inversion and heating schedule/plan shall be submitted at least 24 hours in advance. Heating shall continue uninterrupted until the desired temperature is achieved. Temperatures shall be measured and recorded at both ends by sensitive and accurate measuring devices, and the initials of the Engineer or his representative shall be obtained on the log.

2. Copies of curing temperature/time log sheet on approved format, shall be submitted to the Engineer in a timely manner after the curing is completed. This report shall be attached to the daily report. It shall be imperative on the Contractor to strictly follow the process manufacturer's criteria, guidelines and recommendations. Any changes in guidelines after the contract date will require the owner and/or Engineer's written approval prior to implementing.
- G. External Hydrostatic Design: Acceptable third party testing and verification of enhancement factor, K, (equation 1 - ASTM F1216) shall be submitted.
- H. External Buckling Design: Where the liner tube is design as a stand alone pipe, a fully deteriorated condition, acceptable third party testing and verification of design analysis techniques (ASTM F1216, Section X1.2.2) shall be submitted. This testing requirement can be accomplished with soil box testing, with approval of the Engineer.

3.5 FIELD TEST – INSEPCION AND TESTING PRACTICES

- A. *Sampling* – As designated by the purchaser in the purchase agreement, the preparation of a CIPP sample is required. The sample shall be prepared by securing a flat plate mold using the textile tube material and resin system as used for the rehabilitated pipe.
- B. *Pressure* – The pressure applied on the plate sample will be equal to the highest pressure exerted on the lateral tube during the inversion process.
- C. *Length* – The minimum length of the sample must be able to produce at least five specimens for testing in accordance with ASTM D-790-03.
- D. *Conditioning* – Condition the test specimens at $73.4 \pm 3.6^{\circ}\text{F}$ ($23 \pm 2^{\circ}\text{C}$) and $50 \pm 5\%$ relative humidity for not less than 40 hour prior to test in accordance with Practice ASTM D 618, for those tests where conditioning is required.
- E. *Short-Term Flexural (Bending) Properties* – The initial tangent flexural modulus of elasticity and flexural stress shall be measured for gravity and pressure pipe applications in accordance with Test Method D 790 and shall meet the minimum requirements of Table 1.
- F. *CIPP Wall Thickness* – The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness as agreed upon between purchaser and seller.
- G. *Gravity Pipe Leakage Testing* – If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an air test method where a test plug is placed adjacent to the upstream and downstream ends of the main sheet CIPP and at the upper most end of the lateral tube. This test should take place after the CIPP has cooled down to ambient temperature. This test is limited to pipe lengths with no service connections. The test pressure shall be 4 PSI for a three-minute) minute test time and during this time the pressure shall not drop below 3.5 PSI.

3.6 FINAL TESTING AND INSPECTIONS

- A. Logs, TV tapes and results of final testing and inspections shall be submitted in sets of three (3) copies of original quality within five (5) days of the completion of the related work.
- B. Logs and results shall be available on the job site (or at a field office) for all required tests and inspection as they are performed.
- C. For each inversion length designated by the Owner in the Contract Documents or Purchase Order, one finished liner tube sample shall be prepared using one of the following methods.
 - 1. The sample shall be cut from a section of cured liner tube at an intermediate manhole.
 - 2. At the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
- D. The finished liner tube samples shall be tested in accordance with ASTM F1216, Section 8.1.3.
- E. Leakage testing of the finished liner tube shall be accomplished during cure while under a positive head.
- F. Visual inspection of the finished liner tube shall be in accordance with ASTM F1216, Section 8.4.

3.7 CLEAN-UP AND WARRANTY

- A. Clean-up and final completion of Work.
 - 1. Upon acceptance of the installation Work and testing, the Contractor shall reinstate the Project areas affected by the operations.
 - 2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of TV, cleaning, boiler, steam or other trucks and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and the sole cost of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.
 - 3. Correction of failed liner or liner deemed unacceptable, as a result of the post video (TV) inspection and/or test reports for structural values, thickness, etc. shall be repaired at no extra cost to the Owner. Method(s) of repair shall be approved by the Engineer, which may require field or workshop demonstration.

B. Warranty

1. During the warranty period, which shall be defined as twelve (12) calendar months after acceptance by the Owner, any defects which will affect the integrity or strength of the liner pipe or hydraulic capacity of the sewer shall be repaired at the Contractor's expense, in a manner mutually agreed to by the Owner and the Contractor.

END OF SECTION

SECTION 02750

SEWER RECONSTRUCTION BY SLIP-LINING METHOD

PART 1 – GENERAL

1.01 REQUIREMENTS

- A. The Scope of Work in this section includes all labor, equipment and materials for the reconstruction of sewer lines by installation of a continuous polyethylene liner inserted into an existing sewer.
- B. The finished pipe shall be continuous from manhole to manhole and be sealed at the beginning and ending manholes.
- C. The work includes:
 - 1. Perform cleaning and pre and post construction Closed Circuit TV inspections.
 - 2. Determine "live or abandoned" status of all existing services connected to main line segment(s) designated for slip-lining.
 - 3. Furnishing all new pipeline materials.
 - 4. Flow-Diversion/by-pass pumping existing sewer.
 - 5. Constructing equipment and insertion pits for access to the host pipe.
 - 6. Installing the new pipeline by Slip-Lining Method.
 - 7. Reconnecting service laterals to the new pipeline.
 - 8. Connection of new pipeline to existing and/or new manholes.
 - 9. Backfilling/reconstruction/repair all disturbed areas.
 - 10. Final testing of new liner as specified herein.

1.02 RELATED DOCUMENTS

- A. Section 01310: Construction Schedules
- B. Section 01340: Shop Drawings, Product Data and Samples
- C. Section 01530: Barriers
- D. Section 01560: Temporary Controls
- E. Section 01570: Traffic Regulations
- F. Section 02221: Trenching, Backfilling, and Compacting
- H. Section 02722: Sanitary Sewers, Force Mains and Appurtenances
- I. Section 02790: Sewer Line Cleaning and Closed Circuit TV Inspection

1.03 SUBMITTALS

- A. Submit certified product data for:
 - 1. Polyethylene Pipe

2. Sealing Rope
 3. Foam Type Chemical Grout
 4. Couplings
 5. Service Saddles
 6. Silicone Adhesive
 7. Rapid Setting Hydraulic Cement
- B. Submit six (6) copies of required documents in accordance with Section 01340.
 - C. Submit four (4) copies of required documents.
 - D. Submit six (6) copies of the proposed construction schedules within fourteen (14) calendar days of the Notice to Proceed.
 - E. Submit testing and inspection data as outlined in this Section.

1.04 REFERENCES

- | | | |
|----|-------------------------|------------------------------------|
| A. | ASTM 03350 | Material Properties |
| B. | ASTM F714 | Dimensions and Workmanship |
| C. | ASTM D2321 | Trench, Embedment and Installation |
| D. | ASTM D2657 | Butt - Fusion |
| E. | ASTM F585 | Installation |
| F. | ASTM D1248 & ASTM D3350 | Fittings |
| G. | ASTM C3034 | Saddles |
| H. | ASTM C443 | Rubber Sleeve |
| I. | P. P. I. | Recommendations |

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Pipe shall be stored on level ground, preferable turf or sand, free of sharp objects which could damage the pipe.
- B. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions.
- C. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitable and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- D. Ropes, fabric or rubber-protected slings and straps shall be used when handling pipes.
- E. Chains, cables or hooks inserted into the pipe ends shall not be used.

- F. Care shall be exercised when lowering pipe into the trench to prevent damage or twisting of the pipe.
- G. The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.
- H. Sections of the pipe with deep cuts and gouges shall be removed and the ends of the pipeline rejoined.
- I. The trench bottom shall be free of stumps, stones, boulders, rocks, frozen clods and similar objects.

