
SECTION 5
SPECIFICATIONS

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION OF THE PROJECT

- A. The project is located on East Washington Street in the Village of Chagrin Falls. A portion of the work follows a section of 6" off-road sewer that connects to the Water Control House lateral.

1.2 PROJECT DESCRIPTION

- A. The project consists of waterline work through a WSRLA loan and sanitary and storm sewer rehabilitation through a WPCLF loan. The contractor will have to submit separate Contractor's Estimates for each.
- B. Waterline work includes transferring all connections for side streets, buildings, etc. and all service connections from the existing 10" main to a newer existing 12" main and abandoning the 10" main. On the short side service connections, the contractor shall excavate at the 12" main, tap the main with a ¾" corp stop, and tie in the existing service to the corp stop. If the existing service at the 12" main cannot be located, a new service connection from the main to the curb stop shall be installed. The bid quantities reflect an estimated 50% tied in and 50% replaced. Quantities will be adjusted per the contract. All long side connections shall be replaced with a new service from the curb stop to the 12" main. A Curb Stop & Valve Box item is included in the bid quantities for replacement of the existing curb stops. Bid items for 2" service connections are included in the bid items, should services larger than 1" be encountered.
- C. Sanitary and storm sewer rehabilitation includes lining and rehabilitation of sanitary sewers, laterals, and manholes, installing sanitary lateral cleanouts, and rehabilitation of storm sewers and structures.
- D. Site work shall include site restoration and pavement resurfacing upon completion of the utility work.
- E. There has been limited televising of the main, laterals from the main to the R/W, and laterals from the R/W to the house; but enough has been performed to know that with some point repairs, some of the laterals can be lined, but some will need to be replaced. The bid items and quantities provide for an estimated amount of 50% of the laterals from the main to the R/W being lined (paid by EACH) and 50% of the laterals from the main to the R/W being replaced with new pipe (paid by EACH); however, the final quantity of each will be directed after reviewing the videos. Quantities will be adjusted per the contract. All laterals lined will also have a clean out/test tee installed under a separate pay item. All laterals replaced include a test tee/clean out in the replacement bid item.

- F. The bid items and quantities provide for an estimated amount of televising and lining (paid by FT) for the laterals from the R/W to the house (length varies – used average of 45' per lateral for estimated bid quantity). After reviewing the videos, property owners of the laterals determined to be in satisfactory condition for lining (with possible point repairs) will be notified. Those property owners that wish to voluntarily have their lateral lined at their expense will sign the appropriate fee form with the Owner and the lateral will be added to the list to be lined from the R/W to the house. The bid quantities reflect an estimate of 20 laterals (paid by FT); however, the final quantity will be dependent on the number of property owners signing up for the program. Quantities will be adjusted per the contract. If the lateral from the R/W to the house is found to be in an unsatisfactory condition for lining and needs to be replaced, the lateral replacement will be addressed in a subsequent project.

1.3 SPECIFICATIONS

- A. In general, these Specifications describe the work to be performed by the various trades, other than work specifically excluded. It shall be the responsibility of the Contractor and Subcontractors to perform all work incidental to their trade, whether or not specific mention is made of each item, unless such incidentals are included under another Item.
- B. It is advised that the Contractor and all Subcontractors familiarize themselves with the contents of the complete Specifications, particularly for the trades preceding, following, related or adjacent to their work.

1.4 DRAWING SCHEDULE

- A. The work to be done under this Contract is shown on the following Drawings:

<u>Title</u>	<u>Sheet No.</u>
Cover Sheet	1
General Notes	2
Project Overview	3
Existing Conditions	4-14
Plan and Profile	15-27
Water Valves	28-29
Resurfacing Plan	30-34
Construction Details	35-38
E&S Control	39

END OF SECTION 011100

SECTION 011423 - ADDITIONAL WORK, OVERTIME

PART 1 - GENERAL

1.1 NIGHT, SUNDAY AND HOLIDAY WORK

- A. No work will be permitted at night, Sunday or legal holidays except as noted on the plans or in the case of emergency and then only upon written authorization of the Engineer. Where no emergency exists, but the Contractor feels it advantageous to work at night, Sunday or legal holidays, the Contractor shall notify the Engineer at least two (2) days in advance, requesting written permission. Any work performed during the absence of the Engineer will be done at the Contractor's risk and responsibility and may be subject to rejection upon later inspection.

END OF SECTION 011423

SECTION 012513 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 MATERIALS AND EQUIPMENT

- A. In the specifications and on the Engineer's drawings, are specified and shown certain pieces of equipment and materials deemed most suitable for the service anticipated. This is not done to eliminate other equipment and materials equally as good and efficient. The Contractor shall prepare his bid on the particular materials and equipment specified. Following the award of the contract, should the Contractor desire to use other equipment and materials, he shall submit to the Owner a written request for such change and state the advantage to the Owner and the savings or additional cost involved by the proposed substitution. The determination as to whether or not such change will be permitted rests with the Owner and the Engineer.
- B. Each major item of equipment shall be inspected by a manufacturer's representative during installation and upon completion of the work. The Contractor shall supply the Engineer with a certificate of such inspection.