1.06 JOB CONDITIONS

- A. Conduct all activities in strict accordance with the approved construction schedules, or request an amended schedule a minimum of seven (7) days prior to the proposed change(s).
- B. Immediately notify the Engineer of any unexpected or unforeseen conditions that arise during the course of the Work. Work may be discontinued, with the direction and/or concurrence of the Engineer until such time as the condition can be evaluated and Work be allowed to proceed.
- C. Pre-Insertion Cleaning: The Contractor shall rewash and clean the existing sewer pipe immediately before the pre-insertion Television (TV) inspection, in accordance with Section 02790.
- D. Pre-Insertion Television (TV) Inspection: It shall be the responsibility of the Contractor, to video (TV) inspect, in accordance with Section 02790, the sewer pipe immediately before the installation of the liner, to assure that the pipe is clean and pipe conditions have not changed.
- E. Narrated video recording of the TV inspection along with a detailed written log shall be prepared and reviewed concurrently by the Contractor, Owner and/or the Engineer's representative on the project.
- F. A "GO" decision or "NO-GO" decision will be made at the conclusion of the review, with the following results:
 - 1. "GO" decision: Contractor shall proceed with by-pass pumping, as required, and installation of the pipe liner.
 - 2. "NO-GO" decision: Contractor shall dismantle the TV equipment and relocate to the next area of Work identified on the Project Schedules, with compensation for the Work performed in accordance with Sections 01010 and 01150.
- G. Diversion Pumping: The Contractor shall provide for continuous sewage flow around the section or sections of pipe designated for the insertion process, if required, to properly insert the liner. The pump and bypass lines, shall be provided and operated in accordance with Section 02540.

- H. Line Obstructions: If Pre-Insertion video (TV) inspection reveals an obstruction in the existing pipe, that cannot be removed by conventional sewer cleaning equipment, (such as heavy solids, dropped joints, protruding service connections or collapsed pipe which will prevent completion of the insertion process), then a Point Repair shall be made by the Owner or the Contractor, in accordance with provisions of relevant Sections in these Specifications.
- I. After completion of liner installation, stabilization, sealing at manholes and reconnections of individual services, Contractor shall perform post video (TV) inspection in accordance with Section 02790, and prepare a narrated video with a detailed written log of the completed reach of sewer, including measured distances to each service location from downstream manhole.
- J. Contractor shall provide copies of original quality, of both sets of (TV) video and written logs to the Owner, with the cost incidental to the work.

1.07 QUALITY ASSURANCE

- A. Adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the Work in this section shall be used.
- B. Equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner shall be used.

1.08 PRE-QUALIFICATIONS

- A. Products and/or Contractors pre-qualified for furnishing and installing the elements of the Project specified in this Section are provided in Section 00100 "Instructions to Bidders".

PART 2 - PRODUCTS

2.01 LINER TUBE

- A. The pipe and fittings shall be made of polyethylene resins in accordance with ASTM D1248, latest revision, TYPE III< Category 5, Grade P34, having specific base resin densities of 0.94=1 g/cc minimum and 0.959 g/cc maximum, and having melt indexes of 0.1 g/10 min. maximum and 0.4 g/10 min. minimum, respectively.
- B. The liner shall withstand a minimum head of ten (10') feet for a period of thirty (30) days. The minimum life of the polyethylene slip-liner pipe shall be fifty (50) years. The pipe shall be an outside diameter and a minimum wall thickness as indicated in the table of under item (H) below.
- C. Pipe must have a long-term strength rating of 1600 psi or more per hydrostatic design basis categories of ASTM D2837, latest revisions.

- D. The polyethylene resin shall contain anti-toxicant and be stabilized with 2.5 percent carbon black or other additives against ultraviolet degradation to provide protection during processing and subsequent weather exposure.
- E. The polyethylene resin compound shall have a resistance to environmental stress cracking as determined by the procedure detailed in ASTM D1693, latest revision, Condition C, for not less than 1000 hours of exposure with no failures.
- F. All pipe shall be made from virgin material. No rework compound, except that obtained from the manufacturer's own production of the same formulation, shall be used.
- G. Pipe shall be homogeneous throughout, and be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
- H. The polyethylene pipe and fittings shall be not less than the SDR classes listed below, and the installation shall be limited to the specified depths unless otherwise specified herein and/or noted on the Project Plans.

DIMENSIONS - THICKNESS & CLASSIFICATIONS - DEPTHS						
Original I.D. of Sewer (in.)	Nominal Size (inches)	Average O.D. (inches)	Minimum Wall Thickness (inches)Maximum Depth of Cover Feet/Classification			
			12/SDR26	18/SDR21	24/SDR15.5	30/SDR11.318
4	3	3.500	.135	.167	.226	.318
5 – 6	4	4.500	.173	.214	.290	.409
6	5	5.563	.214	.265	.359	.506
8	6	6.625	.255	.315	.427	.602
8	7	7.125	.274	.339	-	-
10	8	8.625	.332	.411	.556	.784
12	10	10.750	.413	.512	.694	.977
14	12	12.750	.490	.607	.823	1.159
14 – 15	13	13.386	.515	.637	-	-
15 – 16	14	14.000	.538	.667	.903	1.273
18	16	16.000	.615	.762	1.032	1.455
20 – 21	18	18.000	.962	.857	1.161	1.636
21	20	20.000	.769	.952	1.290	1.818
24	21.5	21.500	.827	1.024	1.387	1.955
27	24	24.000	.923	1.143	1.548	2.182
30	28	28.000	1.077	1.333	1.806	-
32	30	30.000	1.154	1.429	1.935	-
34	31.5	31.496	1.211	1.500	2.032	-
36	34	34.000	1.308	1.619	-	-

- Dimensions and Pressure Ratings, where applicable, are in compliance with ASTM F714, "Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter".
- Short Term Surge Pressures to 2.5 times the pressure rating are allowed.
- Inquire for availability of other sizes, and pressure ratings.

2.02 SEALING ROPE

- A. Rope for sealing around and between liner and existing pipe shall be a dry, twisted, activated jute oakum that is manufactured without tar or oil, and be suitable for "EGP" applications.
- B. Rope shall conform to Federal Specifications HH-P-117, Federal Standard Stock Catalog, Section IV, Part 5.HH-P-117.
- C. Material used for this Project shall be AV-219 FIBROTITE as provided by Avanti International.

2.03 CHEMICAL GROUT

- A. Chemical grout shall be used for sealing the space between the liner and the existing pipe in conjunction with the sealing rope.
- B. Material used for this Project shall be Scotch-Seal 5600 Chemical foam type grout as manufactured by 3M Construction Markets.
- C. Grout shall comply with all applicable ASTM Standards and Condition for:
 - 1. Product Properties - Uncured Material
 - 2. Product Properties - Cured Materials
 - 3. Chemical Resistance - Short and Long Term

2.04 FITTINGS

- A. Couplings shall be Fernco Series 1056, or approved equal, for service connections.
- B. Couplings shall be Smith-Blair No. 226 or 228, or approved equal for liner connections.

2.05 SERVICE CONNECTIONS

- A. Prefabricated service saddles (GPK or approved equal) shall be fabricated to accommodate four (4") inch or six (6") inch SDR 35; ASTM 3034 PVC pipe.
- B. Saddles shall have neoprene gaskets to insure a complete seal to the liner.
- C. Silicone adhesive shall be applied to the gaskets to improve the seal to the liner.

- D. Saddles shall have a stub-out to protrude the full wall thickness into the liner to anchor the position of the service on the liner, stub shall not protrude into the liner beyond the internal wall surface.
- E. Saddles shall be held in place by a minimum of two (2) stainless steel bands supplied by the saddle manufacturer.

2.06 SILICONE ADHESIVE

- A. Silicone adhesive to seal service saddles to the new liner shall be 100% silicone RTV-108, as manufactured by the General Electric Corp., or approved equal.

2.07 HYDRAULIC CEMENT

- A. Rapid setting hydraulic expanding cement to seal between liner and manhole opening at the entrance and exit of existing pipe liner shall be "OCTOPLUG" as manufactured by IPA Systems, Inc. or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. The preparation steps herein before and after specified shall be completed, unless approved otherwise by the Engineer.
- B. Prior to the commencement of the actual liner insertion process, the Contractor will plan his work after review of previous or pre-insertion television inspection tapes and reports.
- C. All point repairs must be satisfactorily completed prior to beginning the slip-lining process.
- D. The Engineer shall be informed of any noted problems or deviations from approved Work Schedules for liner installations prior to beginning Work.
- E. Safety
 - 1. The Contractor shall carry out his operations in strict accordance with all applicable OSHA Standards.
 - 2. Particular attention is drawn to those safety requirements involving work involving entry into a confined space, chemical exposure and work in ditches below grade.
 - 3. It shall be the Contractor's responsibility to be knowledgeable of appropriate OSHA Standard and Regulations pertaining to all aspects of the Work.

F. Excavation

1. Excavation and backfill(s) for all activities associated with the slip-lining process shall be accomplished in strict accordance with Section 02221 including all referenced sections and the Project Plans and Details.
2. Excavation shall include, but not necessarily be limited to:
 - a. Insertion and pull-out trenches;
 - b. Point repairs;
 - c. Service connections and reconnections; and
 - d. Trenches for pipe connections, as required.

3.02 LINING INSERTION

The following installation means and methods shall be adhered to unless written approval for modifications is obtained from the Engineer.

A. Final Cleaning

1. Each sewer line segment shall receive a final cleaning immediately prior to beginning the insertion.
2. Obstructions and/or otherwise unknown problems discovered shall be addressed to the Engineer for resolution and direction to the Contractor prior to beginning the insertion.
3. The cost of the final cleaning is considered to be incidental with and included in the Unit Price for the liner insertion.

B. Bypass Pumping

1. Where bypassing may be necessary to properly insert the liner, the Contractor shall bypass the sewage around the section or sections of line that are to be slip-lined by plugging an existing upstream manhole and pumping the sewage into a downstream manhole in accordance with the approved plan submitted in accordance with Sections 01340 and 02540. The pump and bypass lines shall be of adequate capacity and size to transport the required bypassed flow.
2. Under no circumstance will the dumping of raw sewage on private property or, in or near lakes, streams, storm sewers, or in city streets be allowed.
3. At the end of each working day, plugs shall be removed and temporary tie-ins shall be made between the relined section and the existing system.
4. Bypass pumping of sewage shall be considered an incidental obligation of the Contract and no separate payment shall be made for this Work.

C. Point Repairs

1. Point repairs shall be completed prior to beginning slip-lining Work.
2. Contractor shall, at the direction of the Engineer, attempt to utilize sections scheduled for point repairs as "insertion" or "pull-out" excavations to reduce the resulting surface damages.

3. Point repairs noted as a result of final or pre-insertion cleaning and inspections of the existing sewer shall be approved in writing by the Engineer prior to beginning the repairs.

D. Pipe Joints

1. Fusion Joints

- a. Pipe shall be joined on the site by leak-proof, thermal, butt-fusion joints, except as noted, and approved in writing by the Engineer.
- b. All fusion shall be done by personnel trained by the pipe supplier or other qualified persons, using tools approved by the pipe supplier and the Engineer.
- c. Butt-fusion joints between sections of pipe shall have no internal bead projection into the I.D. of the pipe.
- d. Joint strength shall be equal to that of adjacent pipe as demonstrated by tensile test. In addition, results of tensile impact testing of joints shall indicate a ductile rather than a brittle fracture.
- e. External appearance of fusion bead shall be smooth without significant juncture groove.
- f. Butt-fusion joints shall be in strict compliance with ASTM D2657.
- g. Threaded or solvent-cement joints and connection will not be permitted.

2. Other Joints

- a. Where two lengths of pipe are to be joined and where a fusion butt joint is not possible, the pipe shall be joined with a full circle neoprene stainless steel repair type clamp coupling with stainless steel bolts. The entire clamp assembly shall be wrapped with 10 mil plastic sealed to the pipe with plastic tape. The pipe shall then be bedded and backfilled as shown in the Project Plans and as described in appropriate sections of the Specifications.

E. Insertion of the Liner

1. All preliminary activities shall be successfully completed prior to beginning the insertion process.
2. Insertion activities shall be in accordance with approved schedules.
3. Insertion and/or pull-out trench locations are determined by the Contractor, but should coincide with point repairs, service connections or other planned excavations as may be allowed by the actual job conditions to minimize the total excavation and number of trenches on the Project.
4. The slip-lining shall be performed in strict compliance with ASTM F714 and F585 and the recommendations of the Polyethylene Pipe Institute (PPI).
5. Pipe shall be assembled for insertion by the butt-fusion process, as previously described.

6. Concrete bedding and partial encasement shall be placed around the existing pipe and liner at all points where the existing pipe is opened, including insertion pits and house service reconnection locations. Point repairs shall be bedded and encased as shown in the Project Details.
7. Immediately before the insertion operation, it may be desirable to pass a test-head of the same diameter as the polyethylene pipe to be inserted to insure free passage of the liner in areas indicating potential blockage problems from pre-insertion inspections.
8. The liner may be inserted by either the pushing, pulling or, combined methods. Forces induced on the liner shall be such that the liner is not damaged. A nose-cone shall be provided in the liner to guide the pipe past minor obstructions.
9. Where two (2) segments of liner are to be connected in the insertion pit, they shall be connected by a full circle clamp as previously specified and as approved by the Engineer.
10. The inserted liner shall be allowed to stabilize for a minimum of eighteen (18) hours prior to installation of service connection and sealing at the manholes.

3.03 SERVICE CONNECTION AND RE-CONNECTIONS

- A. Provide a minimum of 72 hours notice to customers whose sanitary sewer service will potentially be interrupted.
- B. In the event of any Contractor-related overflow or interruption/backup of an existing customer service line, the Contractor shall immediately notify the Engineer and Owner. The Contractor shall contain and eliminate the overflow/interruption.
- C. Contractor shall be responsible for any fines levied by others, reimbursement of any agency incurred costs, damage, cleanup, restoration of flow and any disruption of service costs to customers as a result of the Contractor's work. This in addition to any and all costs incurred by the customer.
- D. After the replacement pipe has been completely installed and tested, all existing active services as indicated on the Contract Plans and/or identified by the Contractor shall be reconnected to the replacement pipe.
- E. Service installation shall begin within a reasonable time following the insertion and stabilization of the liner to minimize disruption of service to users of the sewer system.
- F. Excavation shall be made for service installations at locations determined by the pre-insertion TV inspection.
- G. Approved pre-fabricated saddles (GPK or approved equal) as identified in Part 2 above, shall be installed at each service location using gaskets, silicone adhesives (where required), and stainless steel bands (where required) as specified.

- H. Saddles shall be installed in strict compliance with the manufacturer's recommendations and as referenced and specified herein.
- I. The new service tap shall be connected to the existing service line and properly bedded as specified herein and as shown in the Project Details.
- J. Reconnect existing service connections, including those that are intended to serve unoccupied or abandoned buildings or to vacant lots, unless directed otherwise by the Owner or Engineer.
- K. The service lateral shall not protrude into the sewer main.
- L. Concrete and crushed stone bedding and haunching shall be placed in accordance with the Project Details.
- M. Initial and final backfill and surface restoration shall be completed as referenced and specified in Section 02221 and other appropriate sections.
- P. Contractor shall provide service locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream), invert of the sewer main at location and depth of cleanout (if installed per Section 02722) in a tabular form.
- Q. Contractor shall provide non-reconnect service locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream, and approximate depth of the sewer main at location in a tabular form.

3.04 SEALING AT MANHOLES

- A. The new liner shall have a water-tight seal installed at the upper and lower manholes after the liner stabilization and installation of all services in accordance with the liner sealer schedule on Page 02750 - 15.
- B. The upper manhole shall be sealed first and then followed by sealing the lower manhole as the last step in the Slip-lining process.
- C. All excess liner material provided at the initial insertion to allow stabilization shall be trimmed to allow one (1) inch of protrusion beyond the manhole face before beginning the sealing process.
- D. All defects in the manhole or in the existing sewer line that might prevent a successful watertight seal with the new liner shall be repaired and accepted by the Engineer prior to beginning the sealing process.
- E. All annular spaces between the existing sewer pipe and the new liner shall be sealed with activated oakum soaked in approved grout and/or grouted, and later covered with approved fortified cementitious grout to finish the process.