END OF SECTION 012513

SECTION 013119 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION MEETING

- A. Prior to the Contractor beginning any work on the project, the Owner will schedule and hold a preconstruction meeting to discuss all aspects of the contract work.
- B. The Contractor shall be present and be prepared to comment in detail on all aspects of his work.
- C. The Contractor shall bring to the preconstruction meeting a proposed construction progress schedule, erosion control plan, quality control program, concrete mix designs, asphalt mix designs (JMF), etc. Approval of each by the Engineer is required prior to the start of any work.
- D. Included in the construction progress schedule shall be an implementation sequence of the proposed erosion control efforts required by the contract.

1.2 PROGRESS MEETINGS

- A. Monthly progress meetings will be held at a location to be determined by the Owner on a regularly scheduled day mutually convenient to the Owner, Contractor, and Engineer.
- B. The Contractor shall provide an updated construction progress schedule and be prepared to comment in detail on all aspects of his work.

END OF SECTION 013119

SECTION 013216 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 PROGRESS SCHEDULE

- A. Immediately after signing the Contract, the General Construction Contractor shall prepare a graphic progress schedule, indicating the work to be executed during each month and the rate of expected progress to secure completion on the agreed-upon completion date. The progress schedule shall be approved by the Engineer and Owner prior to starting work on the site. Copies of such graphic progress charts, upon which has been indicated the actual progress, shall be furnished to the Engineer with each requisition for payment.
- B. Should the rate of progress fall materially behind the scheduled rate of progress, and unless the delay is authorized by the Engineer, each offending Contractor shall furnish additional labor, work overtime, or take other necessary means required for completion of the work on the scheduled date. No additional compensation beyond the set Contract price shall be paid for action taken or overtime expense incurred in maintaining scheduled progress.

END OF SECTION 013216

SECTION 013236 – VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all labor, materials, equipment, and services, and perform all operations necessary to furnish to the Owner a complete color audio-video DVD record of the surface features within the proposed construction zone of influence. This record shall include, but not be limited to, all audio-video DVDs, storage cases, video logs, and indices. The purpose of this coverage shall be to accurately document the pre-construction condition of these surface features.

1.2 QUALIFICATIONS

- A. The video DVD documentation shall be done by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio-video DVD documentation. The firm shall furnish such information as the Owner deems necessary to determine the ability of that firm to perform the work in accordance with the Contract specifications.

1.3 PRODUCTS

- A. The color audio-video recording delivered to the Owner shall be on a high quality DVD format.

END OF SECTION 013236

SECTION 013319 - FIELD TEST REPORTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes, but is not limited to, services performed by an independent testing laboratory. Laboratory services covered under this section are for testing materials used for field constructed elements of the work. Performance testing of manufactured items and shop fabricated materials shall be covered under their respective specification section.
- B. All testing performed under this item shall be for the protection and benefit of the Owner and shall not be construed by the Contractor as a comprehensive quality control program intended to protect the Contractor, his subcontractors, or his suppliers. The testing frequency and types of testing shall be as scheduled herein.
- C. Inspections, tests, and related actions specified in this section and elsewhere in the contract documents are not intended to limit the Contractor's own quality control procedures and testing, which facilitate overall compliance with requirements of the contract documents. Requirements for the Contractor to provide quality control services as required by the Engineer, the Owner, governing authorities, or other authorized entities are not limited by the provisions of this Section.
- D. The Contractor is required to cooperate with the independent testing laboratories performing required inspections, test, and similar services and the Engineer or his representative.
- E. Materials and installed work may require testing or retesting at any time during progress of work. Retesting of rejected materials or installed work shall be done at Contractor's expense.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. The Contract Documents may include testing requirements furnished under other Sections. Work elements which may include other testing requirements are:
 - 1. Water distribution systems.
 - 2. Storm sewer systems.
 - 3. Sanitary sewer systems.

1.3 SELECTION AND PAYMENT

- A. The Contractor will employ an independent testing laboratory to perform specified testing. Payment shall be incidental to the related work bid item. The laboratory shall be mutually agreed upon by the Owner, Engineer, and Contractor.
- B. Employment of testing laboratory in no way relieves the Contractor of the obligation to perform work in accordance with requirements of the contract documents.
- C. The testing laboratory and their personnel shall be under the direction of the Engineer's on-site representative, regardless of who employs their services.

1.4 REFERENCES

- A. AASHTO T-19, Standard Method of Test for Unit Weight and Voids in Aggregate.
- B. AASHTO T-37, Standard Method of Test for Sieve Analysis of mineral Filler for Road and Paving Materials.
- C. AASHTO T-230, Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures.
- D. ASTM C-29, Standard Method of Test for Unit Weight and Voids in Aggregate.
- E. ASTM C-31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- F. ASTM C-33, Standard Specification for Concrete Aggregates.
- G. ASTM C-39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- H. ASTM C-40, Test Method for Organic Impurities in Fine Aggregates for Concrete.
- I. ASTM C-42, Standard Test Methods for Obtaining and Testing Drilled Cored and Sawed Beams of Concrete.
- J. ASTM C-88, Standard Test Method for Soundness of Aggregate by use of Sodium Sulfate or Magnesium Sulfate.
- K. ASTM C-94, Standard Specification for Ready-Mixed Concrete.
- L. ASTM C-117, Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.
- M. ASTM C-136, Standard Method for Sieve Analysis of Fine and Course Aggregate.