3.05 FINAL TESTING AND INSPECTIONS

- A. Logs, TV videos, and results of final testing and inspection shall be submitted in sets of three (3) copies of original quality within five (5) days of the completion of the related Work.
- B. Logs, tests results and videos shall be available on the jobsite (or at a field office) for all required activities.
- C. After completion of the insertion process, a physical inspection of the liner shall be performed. Any observed problems (crimping, collapse, binding, etc.) that reflect on the quality of the liner or that may restrict the sewage flow will be corrected, at the Contractor's expense, before proceeding with additional Work.
- D. Low pressure air exfiltration:
 - 1. Tests shall be performed on the liner including all couplings and service saddles.
 - 2. Caps or plugs shall be installed on service saddles for air testing prior to completing and backfilling the service connection.
 - 3. Testing in segments may be allowed in areas where the location and number of services present undesirable or unsafe conditions if not completed until all services are finished and the total length tested.
 - 4. Tests performed on segments of the total liner length shall use isolation plugs or other approved methods.
 - 5. The Owner reserves the right to require air testing of new and relocated service connections to verify the quality of the Work.
 - 6. The services shall be tested with the liner or shall be independently tested by being uncovered and plugged or capped at the property line and at the saddle (before connections) and tested as specified herein.
 - 7. Air testing of services, where required, shall be at the sole cost of the Contractor.
- E. T.V. Inspection
 - 1. Upon completion of the insertion process, including service connections and reconnections, sealing at the manholes, and air testing, the Contractor shall conduct a T.V. inspection of the finished components as a final inspection.
 - 2. The T.V. inspection shall note areas that deviate from round pipe or straight grades, protruding laterals and other imperfections, and shall accurately locate the service connections measured in feet from the downstream manhole.
- F. All Work failing tests and/or inspections shall be corrected, at the sole expense of the Contractor, in a timely manner to minimize disruptions of sewer service.

3.06 LOW PRESSURE AIR EXFILTRATION TEST - GRAVITY SEWERS

- A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 4 to 3 PSIG.
- B. Times for mixed pipe sized of varying lengths should be calculated as described in ASTM, C828-76T using formula $t = K d/q$ ($q = .0020$).
- C. Lengths of section under test shall not exceed 500 linear feet.
- D. The items shown in the Air Test Table are for one pipe size only.

AIR TEST TABLE
SPECIFICATION TABLE (MIN:SEC) REQUIRED WHEN TESTING ONE PIPE DIAMETER ONLY
PIPE DIAMETER, INCHES

	4	6	8	10	12	15	18	21	24	27	38	33	36	39	42
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	8:05
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	16:10
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35			19:50
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20				20:25	19:58	
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30			13:24	16:32	17:09	23:49	23:57	23:06
175	0:31	1:09	2:03	3:13	4:37	7:05			12:06	15:19	18:54	20:01	27:13	27:57	27:43
200	0:35	1:19	2:21	3:40	5:17			10:25	13:36	17:13	21:16	22:52	30:37	31:56	32:20
225	0:40	1:29	2:38	4:08	5:40		8:31	11:35	15:07	19:08	23:38	25:44	34:01	35:56	36:58
250	0:44	1:39	2:56	4:35			9:24	12:44	16:38	21:03	25:59	28:35	37:25	39:56	41:35
275	0:48	1:49	3:14	4:43		8:16	10:12	13:53	18:09	22:58	28:21	31:27	40:49	43:55	46:12
300	0:53	1:59	3:31		6:03	9:27	11:54	16:12	21:10	26:47	33:05	34:16	47:38	47:55	50:49
350	1:02	2:19	3:47		6:48	10:38	13:36	18:31	24:12	30:37	37:48	40:01	54:26	55:54	55:26
400	1:10	2:38			7:34	11:49	15:19	20:50	27:13	34:27	42:32	45:44	61:14	63:53	64:41
450	1:19	2:50		5:14	8:19	13:00	17:01	23:09	30:14	38:16	47:15	51:27	68:02	71:52	73:55
500	1:28			5:45	9:04	14:11	18:43	25:28	33:16	42:06	51:59	57:10	74:51	49:51	83:10
550	1:37		4:02	6:17	9:50	15:21	20:25	27:47	36:17	45:56	56:42	62:53	81:39	87:50	92:24
600	1:46	2:50	4:22	6:48			22:07	30:06	39:19	49:45	61:26	68:36	88:27	95:49	101:38
650	1:54											74:19		103:48	110:53
															120:07

3.07 CLEAN-UP AND WARRANTY

A. Clean-up and final completion of Work.

1. Upon acceptance of the installation Work and testing, the Contractor shall reinstate the Project areas affected by the operations.
2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of TV, cleaning, excavating or other equipment and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and the sole expense of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.
3. Correction of failed liner or liner deemed unacceptable, and protruding laterals, as a result of the post video (TV) inspection and/or other tests and inspections for structural values, shall be repaired at no extra cost to the Owner. Method(s) of repair shall be approved by the Engineer, which may require field or workshop demonstration.

B. Warranty

1. During the warranty period, which shall be defined as twenty-four (24) calendar months after acceptance by the Owner, any defects which will affect the integrity or strength of the liner pipe or hydraulic capacity of the sewer shall be repaired at the Contractor's expense, in a timely manner by methods mutually agreed to by the Owner and the Contractor.
2. The Contractor shall provide a representative to accompany the Owner's inspection team to inspect the liner at intervals of twelve (12) and twenty-four (24) months after acceptance by the Owner.
3. Contractor shall maintain a continuing responsibility to complete the correction of all defects noted during the warranty period.

LINER SEALING SCHEDULE (See Project Details for Additional Information)				
HYDRAULIC DEPTH (FEET)	ID (Sewer) Minus OD (Liner)			
	Up to 2 inches		Over 2 inches	
	Oakum Rings	Grout Space Between Rings	Oakum Rings	Grout Space Between Rings
0 - 10	2	-0-	2 @ 2	0.5 Dia. (Min 8")
10 - 16	3	-0-	2 @ 2	.75 Dia. (Min 8")
16 - 24	1 @ 2 places	0.5 Dia. (Min 8")	2 @ 2	1.0 Dia. (Min 8")
24*				

*Special Design required for all conditions.

END OF SECTION

SECTION 02760

SEWER REHABILITATION BY PIPE-BURSTING METHOD

PART 1 - GENERAL

1.01 REQUIREMENTS

- A. The Scope of Work in this Section includes all labor, equipment and materials for the rehabilitation/replacement of gravity sewer lines by the Pipe Bursting Method.
- B. The work includes:
 - 1. Perform cleaning and pre and post construction CCTV inspections.
 - 2. Determine "live or abandoned" status of all existing services connected to main line segment(s) designated for Pipe Bursting.
 - 3. Furnishing all new pipeline materials.
 - 4. Flow-Diversion/By-Pass pumping existing sewer.
 - 5. Constructing equipment and insertion pits for access to the host pipe.
 - 6. Installing the new pipeline by Pipe Bursting Method.
 - 7. Reconnecting service laterals to the new pipeline.
 - 8. Connection of new pipeline to existing and/or new manholes.
 - 9. Backfilling/reconstruction/repair of all disturbed areas.
 - 10. Final testing of new liner as specified herein.

1.02 RELATED DOCUMENTS

- A. Section 01310: Construction Schedules
- B. Section 01340: Shop Drawings, Product Data, and Samples
- C. Section 01530: Barriers
- D. Section 01560: Temporary Controls
- E. Section 01570: Traffic Regulations
- F. Section 02221: Trenching, Backfilling, and Compacting
- G. Section 02540: Sewer Flow Control and Bypass Pumping
- H. Section 02722: Sanitary Sewers, Force Mains, and Appurtenances
- I. Section 02790: Sewer Line Cleaning and Closed Circuit TV Inspection

1.03 SUBMITTALS

- A. Submit certified product data for:
 - 1. Polyethylene Pipe.
 - 2. Adapters for Sealing at Manholes.
 - 3. Couplings.

4. Service Inserts
 5. Rapid Setting Hydraulic Cement
 6. Manhole Repair Materials.
- B. Submit six (6) copies of required documents in accordance with Section 01340.
 - C. Submit four (4) copies of required documents in accordance with Section 02540.
 - D. Submit six (6) copies of the proposed construction schedules within fourteen (14) calendar days of the Notice to Proceed.
 - E. Submit testing and inspection data as outlined in this Section.

1.04 REFERENCES

- | | | |
|----|-------------------------|------------------------------------|
| A. | ASTM 03350 | Material Properties |
| B. | ASTM F714 | Dimensions and Workmanship |
| C. | ASTM D2321 | Trench, Embedment and Installation |
| D. | ASTM D2657 | Butt - Fusion |
| E. | ASTM F585 | Installation |
| F. | ASTM D1248 & ASTM D3350 | Fittings |
| G. | ASTM C3034 | Saddles |
| H. | ASTM C443 | Rubber Sleeve |
| I. | P. P. I. | Recommendations |

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Pipe shall be stored on level ground, preferable turf or sand, free of sharp objects which could damage the pipe.
- B. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions.
- C. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitable and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- D. Ropes, fabric or rubber-protected slings and straps shall be used when handling pipes.
- E. Chains, cables or hooks inserted into the pipe ends shall not be used.
- F. Care shall be exercised when lowering pipe into the trench to prevent damage or twisting of the pipe.

- G. The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.
- H. Sections of the pipe with deep cuts and gouges, as determined by the Engineer, shall be removed and the ends of the pipeline rejoined.
- I. The trench bottom shall be free of stumps, stones, boulders, rocks, frozen clods and similar objects.

1.06 JOB CONDITIONS

- A. Conduct all activities in strict accordance with the approved construction schedules, or request an amended schedule a minimum of seven (7) days prior to the proposed change(s).
- B. Immediately notify the Engineer of any unexpected or unforeseen conditions that arise during the course of the Work. Work may be discontinued, with the direction and/or concurrence of the Engineer until such time as the condition can be evaluated and Work be allowed to proceed.
- C. Pre-Insertion Cleaning: The Contractor shall rewash and clean the existing sewer pipe immediately before the pre-insertion Television (TV) inspection in accordance with Section 02790.
- D. Pre-Insertion Television (TV) Inspection: It shall be the responsibility of the Contractor, to video (TV) inspect in accordance with Section 02790 the sewer pipe in accordance with Section 02790 immediately before the installation of the liner, to assure that the pipe is clean and pipe conditions have not changed.
- E. Narrated video recording of the TV inspection along with a detailed written log shall be prepared and reviewed concurrently by the Contractor, Owner and/or the Engineer's representative on the project.
- F. A "GO" decision or "NO-GO" decision will be made at the conclusion of the review, with the following results:
 - 1. "GO" decision: Contractor shall proceed with by-pass pumping, as required, and installation of the pipe liner.
 - 2. "NO-GO" decision: Contractor shall dismantle the TV equipment and relocate to the next area of Work identified on the Project Schedules, with compensation for the Work performed in accordance with Sections 01010 and 01150.
- G. Diversion Pumping: The Contractor shall provide for continuous sewage flow around the section or sections of pipe designated for the insertion process, if required, to properly insert the liner. The pump and bypass lines, shall have adequate capacity and size to handle the anticipated flow in accordance with the approved plan submitted in accordance with Sections 01340 and 02540.

- H. After completion of liner installation, stabilization, sealing at manholes and reconnections of individual services, Contractor shall perform a post video (TV) inspection in accordance with Section 02790 and prepare a narrated video with a detailed written log of the completed reach of sewer, including measured distance to each service location from the downstream manhole
- I. Contractor shall provide copies of original quality, of both sets of (TV) video and written logs to the Owner, with the cost incidental to the work.

1.07 QUALITY ASSURANCE

- A. Adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the Work in this section shall be used.
- B. Equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner shall be used.

1.08 PRE-QUALIFICATIONS

- A. Products and/or Contractors pre-qualified for furnishing and installing the elements of the Project specified in this Section are provided in Section 00100 "Instructions to Bidders".

1.09 DEFINITIONS

- A. Pipe Bursting is a method of replacing existing sanitary sewers or storm drains by fragmenting the existing host conduit and installing the replacement pipe in its void.

- 1. Static Pipe Bursting Method - The static pipe bursting process is accomplished by inserting a rod into the existing host conduit, attaching a bursting head to the rod, and retracting the rod, causing the bursting of the host pipe and installation of the new pipe simultaneously. Essentially the process involves the use of a non percussive "moling" device, suitably sized to break out the old pipe with a flared plug that bursts the existing sewer pipe.

Pneumatic Pipe Bursting Method - The pneumatic pipe bursting process is accomplished by creating an impact load in the pipe by applying stress to the host pipe causing it to burst in tension. This technique uses a pneumatic bursting head (air hammer) with a properly sized expander, and relies on percussive hammering action to break out the old pipe in which the tool travels. The new replacement pipe is installed into the space created by the bursting head simultaneously. A winch cable is attached to the nose of the bursting head to maintain correct alignment and grade by providing constant pulling tension and enhancing the percussive force.

- B. Host conduit is defined as the existing sanitary sewer or storm drain which is to be replaced by the pipe bursting method. The host conduit varies in size from four (4") inch pipe to thirty (30") inch pipe. The host conduits may be partially collapsed and of various materials.
- C. Replacement pipe is defined as the new High Density Polyethylene (HDPE), to be installed by pipe bursting, which will replace the host conduit.

1.10 ADDITIONAL WARRANTY

- A. The Contractor shall also warrant to the Owner that the equipment used on this Contract, where covered by patents or license agreements, is furnished in accordance with such agreements and that the prices included herein cover all applicable royalties and fees in accordance with such license agreements. The Contractor shall defend, indemnify and hold the Owner harmless from and against any and all costs, loss, damages or expenses arising out of or in any way connected with any claim of infringement of patent, trademark or, violation of license agreement.

PART 2 - PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE (HDPE) PIPE FOR PIPE BURSTING GRAVITY SEWERS

- A. The replacement pipe shall be manufactured from a high density high molecular weight polyethylene resin which conforms to ASTM F714, Polyethylene Plastic Pipe (SDR) based on outside diameter, or ASTM D3035, Polyethylene Plastic Pipe (DR-PR) based on controlled outside diameter, and having a PPI rating of PE 3408, when compounded. The pipe produced from this resin shall have a minimum cell classification of 345444C or 345444 E under ASTM D3350.
- B. The HDPE pipe shall meet the following:
 - 1. Minimum Wall Thickness: SDR 17
- C. Inside Diameter (I.D.) shall match (or exceed) the I.D. of existing pipe, or I.D. shall match (or exceed) the increased pipe size designated on the drawings for pipe bursting, whichever is greater.
- D. Where excavations for the insertion of the replacement pipe are made between two (2) manholes, the ends of the pipe will be cut smooth and square to the axis so that it can be joined in a workman like manner such that both ends meet and touch uniformly and continuously. A Full Circle Repair Clamp (Smith-Blair or approved equal) shall be used. Minimum clamp width shall be twelve (12") inches.

2.02 SERVICE CONNECTIONS

- A. Service compressions fittings (Inserta-Tee or approved equal), shall be fabricated to accommodate four (4") inch or six (6") inch SDR 35; ASTM 3034 PVC pipe.

2.03 PIPE CONNECTIONS TO EXISTING MANHOLES

- A. All pipe entering or leaving the manhole shall be placed on firmly compacted bedding. Special care shall be taken to see that the openings through which pipes enter the structure are completely and firmly filled with mortar from the outside to insure water tightness. All PVC/HDPE pipe connections to manholes shall be made with GPK PVC Manhole Adapters (also known as "sand collars") with an external abrasive silica layer or approved equal.

PART 3 - EXECUTION

3.01 PRE PIPE BURSTING OPERATIONS

- A. Pre-Location of Service Connections
 - 1. Before pipe bursting operations commence, the Contractor shall determine status of all existing services "live or abandoned" that are connected to main line segment(s) designated for Pipe Bursting during the Pre-Insertion Television (TV) Inspection.
- B. Flow-Diversion/Bypass Pumping
 - 1. The Contractor shall provide for diversion where and when required for the pipe bursting operation to be completed.
- C. Existing Manholes
 - 1. If the pipe bursting tool and the replacement pipe is to traverse any existing manhole which is to remain in-place without interruptions during the pipe bursting operation (as shown on Plans), the conduit entrances and exits to the existing manhole shall be opened out to the required dimensions and modifications shall be made to the invert before the pipe bursting operations commence.
- D. Cleaning
 - 1. The Contractor shall clean the host conduit prior to commencing pipe bursting operations. The cleaning shall only be to the extent necessary to conduct pipe bursting operations and to televise and identify surface connections. It is the Contractor's responsibility to insure that the host conduit is sufficiently clean so as not to prohibit pipe bursting operations. No additional compensation will be made if the conduit is not sufficiently cleaned.

3.02 PIPE BURSTING OPERATIONS

- A. General
 - 1. The Contractor shall carry out operations in strict accordance with all applicable OSHA, local and state safety Standards.