- N. ASTM C-142, Test Method for Clay Lumps and Friable Particles in Aggregate.
- O. ASTM C-143, Standard Test Method for Slump of Hydraulic Cement Concrete.
- P. ASTM C-172, Standard Practice for Sampling Freshly Mixed Concrete.
- Q. ASTM C-173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- R. ASTM C-231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- S. ASTM C-535, Standard Test Method for Resistance to Degradation of Large-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine.
- T. ASTM C-1064, Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- U. ASTM D-698, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb. (2.49-kg) Rammer and 12-inc. (305-mm) Drop.
- V. ASTM D-2487, Standard Test Method for Classification of Soils for engineer purposes.
- W. ASTM D-2940, Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
- X. ASTM D-4253, Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
- Y. ASTM D-4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- Z. ASTM D-4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
- AA. ODOT Supplement 1021, Method of Test for Determination of the Percent of Fractured Pieces in Gravel.
- AB. ODOT Supplement 1029, Method of Test for Determining the Percentage of Deleterious Materials in Course Aggregate.
- AC. ODOT Supplement 1036, Method of Test for Determination of Percent Air Voids in Compacted Dense Bituminous Paving Mixtures.
- AD. ODOT Supplement 1044, Mix Design Method for Bituminous Aggregate Base.

- AE. Uni-Bell PVC Pipe Association UNI-B-6-98 for Low Pressure Air Testing of Installed Sewer Pipe.
- AF. ASTM – C969 – Standard practice for infiltration and exfiltration acceptance of installed concrete sewer pipe.

1.5 SUBMITTALS

- A. Prior to the start of work, submit testing laboratory name, address, and telephone number, and names of full-time registered Engineer or specialist and responsible officer.
- B. Submit copy of the testing laboratory's evaluation report issued by one of the evaluation authorities identified in Article 1.6 of this Section with memorandum of remedies of any deficiencies reported by the inspection.
- C. Submit the chain of custody and other QA/QC procedures for each test to be utilized by the laboratory.
- D. Submit a sample test report for review by the Engineer to demonstrate conformance with Article 3.2 herein.

1.6 QUALITY ASSURANCE

- A. Except as otherwise indicated, the testing laboratory engaged shall be prequalified by the Ohio Department of Transportation for the types of services specified herein.
- B. The field personnel utilized to perform all field-testing and preparation shall be certified for those tests being performed.

1.7 RESPONSIBILITIES

- A. Testing Laboratory Responsibilities:
 - 1. Provide qualified personnel at the site. Cooperate with the Engineer and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with the specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of the contract documents.
 - 4. Immediately notify the Engineer and Contractor of observed irregularities or nonconformance of work or products.
 - 5. Perform additional tests required by the Engineer.
 - 6. Testing personnel are to report to the Engineer or his representative upon arrival on site for instructions and requirements. Prior to leaving the site, furnish the Engineer or his representative all test results whether in a formal or informal format.

7. Attend preconstruction meetings and progress meetings.
- B. Contractor Responsibilities:
1. Provide access to materials proposed to be used which require testing.
 2. Cooperate with laboratory personnel and provide access to the work.
 3. Provide incidental labor and facilities:
 - a. To provide access to work to be tested.
 - b. To obtain and handle samples at the site or at the source of products to be tested.
 - c. To facilitate tests.
 - d. To provide storage and curing of test samples as required by the testing laboratory.
 4. Notify the Engineer and laboratory 24 hours prior to expected time for operations requiring testing services for scheduling purposes. Materials will not be permitted to be placed without the proper testing being performed in conformance with this Section.

1.8 LIMITS OF LABORATORY AUTHORITY

- A. The laboratory may not release, revoke, alter, or enlarge the requirements of the contract documents.
- B. The laboratory may not approve or accept any portion of the work.
- C. The laboratory may not assume any duties of the Contractor.
- D. The laboratory has no authority to stop the work.

1.9 SCHEDULE OF TESTS

Testing anticipated on this project shall include, but is not limited to:

- A. Earthwork
 1. Special backfill material sieve analysis per ASTM C-136, one test per source.
 2. On-site trench backfill analysis per ASTM D-2487, as directed by Engineer.
 3. Pipe bedding and cover sieve analysis per ASTM C-136, one test per source.
 4. Drainage fill sieve analysis per ASTM C-136, one test per source.
 5. Soil compaction per ASTM D-698.
 - a. Embankment testing shall be at least one (1) test/5,000 S.F. of each lift;
 - b. Trench backfill testing shall be at least one (1) test/50 L.F. of each lift;
 - c. Subgrade and/or subbase testing shall be at least one (1) test/200 L.F. of pavement or 5,000 S.F. of slabs subject to greater frequency due to soil conditions or Engineer's direction.

6. Backfill compaction per ASTM D-4253 and D-4254, one test per 50 L.F. of each lift.
7. Low Strength Mortar testing per ASTM D-4832.