2. Though the installation process may be licensed or proprietary in nature, the Contractor shall not change any material, thickness, design values or procedural matters stated in the submittals, without the prior knowledge and approval of the Engineer. The Contractor shall submit, in writing, full details about component materials, their properties and installation procedures and shall abide by them fully during the entire course of the work.
- B. Pit Locations
1. The location and number of pits may be shown on the plans or otherwise approved by the Engineer. Should the Contractor want to relocate any pit, the Contractor shall submit in writing, for review by the Engineer, the new location and reasons for relocation. This submittal shall include any appropriate sketches deemed necessary by the Engineer. The Contractor shall be responsible for obtaining all necessary permits from the City as they relate to the new location should it be approved by the Engineer.
- C. Operation of Pipe Bursting Machine and Installation of Replacement Pipe
1. The specific type of replacement pipe material shall be installed in the locations as shown on the Contract plans.
 2. Due to the potential for significant numbers of utilities in the area, the pipe bursting method shall limit vibrations transmitted to the surrounding soils. The peak particle velocity of ground vibrations resulting from pipe bursting operations shall be limited to a maximum of 0.5 inches per second.
 3. As the pipe bursting tool is advanced through the host conduit, the replacement pipe shall be advanced directly behind the tool to fill the void left by the fragmented host conduit.
 4. The maximum length of the continuous replacement pipe which shall be assembled on the surface and pulled into the insertion shaft shall be six hundred (600') feet.
- D. Sealing and Benching in Existing Manhole
1. When the replacement pipe passes through an existing manhole or terminates at an existing manhole, the top half of the pipe within the existing manhole shall protrude at least four inches into the manhole and shall be neatly cut off and not broken or sheered off. The pipe shall be sealed at the existing manhole by providing a GPK PVC manhole adapter (also known as "sand collars") in the manhole wall at the end of the pipe, centered in the existing manhole wall. The flexible connector shall be grouted in the manhole wall, filling all voids for the full thickness of the manhole wall.
 2. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Benches and channel cross section shall be constructed in such a manner to return the manhole to serviceable condition without imperfections that would interfere with the flow.

3.03 SERVICE CONNECTIONS AND RE-CONNECTIONS

- A. Provide a minimum of 72 hours notice to customers whose sanitary sewer service will potential be interrupted.
- B. In the event of any Contractor-related overflow or interruption/backup of an existing customer service line, the Contractor shall immediately notify the Engineer and Owner. The Contractor shall contain and eliminate the overflow/interruption.
- C. Contractor shall be responsible for any fines levied by others, reimbursement of any agency incurred costs, damage, cleanup, restoration of flow and any disruption of service costs to customers as a result of the Contractor's work. This in addition to any and all costs incurred by the customer.
- D. After the replacement pipe has been completely installed and tested, all existing active services as indicated on the Contract Plans and/or identified by the Contractor shall be reconnected to the replacement pipe.
- E. Service installation shall begin within a reasonable time following the insertion and stabilization of the liner to minimize disruption of service to users of the sewer system.
- F. Excavation shall be made for each service installation at locations determined by the pre-insertion TV inspection.
- G. Approved compressions fittings (Inserta-Tee or approved equal), as identified in Part 2 above, shall be installed at each service location as specified.
- H. Compression fittings shall be installed in strict compliance with the manufacturer's recommendations and as referenced and specified herein.
- I. The new service tap shall be connected to the existing service line and properly bedded as specified herein and as shown in the Project Details.
- J. Reconnect existing service connections, including those that are intended to serve unoccupied or abandoned buildings or vacant lots, unless directed otherwise by the Owner or Engineer.
- K. The service lateral shall not protrude into the sewer main.
- L. Concrete and crushed stone bedding and haunching shall be placed in accordance with the Project Details.
- M. Initial and final backfill and surface restoration shall be completed as referenced and specified in Section 02221 and other appropriate sections.
- N. Contractor shall provide service locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream), invert of the sewer main at the location and depth of cleanout (if installed per Section 02722) in a tabular form.

- O. Contractor shall provide non-reconnect service locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream), and approximate depth of the sewer main at location in a tabular form.

3.04 FINAL TESTING AND INSPECTIONS

- A. Logs, TV videos and results of final testing and inspection shall be submitted in sets of three (3) copies of original quality within five (5) days of the completion of the related Work.
- B. Logs, tests results and videos shall be available on the jobsite (or at a local field office) for all required activities.
- C. After completion of the insertion process, a physical inspection of the liner shall be performed. Any observed problems (crimping, collapse, binding, etc.) that reflect on the quality of the liner or that may restrict the sewage flow will be corrected, at the Contractor's expense, before proceeding with additional Work.
- D. Low pressure air exfiltration:
 - 1. Tests shall be performed on the liner including all couplings and service saddles.
 - 2. Caps or plugs shall be installed on service connections for air testing prior to completing and backfilling the service connection.
 - 3. Testing in segments may be allowed in areas where the location and number of services present undesirable or unsafe conditions if not completed until all services are finished and the total length tested.
 - 4. Tests performed on segments of the total liner length shall use isolation plugs or other approved methods.
 - 5. The Owner reserves the right to require air testing of new and relocated service connections to verify the quality of the Work.
 - 6. The services shall be tested with the liner or shall be tested by itself by being uncovered and plugged or capped at the property line and at the saddle (before connections) and tested as specified herein.
 - 7. Air testing of services, where required, shall be at the sole cost of the Contractor.
- E. T.V. Inspection
 - 1. Upon completion of the insertion process, including service connections and reconnections, sealing at the manholes, and air testing, the Contractor shall conduct a T.V. inspection of the finished components as a final inspection.
 - 2. The T.V. inspection shall note areas that deviate from round pipe or straight grades, protruding laterals and other imperfections, and shall accurately locate the service connections measured in feet from the downstream manhole.
- F. All Work failing tests and/or inspections shall be corrected, at the sole expense of

the Contractor, in a timely manner to minimize disruptions of sewer service.

3.05 LOW PRESSURE AIR EXFILTRATION TEST - GRAVITY SEWERS

- A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 4 to 3 PSIG.
- B. Times for mixed pipe sized of varying lengths should be calculated as described in ASTM, C828-76T using formula $t = K d/q$ ($q = .0020$).
- C. Lengths of section under test shall not exceed 500 linear feet.
- D. The items shown in the Air Test Table are for one pipe size only.

AIR TEST TABLE
SPECIFICATION TABLE (MIN:SEC) REQUIRED WHEN TESTING ONE PIPE
DIAMETER ONLY PIPE DIAMETER, INCHES

	4	6	8	10	12	15	18	21	24	27	38	33	36	39	42
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	8:05
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	16:10
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35			19:50
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20				20:25	19:58	
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30			13:24	16:32	17:09	23:49	23:57	23:06
175	0:31	1:09	2:03	3:13	4:37	7:05			12:06	15:19	18:54	20:01	27:13	27:57	27:43
200	0:35	1:19	2:21	3:40	5:17			10:25	13:36	17:13	21:16	22:52	30:37	31:56	32:20
225	0:40	1:29	2:38	4:08	5:40		8:31	11:35	15:07	19:08	23:38	25:44	34:01	35:56	36:58
250	0:44	1:39	2:56	4:35			9:24	12:44	16:38	21:03	25:59	28:35	37:25	39:56	41:35
275	0:48	1:49	3:14	4:43		8:16	10:12	13:53	18:09	22:58	28:21	31:27	40:49	43:55	46:12
300	0:53	1:59	3:31		6:03	9:27	11:54	16:12	21:10	26:47	33:05	34:16	47:38	47:55	50:49
350	1:02	2:19	3:47		6:48	10:38	13:36	18:31	24:12	30:37	37:48	40:01	54:26	55:54	55:26
400	1:10	2:38			7:34	11:49	15:19	20:50	27:13	34:27	42:32	45:44	61:14	63:53	64:41
450	1:19	2:50		5:14	8:19	13:00	17:01	23:09	30:14	38:16	47:15	51:27	68:02	71:52	73:55
500	1:28			5:45	9:04	14:11	18:43	25:28	33:16	42:06	51:59	57:10	74:51	49:51	83:10
550	1:37		4:02	6:17	9:50	15:21	20:25	27:47	36:17	45:56	56:42	62:53	81:39	87:50	92:24
600	1:46	2:50	4:22	6:48			22:07	30:06	39:19	49:45	61:26	68:36	88:27	95:49	101:38
650	1:54											74:19		103:48	110:53
															120:07

3.06 CLEANING

- A. Disturbed Areas
 1. Upon completion of the pipe bursting operations, the Contractor shall restore all areas disturbed by these operations.
 2. Repair all pavement per Section 02610.
 3. Repair all sodded and grass areas to original condition per Section 02485
 4. Repair all incidental damage to building, structures, utilities, pavements landscaping, etc...