B. Concrete

1. Concrete aggregate deleterious substances per ASTM C-40, ASTM C-117, and ASTM C-142, one test per source.
2. Concrete aggregate abrasion per ASTM C-535, one test per source.
3. Sodium sulfate soundness of coarse aggregate per ASTM C-88, one test per source.
4. Sampling Fresh Concrete: ASTM C-172, except modified for slump to comply with ASTM C 94.
 - a. When cylinders and/or beam samples are made, the slumps and air test shall be made using concrete from the same batch.
 - b. Slump: ASTM C-143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - c. Air Content: ASTM C-173, volumetric method of lightweight concrete; ASTM C-231 pressure method for normal weight concrete; at least one for each pour of each type of air-entrained concrete, and each time a set of compression test specimens is made.
 - d. Concrete Temperature: ASTM C-1064, test hourly when air temperature is 40° F. (4° C.) and below, and when 80° F. (27° C.) and above; and each time a set of compression test specimens is made.
 - e. Compression Test Specimen: ASTM C-31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - f. Compressive Strength Tests: ASTM C-39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days.
 - i. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 - ii. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

- g. Two (2) tests beams shall be made for each 250 square yards of concrete pavement and/or slabs on grade placed.
 - i. For traffic to be allowed on pavement or slab, the modulus of rupture shall be a minimum of 600 psi for Class C concrete or 400 psi for ODOT Class MS or FS.
 - h. When cylinders and/or beam samples are made, the slumps and air test shall be made using concrete from the same batch.
 - 5. Nondestructive Testing: Penetration resistance, sonoscope, or other nondestructive devices may be permitted but shall not be used as the sole basis for acceptance or rejection.
 - 6. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
 - a. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.
- C. Pavement
- 1. Aggregate base sieve analysis per ASTM D-2940, one test per source.
 - 2. Sodium sulfate soundness of aggregate base per ASTM C-88, one test per source.
 - 3. Percent of fractured pieces for aggregate base per ODOT Supplement 1021, one test per source.
- D. Asphalt
- 1. Provide testing for mixture acceptance in accordance with Ohio Department of Transportation Procedures. The person performing the testing must have a current Level 1 Bituminous Concrete approval from ODOT.
- E. Sewers
- 1. Deflection Testing
 - a. All thermoplastic gravity sanitary sewer pipe shall be tested for allowable deflection.
 - b. Deflection tests shall be performed before final acceptance and no sooner than thirty (30) days after installation of final backfill
 - c. Maximum allowable pipe deflection shall be five (5) percent of the average inside diameter for the size and class of pipe specified.
 - d. Acceptance testing shall be performed with a non-adjustable "go, no-go" mandrel with a minimum of eight (8) contact points. Adjustable mandrels for acceptance testing shall be used only with permission of the Engineer.

- e. The mandrel size shall be ninety-five (95) percent of the average inside diameter for the size and class of pipe specified.
- f. If the "go, no-go" mandrel will not pass through a section of pipe a deflector or adjustable mandrel may be used to determine the extent and/or severity of the non-acceptable area. A "go, no-go" mandrel shall be re-run through the pipe section for final acceptance testing at no additional cost to the Owner.
- g. The Contractor or subcontractor performing the test shall be experienced and qualified to perform deflection testing with the equipment and procedures utilized. The contractor shall provide all labor, materials, tools and equipment necessary to clean and test all sections of sewer pipe, locate deficient areas, repair, deficient areas, and retest all repaired areas.
- h. All sewer runs shall be cleaned prior to testing.
- i. The acceptance test shall be performed without mechanical pulling devices.
- j. All pipe failing the deflection test shall be exposed, repaired or replaced and retested at no additional cost to the Owner.

2. Leakage Testing

- a. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- b. The Contractor shall perform sufficient tests to determine that the installation of all pipe materials have been as specified and that test results are in accordance with those required for approval of the installation.
- c. The Contractor shall furnish all pressure gauges, suitable pump or pumps, pipes, test heads, and any other apparatus and materials used for these tests. These tests are to be considered as part of the work, and no additional compensation shall be made.
- d. The tests shall be conducted under the direction of the Engineer or an appointed agent. Any testing done without direction and supervision as specified shall not be considered as a proper means of approval.
- e. The Contractor may obtain water for testing as may be required by observing the rules and regulations enforced in the municipality in which the work is being done.
- f. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

3. Infiltration and Exfiltration Testing

- a. All sewers shall be tested using an exfiltration test or, where specifically allowed in writing by the Engineer, an infiltration test.
- b. All sewers shall be tested. No visible leakage in the sewers or manholes shall be permitted.

- c. Bulkheads shall be used to isolate the test sections as required to perform the work. All service laterals, stubs and fittings shall be plugged or capped at the connection to the test section.
- d. Each manhole run shall be tested separately.

4. Exfiltration Testing

- a. The test shall be performed first with a minimum head of water of three (3) feet above the top of the high end of the sewer or two (2) feet above the high end of the highest lateral in the section or sections to be tested, or three (3) feet above the existing groundwater elevation, whichever is higher.
- b. The exfiltration test shall be conducted between two manholes by sealing the downstream end of the test section and all inlet sewers at the upstream manhole with pipe stoppers.
- c. The average internal pressure in the system shall not exceed 11.6 feet of water or 5 psi and the maximum internal pipe pressure at the lowest end shall not exceed 23 feet of water or 10 psi.
- d. Water shall be added to the pipe section at a steady rate from the upstream manhole to allow air to escape from the sewer until the water is at the specified level above the crown of the pipe. The water may stand in the pipe and manhole up to seventy-two (72) hours prior to measurement of leakage to allow for absorption by the pipe and bleeding of air. After absorption into the pipe and manhole has stabilized, the water in the upstream manhole shall be brought to test level.
- e. The leakage rate shall be determined by measurement of the drop in water elevation measured in the upstream manhole and the loss of water calculated. The test period shall be a minimum of sixty (60) minutes duration. Use the following table to determine loss of water as measured in the manhole:

Water Level Change in Test Manhole		Volume of Leakage	
		4 Ft. Dia. MH	5 Ft. Dia. MH
(Inches)	(Feet)	(Gals.)	(Gals.)
1/8	0.01	0.98	1.53
1/4	0.02	1.96	3.06
3/8	0.03	2.94	4.59
1/2	0.04	3.92	6.12
5/8	0.05	4.90	7.65
3/4	0.06	5.87	9.18
7/8	0.07	6.85	10.71
1	0.08	7.83	12.24
1-1/8	0.09	8.81	13.77
1-1/4	0.10	9.79	15.30
1-3/8	0.11	10.77	16.83
1-1/2	0.12	11.75	18.36
1-5/8	0.13	12.72	19.89

1-3/4	0.14	13.71	21.42
1-7/8	0.16	14.69	22.90
2	0.17	15.67	24.48

5. Infiltration Testing

- a. An infiltration test shall be conducted for all sections of sewer, only when the ground water level is two (2) feet or more above the elevation of the inside crown of pipe at the upstream limit of the section being tested.
- b. The use of well point pumps or other dewatering devices shall have been discontinued for 24 hours prior to testing to permit the groundwater table to return to a static condition.
- c. The leakage rate shall be measured by a weir, by determination of the time required to fill a container of known volume, or other measuring device approved by the Engineer in the lower end of the sewer section to be tested.
- d. The incoming sewer or sewers in the upper end of the test section shall be securely sealed.

6. Allowable Leakage

- a. The maximum allowable leakage for either infiltration or exfiltration shall be 50 gallons per inch of internal pipe diameter per mile per day.
- b. If actual leakage measured exceeds the limits specified, the Contractor must locate and repair or remove and replace the defective pipe sections to the satisfaction of the Engineer and retest the section accordingly at no additional cost to the Owner.
- c. All sanitary manholes shall be tested separately by using an exfiltration test (or infiltration test where groundwater conditions permit) to two (2) feet above the highest joint with no measurable leakage for a one hour test.

7. Low Pressure Air Testing

- a. PVC sanitary sewers 54-inch diameter and less may be air tested as specified. If the groundwater level is two (2) feet or more above the top of the pipe at the upstream end or if the air pressure required for the test is greater than 5 psig, the air test method should not be used for RCP sanitary sewers.
- b. Each manhole run shall be tested separately, unless otherwise approved by the Engineer, as the construction progresses. Backfill shall be brought to final grade before testing. Testing shall be done prior to surface restoration, and preferably with not more than four (4) manhole runs constructed ahead of testing.
- c. Test equipment consists of valves and pressure gages to control airflow and to monitor pressure within the test section.
- d. The sewer shall be flushed and cleaned prior to testing to clean out any debris. The pipe surface should be wet for more consistent results.

- e. The section of pipe to be tested shall be plugged at each end and the ends of laterals, stubs and fittings to be included in the test section shall be plugged and securely braced to prevent air leakage, and possible blowouts.
- f. Equipment used shall meet the following minimum requirements and be approved by the Engineer:
 - i. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - ii. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - iii. All air used shall pass through a single control panel.
 - iv. Three (3) individual hoses shall be used for the following connections:
 - a). From control panel to pneumatic plugs for inflation.
 - b). From control panel to sealed line for introducing the low pressure air.
 - c). From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
- g. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be used for the test. The sealed pipe shall be pressurized to 9 psig. The plugs must hold against this pressure without having to be braced. No persons shall be allowed in the alignment of the pipe during plug testing.
- h. After a manhole to manhole run of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole. Low pressure air shall be slowly introduced into this sealed line until the internal air pressure reaches approximately 4 psig greater than the average groundwater back pressure, but not greater than 9 psig for PVC pipe or 5 psig for RCP.
- i. In areas where groundwater is known to exist, the Contractor must determine the average groundwater back pressure. The Contractor shall install a 1/2-inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sanitary sewer lines entering the manhole. See Figure No. 1. This shall be done at the time the sanitary sewer line is installed or install an 8-inch diameter stand pipe outside of the manhole backfilled with a column of clean stone of 2-inch minimum diameter to subgrade. Immediately prior to the performance of the low pressure air test, the ground water back pressure shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The plastic tube shall be vertical and a measurement of the height, in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. This height, divided by 2.307, will equal the average groundwater back pressure.