3.07 CLEAN-UP AND WARRANTY

- A. Clean-up and final completion of Work.
 - 1. Upon acceptance of the installation Work and testing, the Contractor shall reinstate the Project areas affected by the operations.
 - 2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of TV, cleaning, excavating or other equipment and/or erection of equipment and/or any other activities associated with the Work shall be the sole responsibility and at the sole expense of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.
 - 3. Correction of failed liner or liner deemed unacceptable, and protruding laterals as a result of the post video (TV) inspection and/or other tests and inspections for structural values, shall be repaired at no extra cost to the Owner. Method(s) of repair shall be approved by the Engineer, which may require field or workshop demonstration.
- B. Warranty
 - 1. During the warranty period, which shall be defined as twenty-four (24) calendar months after acceptance by the Owner, any defects which will affect the integrity or strength of the liner pipe or hydraulic capacity of the sewer shall be repaired at the Contractor's expense, in a timely manner by methods mutually agreed to by the Owner and the Contractor.
 - 2. The Contractor shall provide a representative to accompany the Owner's inspection team to inspect the liner at intervals of twelve (12) and twenty-four (24) months after acceptance by the Owner.
 - 3. Contractor shall maintain a continuing responsibility to complete the correction of all defects noted during the warranty period.

END OF SECTION

SECTION 02790

SEWER LINE CLEANING AND CLOSED CIRCUIT TV INSPECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Cleaning gravity sewer lines for the purpose of:
 - 1. Inspecting the lines to determine conditions and/or locate connections and/or defects.
 - 2. Preparing of the line for repair by conventional and/or trenchless methods.
 - 3. Root removal.
 - 4. Removing non-structural blockage.
 - 5. Others as may be specified.
- B. Closed Circuit TV Inspection for the purpose of:
 - 1. Inspecting the lines to determine physical and hydraulic conditions and/or locate defects.
 - 2. Locate connections.
 - 3. Locate sources of I/I.
 - 4. Inspecting the lines to determine the applicable method(s) of repair or replacement.
 - 5. Others as may be specified.
- C. The Closed Circuit TV Inspection (CCTV) work must be completed by certified National Association of Sewer Service Companies (NASSCO), Pipeline Assessment and Certification Program (PACP) trained operator(s), using established PACP coding and observations.

1.02 RELATED DOCUMENTS

- A. Section 01570: Traffic Regulations
- B. Section 01710: Cleaning

1.03 SUBMITTALS

- A. Sample forms for job site generated cleaning and TV inspection logs shall be submitted to Engineer for approval prior to performing cleaning and TV inspection operations.
- B. A hard drive or DVD(s) containing the database, video, and photo files.
- C. A printed Report in a hardcover white clear view 3-ring binder containing the following information:
 - 1. Footage calibration report for each camera used.
 - 2. Copies of PACP Certificates for all operators.
 - 3. Summary table of all pipeline segments inspected with the following fields in the order listed:
 - a. Column 1: Date of Inspection
 - b. Column 2: Start Manhole

- c. Column 3: Stop Manhole
- d. Column 4: Total pipe length (per as-built or design plan)
- e. Column 5: Televised Length
- f. Column 6: Quick Maintenance Rating (per PACP)
- g. Column 7: Quick Structure Rating (per PACP)
- h. Column 8: Section Number

(Note: The Table shall be sorted by Start Manhole)

- 4. An observation table of all pipeline segments inspected with the following fields in the order listed:

- a. Column 1: Section Number
- b. Column 2: Position of Defect
- c. Column 3: Observation Code (per PACP)
- d. Column 4: Observation Description (per PACP)
- e. Column 5: Structural Grade (per PACP)
- f. Column 6: O&M Grade (per PACP)

(Note: The Table shall be sorted by Section Number)

- D. Job site generated cleaning and TV inspection logs shall be submitted on approved forms in sets of three (3) copies of original quality within five (5) working days of the completion of the Work on the line segment(s).
- E. A single copy of original quality of the digital discs (DVD Format) of the actual remote TV inspection shall be submitted concurrently with the logs of the subject line segment(s).
- F. A sample video disc shall be submitted to Engineer for approval prior to performing cleaning and TV inspection operations.

1.04 JOB CONDITIONS

- A. Notify the Engineer immediately if unusual or unexpected conditions are encountered. Discontinue Work until Engineer provides notification to resume Work.
- B. All Work in streets and roadways shall be conducted in strict accordance with provisions of Section 01570.
- C. By-pass pumping of sewage will be allowed only as provided in the Project Work Schedule and approved in writing by the Owner.
- D. Cleaning Precautions: During sewer cleaning operations, satisfactory precautions shall be taken in the use of hydraulically propelled cleaning equipment. Precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer.
- E. Contractor shall plan the Work and arrange the Work schedules to minimize the length of the time sewer service is interrupted.

1.05 QUALITY ASSURANCE

- A. Adequate numbers of skilled workman who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specific requirements and the methods needed for proper performance of the Work in this sections shall be provided and used to complete the work.
- B. Video inspection shall be performed by a certified NASSCO PACP trained Operator.
- C. Equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner shall be provided and used to complete the Work.
- D. Contractor shall provide an adequate on-the-job supervisor of all Work and workmen to assure the Work meets all requirements of the Contract.

1.06 CLEANING EQUIPMENT

- A. High-Velocity Jet (Hydrocleaning) Equipment:
 - 1. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation.
 - 2. 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.
 - 3. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream.
 - 4. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.
 - 5. Additional equipment shall be provided for removal of large objects and/or roots from the sewer line or may be required to complete the cleaning process.
- B. Self-Contained Vacuum Equipment:
 - 1. Equipment shall be capable of removing solid and liquid fractions common to sanitary and storm sewer lines.
 - 2. Equipment shall be self contained and capable of holding water/liquid pumpage. Holding facilities shall be capable of separating the solids from the liquids and providing for the liquid only to be returned to the sewer system when allowed by the Specifications.
 - 3. Equipment shall be capable of a minimum vacuum lift of 12 feet below the grade level.
 - 4. Other mechanical equipment and accessories may be required and/or allowed to affect the planned cleaning activities.
- C. Screen
 - 1. Screens and/or other physical devices shall be furnished and installed in the downstream manhole of the line section being actively cleaned to trap loose material.
 - 2. Screens and devices shall have a maximum opening size of ½ inch.

1.07 CLOSED CIRCUIT TV INSPECTION EQUIPMENT

- A. Closed Circuit TV Inspection shall be accomplished using a self-contained system of all necessary equipment to complete the TV activities.
- B. All equipment components shall be compatible and designed to work as a unit.
- C. Closed Circuit Television Camera Unit:
 - 1. The TV camera used for the inspection shall be a full color unit specifically designed and constructed for such inspection.
 - 2. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe.
 - 3. The camera shall be operative in 100% humidity conditions.
 - 4. The camera shall be pan-and-tilt type with an articulating eye and have suitable lighting to allow axial observation of service laterals.
 - 5. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Engineer.
 - 6. Two (2) digital video recorders (DVR) shall be required within the closed circuit TV inspection vehicle so that the engineer may obtain an original (un-edited) video disc(s) at the end of each work day.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Videos shall be submitted in standard DVD format.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Secure approval of "Traffic Control Plan" prior to working in roadways.
- B. Install barriers, signs and other devices to identify and protect the work site and all adjacent areas.
- C. Notify all properties that will or potentially have sewer service disruptions due to the planned work activities.

3.02 SEWER CLEANING

- A. General Cleaning
 - 1. The designated storm sewer or sanitary sewer sections shall be cleaned using hydraulically propelled, high-velocity jet equipment.
 - 2. Selection of the equipment used shall be based on the conditions of lines at the time the Work commences. The equipment and methods selected shall be satisfactory to the Engineer.
 - 3. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes.
 - 4. When cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted.

5. When successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, the Engineer shall determine if alternate cleaning equipment/methods shall be used to complete the cleaning activity or the cleaning effort abandoned.
- B. Root Removal:
1. Roots shall be removed in the pipe sections designated for cleaning where root intrusion is a problem.
 2. Special attention should be used during the cleaning operation to assure complete removal of roots from the joints and cracks.
 3. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters or porcupines, and equipment such as high-velocity jet cleaners.
 4. Any roots which could prevent the seating of the packer, could prevent the proper application of chemical sealants, pipe lining or other planned repairs shall be removed.
- C. Material Removal:
1. Sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole section of the section being cleaned.
 2. Passing material from manhole section to the manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.
 3. A screening device or other positive means to prevent passage of solids downstream of the section being cleaned shall be in place during all cleaning activities, and shall be cleaned periodically to prevent blockages.
- D. Disposal of Materials:
1. The Contractor is responsible for transporting all debris removed from the sewers during the cleaning operation to a proper disposal site.
 2. Any hazardous waste material encountered during this Project will be considered as a "Changed Condition".