- j. At least two (2) minutes shall be allowed for the air to stabilize when the specified internal air pressure has been obtained. When the pressure has stabilized and is at or above 3.5 psig, the air hose from the control panel to the air supply shall be disconnected. The portion of the line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average groundwater back pressure calculated) shall not be less than the time in the tables in Reference Table 1.
 - k. If a one (1) psi drop in pressure does not occur within the test time, the line has passed. If the pressure drop is more than one (1) psi during the test time, the line is presumed to have failed the test. If the line fails the test, segmented testing may establish the location of any leaks.
 - l. The Contractor must repair the leak or remove and replace the defective pipe section and re-test the section to the satisfaction of the Engineer at no additional cost to the Owner.
 - m. The pneumatic plugs must be installed in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or a plug, which is partially deflated before the pipe pressure is released, can be dangerous.
 - n. The Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.
 - o. Pressurizing equipment shall include a regulator or relief valve set at no higher than 9 psig for PVC pipe or 5 psig for RCP pipe to avoid over-pressurizing and damaging an otherwise acceptable line.
 - p. No one shall be allowed in the trench or manholes during testing.
 - q. Plugs shall not be removed until all pressure has been released.
 - r. All sanitary manholes shall be tested separately by using an exfiltration test (or infiltration test where groundwater conditions permit) to two (2) feet above the highest joint with no measurable leakage for a one hour test.
 - s. The air test data sheet marked Exhibit "A" at the end of this section shall be filled out for each section of piping tested in this manner.
 - t. Testing concrete pipe sewer lines by the low pressure air test method will be per ASTM C924-02 and C1103.
8. Hydrostatic Testing – Pressure Pipe, For Watermain and Force Main
- a. The pipe to be tested must be sufficiently backfilled to prevent movement while under test pressure.
 - b. Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure. A cure time of seven (7) days is recommended when Type I Portland Cement is used; three (3) days is recommended when Type III high-early Portland Cement is used.

- c. Test ends should be restrained to withstand the appreciable thrusts that are developed under test pressure.
- d. Air pressure testing of installed pressure pipe is expressly prohibited.
- e. Any testing performed without the knowledge of the Engineer shall not be considered a test for the purpose of this specification.
- f. The hydrostatic testing sheet marked "Exhibit D" following this section shall be filled out for each section of piping tested in this manner.
- g. After the pipe has been installed and partially backfilled (if applicable) subject all newly installed pipe, or any valved sections of it in such lengths of the force main as determined by the responsible agency, unless otherwise specified, to a hydrostatic pressure test equal to 1-1/2 times the line working pressure (50% over the working pressure) but not less than 1.25 times the working pressure at the highest point along the test section; but, in no case, shall such force mains be tested at less than 150 pounds per square inch.. The duration of each test shall be at least 2 hours.
- h. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a booster pump connected to the pipe in a manner satisfactory to the Engineer. The duration of the test shall be for a minimum of sixty (60) minutes.
- i. No pipe installation will be accepted unless the leakage rate for the section of pipe being tested does not exceed a rate as shown on hydrostatic test chart, during a 24-hour test duration.
- j. The Contractor shall furnish suitable means for determining the quantity of water lost by leakage during the test.

9. Manhole Vacuum Testing

- a. Temporarily plug all pipe entering the manhole. Each plug must be installed at a location beyond the manhole/pipe gasket (i.e. outside the manhole wall), and shall be braced to prevent the plug or pipe from being drawn into the Manhole.
- b. The test head shall be placed inside the rim of the cast iron frame at the top of the manhole and inflated, in accordance with the manufacturer's recommendations.
- c. A vacuum of at least 10 inches of mercury (10" Hg) shall be drawn on the manhole. Shut the line on the vacuum line to the manhole and shut off the pump or disconnect the vacuum line from the pump.
- d. The pressure gauge shall be liquid filled, having a 3.5" diameter face with a reading from zero to thirty inches of mercury.
- e. The manhole shall be considered to pass the vacuum test if the vacuum reading does not drop more than 1" Hg (i.e from 10" to 9" Hg) during the Table 1 minimum test time.
- f. If a manhole fails the vacuum test, the manhole shall be repaired with non-shrinkable grout or other material or method approved by the engineer. The manhole surfaces shall be properly prepared prior

- to any repairs. Once the repair material has cured according to the manufacturer's recommendations, the vacuum test shall be repeated. This process shall continue until a satisfactory test is obtained.
- g. All temporary plugs and braces shall be removed after each test.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 SEQUENCING AND SCHEDULING

- A. The Contractor shall coordinate the sequence of work activities so as to accommodate required testing and shall allow sufficient time for testing of materials by the laboratory so as to cause no delay in the work or the work of any other Contractor. In addition, the Contractor shall coordinate his work so as to avoid the necessity of removing and replacing work to accommodate inspections and tests.