3.03 SEWER FLOW CONTROL

- A. When sewer line depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, joint testing and/or sealing; the flow shall be reduced to the level shown below by operations of pump stations, plugging or blocking of the flow, or by pumping and bypassing of the flow as specified.
- B. Depth of flow shall not exceed that shown below for the respective pipe sizes as measured in the manhole when performing television inspection, joint testing and/or sealing.
1.

Maximum Depth of Flow	Television Inspection
6" - 10" Pipe	20% of Pipe Diameter
12" - 24" Pipe	25% of Pipe Diameter
27" Pipe & Larger	30% of Pipe Diameter

2. Maximum Depth of Flow..... Joint Testing/Sealing
 - 6" - 12" Pipe..... 25% of Pipe Diameter
 - 15" - 24" Pipe..... 30% of Pipe Diameter
 - 27" Pipe & Larger..... 35% of Pipe Diameter
- C. Plugging or Blocking:
 1. A sewer line plug shall be inserted into the lines upstream of the line section being worked.
 2. The plug shall be so designed that all or any portion of the sewage can be released. During TV inspection, testing and sealing operations, flow shall be reduced to within the limits specified above.
 3. After the Work has been completed, flow shall be restored to normal.
- D. Pumping and Bypassing:
 1. When pumping and bypassing is required the Contractor shall supply the pumps, conduits, and other equipment to divert the flow of sewage around the line section in which Work is to be performed.
 2. The bypass system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during the inspecting testing or sealing activities.
 3. The Contractor shall also be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to minimize noise.
- E. Flow Control Precautions:
 1. 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.
 2. Precautions must also be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

3.04 CLOSED CIRCUIT TV INSPECTION - MAIN LINES

- A. General:
 1. After cleaning, the storm lines segments or sewer line sections shall be visually inspected by means of remote controlled closed-circuit television equipment.
 2. The inspection will be performed one segment or section at a time. Flow in the section being inspected shall be suitably controlled as specified herein.
- B. TV Inspection:
 1. 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's condition.

2. A full 360 degree pan of all manholes is required. The video footage shall occur at the beginning of each pipe segment survey inspection from the bottom of the manhole panning up the manhole shaft. The Contractor shall cover the manhole opening to prevent excess light from entering the structure and to insure a clear and focused view of the manhole interior. In instances where the manhole is a terminal manhole, the pan shall occur at the end of the pipe segment survey inspection.
 3. In no case will the television camera be pulled at a speed greater than 30 feet per minute.
 4. A view axially into each service connection shall be provided for a minimum of 10 seconds.
 5. The contractor shall pause the digital recording at any time there is a delay in the inspection and restart the digital recording in the same digital file. The pause shall in no way affect, freeze or interrupt the replay video and shall not close the video file during the inspection.
 6. Manual winches, power winches, TV cable, and powered rewinds, self powered crawlers 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. The camera lens shall be kept clear of condensation and debris during CCTV inspection.
 7. If, during the inspection operation, the television camera will not pass through the entire segment or manhole section, the Contractor shall set up his equipment so that inspection can be performed from the opposite end of the segment or section.
- C. Locating Defects and Service Connections:
1. The importance of accurate distance measurements is emphasized. The cable footage-counter shall be accurate to plus/minus two (2) feet per 1,000 feet.
 2. Measurement for location of defects and service connections shall be above ground by means of a meter device, cable device or other approved means.
 3. Accuracy of the distance meter shall be checked by use of a suitable device, and the accuracy shall be satisfactory to the Engineer.
- D. Documentation of the Television Results
1. Television Inspection Logs:
 - a. Printed location logs shall be prepared by the Contractor on the job site and will clearly show the location in relation to an adjacent manhole of each identified point observed during inspection.
 - b. All points of significance shall be identified by audio and on PACP log to include all manholes, active and inactive service connections, structural defects, maintenance problems, grease, roots, infiltration, obvious inflow sources, building sewers, unusual conditions, storm sewer connections, broken pipe, presence of scale, corrosion, etc. and other discernible features. See Section 1.03 for submittals.

E. DVD (Video) Recordings:

1. The purpose of the recording shall be to supply a visual and audio record of problem areas of the lines that is suitable to be replayed.
2. Slow motion or stop-motion playback features may be supplied at the option of the Contractor, with approval of the Engineer.
3. The naming of the video file shall consist of the "FROM MANHOLE NUMBER/STATION NUMBER", "TO MANHOLE NUMBER/STATION NUMBER", and the eight digit inspection date. Verify with the Engineers for any specific Sewer Line Identification to be included.
4. All defects and significant observations shall include a text overlay of the recorded observation.
5. Contractor shall release title to the digital recordings upon submittal to the Owner as detailed in Section 1.03 above.

F. Photographs:

1. Digital photographs in JPEG format shall be made of all recorded defect observations. These photographs will be computer generated with the use of the inspection reporting system software.
2. JPEG images shall be captured at a minimum resolution of 640x480 pixels.
3. At a minimum, all photographs shall be named consisting of the following description: "FROM MANHOLE NUMBER/STATION NUMBER", "TO MANHOLE NUMBER/STATION NUMBER", eight digit inspection date, and the defect 'station' location along the pipe. It is to the Contractor's discretion as to the additional data information that may be needed in the naming of the files to make the file unique within the file naming constraints of their inspection software. Verify with the Engineer for any the specific Sewer Line Identification to be included.
4. Any additional information shall be included after the mandatory info specified above. The naming convention shall be consistent throughout the project.
5. A minimum of two (2) photographs of each defect shall be taken, one with a perspective view and one with a close-up view.
6. One (1) photograph is required for each lateral connection looking directly at the connection and each manhole observation from the bottom looking up.

3.05 ACCEPTANCE OF WORK

A. Cleaning

1. Where cleaning activities are not followed by closed circuit TV inspection, the line/liner will be accepted after:
 - a. The final pass of the cleaning equipment does not produce debris in the water passing beyond the line segment.
 - b. The line segment passes a physical inspection by the Owner/Engineer by means determined prior to commencing the Work.

2. Where cleaning activities are followed by closed circuit TV inspection, the line/liner will be accepted after:
 - a. The final pass of the cleaning equipment does not produce debris in the water passing beyond the line segment.
 - b. Review of the video recordings indicate the line has been satisfactorily cleaned for the stated purpose(s) of the cleaning activities.
- B. Closed Circuit TV Inspection
 1. The Owner/Engineer shall review the TV recordings and logs in a timely manner after receipt from the Contractor for the purpose of determining acceptability of the Work.
 2. The Contractor shall be notified of any problems noted with the Work to allow scheduling of Re-Work as may be required to produce acceptable quality documents.
 3. The Contractor shall schedule the Re-Work of all rejected Work as a priority over unattempted areas of the Work.
 4. All re-work shall be at the Contractor's expense.

3.06 ADDITIONAL RESPONSIBILITIES OF THE CONTRACTOR

- A. In the event of any Contractor-related overflow or interruption/backup of customer service, the Contractor shall immediately notify the Engineer and Owner. The Contractor shall contain and eliminate the overflow/interruption.
- B. The Contractor shall be responsible for any fines levied by others, reimbursement of any agency incurred for costs, damage, cleanup, restoration of flow and any disruption of service costs to customers as a result of the Contractor's work. This in addition to any and all costs incurred by the customer.
- C. The Contractor shall respect the rights of property owners, and not enter upon private property without obtaining permission from the owner of the property.
- D. For manholes located in easements of private property, the Contractor shall provide the residents with 24-hour advanced notice for easement access prior to entering the property, unless the resident provides immediate permission.

3.07 CLEAN-UP

- A. Clean-up and final completion of the Work.
 1. Upon acceptance of the Work, the Contractor shall reinstate the Project areas affected by the operations.
 2. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, roads, other utilities, etc. due to movement of TV, cleaning, excavating or other equipment, and/or erection of equipment and/or any other activities associated with the Work, shall be the sole responsibility and the sole cost of the Contractor unless specifically designated for payment under the Contract Unit Price Schedule.

END OF SECTION