3.2 LABORATORY TEST RESULTS

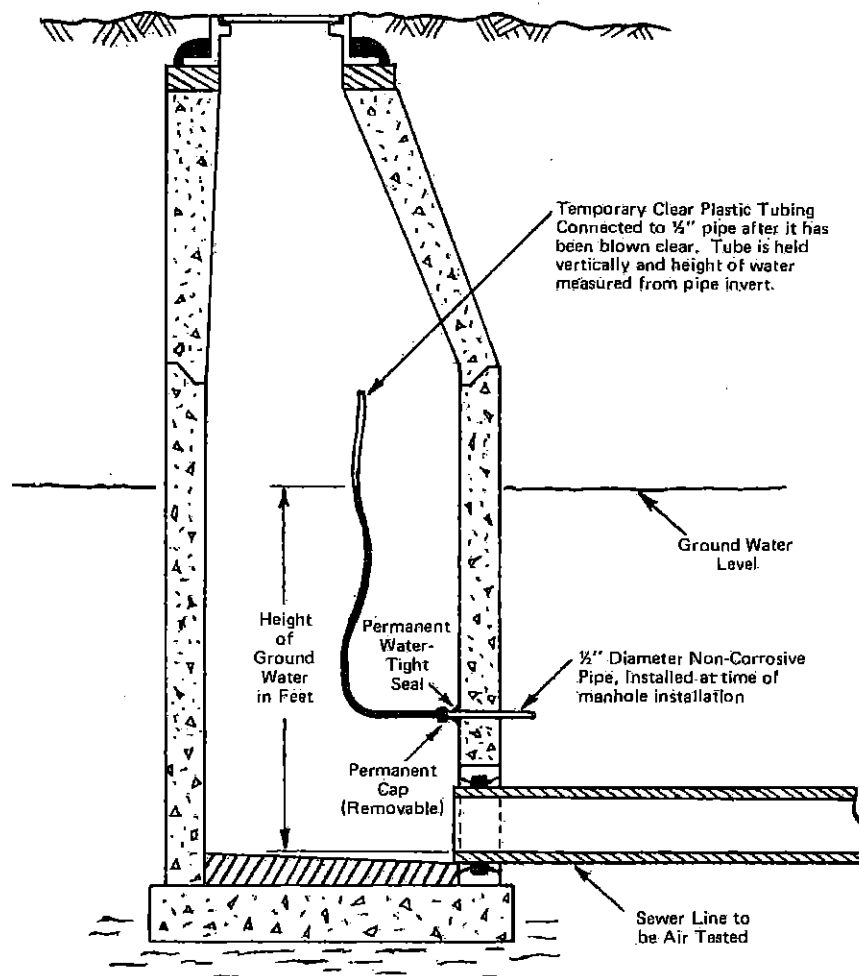
- A. The testing laboratory shall submit a certified written report of each inspection, test, or similar service concurrently to the Owner, Engineer, and Contractor.
- B. Written reports of each inspection, test, or similar service shall include, but not be limited to, the following:
1. Name of testing laboratory.
 2. Project name and construction contract reference number.
 3. Dates and locations of samples and tests or inspections.
 4. Date of report.
 5. Names of individuals making the inspection or test.
 6. Designation of the work and test method.
 7. Test results.
 8. Notation of significant ambient conditions at the time of sample taking and testing.

END OF SECTION

UNI-B-6-98

FIGURE NO. 1

**MANHOLE CROSS-SECTIONAL VIEW
OF THE PROPER METHOD FOR
DETERMINING GROUND WATER HEIGHT**



NOTE: Pressurize pipe to 4.5 P.S.I.F. and let stabilize for 5 minutes. Pressure should then be backed off to 4.0 P.S.I.G. and test time started.

JOB NAME:
JOB LOCATION:
JOB NO.
SPECIFIED PRESSURE DROP () P.S.I.G.
 (See Table I or Table II for Reference)

SANITARY ☐ **STORM** ☐

DATE:
TEST COMPANY:
PROJECT REP:
PIPE MATERIAL:

BASE PRESSURE: 4.0 P.S.I.G.
 (Note: No test shall exceed 9.0 P.S.I.G.)

[illegible]

***Identify any section(s) that failed:**

***Leak (was) (was not) located. Method used:**

REMARKS:

TABLE IMinimum specified time required for a 1.0 P.S.I.G. Pressure Drop

1 Pipe Diameter (Inches)	2 Minimum Time (Min:Sec)	3 Length for Minimum Time (Ft.)	4 Time for Longer Length (Sec)	Specification Time for Length (L) Shown (Min:Sec)							
				100 Ft.	150 Ft.	200 Ft.	250 Ft.	300 Ft.	350 Ft.	400 Ft.	450 Ft.
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	28.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

for size and length of pipe indicated for Q = 0.0015

NOTE: If there has been no leakage, (zero P.S.I.G. drop), after one hour of testing, the test shall be accepted and the test complete. (See Section 7.5)

TABLE II

Minimum specified time required for a 0.5 P.S.I.G. Pressure Drop
for size and length of pipe indicated for Q = 0.0015

1 Pipe Diameter (Inches)	2 Minimum Time (Min:Sec)	3 Length for Minimum Time (Ft.)	4 Time for Longer Length (Sec)	Specification Time for Length (L) Shown (Min:Sec)							
				100 Ft.	100 Ft.	100 Ft.	100 Ft.	100 Ft.	100 Ft.	100 Ft.	100 Ft.
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942 L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352 L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09
54	25:31	44	34.618 L	57:42	86:33	115:24	144:15	173:05	201:56	230:47	259:38
60	28:20	40	42.738 L	71:14	106:51	142:28	178:05	213:41	249:18	284:55	320:32

NOTE: If there has been no leakage, (zero P.S.I.G. drop), after one hour of testing, the test shall be accepted and the test complete. (See Section 7.5)

CT CONSULTANTS, INC.
HYDROSTATIC LEAKAGE TEST

JOB. NO. _____ PROJECT: _____

CONTRACTOR: _____ CLIENT: _____

WATERLINE TESTED AT: _____
(Street Name) (Station of Gauge)

FROM STATION _____ TO STATION _____ ON _____

WATERLINE SIZE _____ TYPE _____

TESTED _____ AT _____ FOR _____
TOTAL L.F. PIPE SIZE PSI DURATION

ALLOWABLE LEAKAGE _____ PER 1,000 L.F. OR _____
GALS./HR. TOTAL GALS. TOTAL L.F.

1ST TEST _____ AND _____
PASS / FAIL PRESSURE LOST GALLONS LOST

2ND TEST _____ AND _____
PASS / FAIL PRESSURE LOST GALLONS LOST

APPROVED BY _____
(INSPECTOR)

COMMENTS: _____

ALLOWABLE LEAKAGE PER 1,000 FEET OF WATERMAIN:

<u>PIPE SIZE</u> <u>INCH DIAMETER</u>	<u>ALLOWABLE LEAKAGE</u> <u>GALS. / 1,000 FEET</u>
6	1
8	1.3
10	1.6
12	1.9
16	2.5
20	3.2
24	3.8
30	4.8
36	5.7

NOTE: IN NO CASE SHALL THE TESTED SECTION EXCEED 2,000 FEET IN LENGTH.

PROJECT: _____ **SHEET NO. 1 OF** _____

JOB NO. _____ **STREET:** _____

CONTRACTOR: _____ **PROJECT REP:** _____

MANHOLE VACUUM TEST

M.H. NO.	M.H. Diameter (in.)	M.H. Depth (ft.) (btm.m.h. cover to shelf)	Vacuum Required (in Hg)	Vacuum Attained (in Hg)	Vacuum Drop (in Hg)	Holding Time Required (sec.)	Pass/Fail	Date Tested	Contractor Attest	Engineer Attest	Remarks

TABLE 1 – Minimum Test Times for Various Manhole Diameter

Depth		Diameter, in.									
(ft)		30	33	36	42	48	54	60	66	72	
Time(s)											
8	11	12	14	17	20	23	26	29	33	36	41
10	14	15	18	21	25	30	35	41	46	51	57
12	17	18	21	25	30	35	41	46	52	58	67
14	20	21	25	30	35	40	45	52	59	65	73
16	22	24	29	34	40	45	50	55	64	72	81
18	25	27	32	38	45	50	55	64	72	79	89
20	28	30	35	42	50	55	64	72	78	87	97
22	31	33	39	46	55	64	75	85	91	101	113
24	33	36	42	51	59	69	81	91	101	108	121
26	36	39	46	55	64	74	87	98			
39	42	45	53	63	74						
42											

Note: Allowable drop equals 1 in. Hg for time shown

PROJECT REP: _____ **DATE:** _____

SECTION 013323 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.1 GENERAL

- A. The Contractor shall submit detailed drawings, acceptable catalog data, specifications and material certifications for all equipment and materials specified or required for the proper completion of the work.
- B. The intent of these items is to demonstrate compliance with the design concept of the work and to provide the detailed information necessary for the fabrication, assembly and installation of the work specified. It is not intended that every detail of all parts of manufactured equipment be submitted, however sufficient detail will be required to ascertain compliance with the specifications and establish the quality of the equipment proposed.

Shop Drawings shall be sufficiently clear and complete to enable the Engineer/Architect and Owner to determine that items proposed to be furnished conform to the specifications and that items delivered to the site are actually those that have been reviewed.

- C. It is emphasized that the Engineer/Architect's review of Contractor's submitted data is for general conformance to the contract drawings and specifications but subject to the detailed requirements of drawings and specifications. Although the Engineer/Architect may review submitted data in detail, such review is an effort to discover errors and omissions in Contractor's drawings. The Engineer/Architect's review shall in no way relieve the Contractor of his obligation to properly coordinate the work and to Engineer/Architect the details of the work in such manner that the purposes and intent of the contract will be achieved. Such review by the Engineer/Architect shall not be construed as placing on him or on the Owner any responsibility for the accuracy and for proper fit, functioning or performance of any phase of the work included in the contract.
- D. Shop Drawings shall be submitted in proper sequence and with due regard to the time required for checking, transmittal and review so as to cause no delay in the work. The Contractor's failure to transmit appropriate submittals to the Engineer/Architect sufficiently in advance of the work shall not be grounds for time extension.
- E. The Contractor shall submit Shop Drawings for all fabricated work and for all manufactured items required to be furnished in the Contract in accordance with the General Provisions and as specified herein. Shop Drawings shall be submitted in sufficient time to allow at least twenty-one (21) calendar days after receipt of the Shop Drawings from the Contractor for checking and processing by the Engineer/Architect.
- F. It is the responsibility of each Prime Contractor to furnish to all other Prime Contractors and especially the General Construction Contractor reviewed Shop Drawings for guidance in interfacing the various trades; i.e., sleeves, inserts, anchor bolts, terminations, and space requirements.

- G. No work shall be performed requiring Shop Drawings until same have been reviewed by Engineer/Architect.
- H. Accepted and reviewed Shop Drawings shall not be construed as approval of changes from Contract plan and specification requirements.
- I. The Engineer/Architect will review the first and second Shop Drawing item submittals at no cost to the Contractor. Review of the third submittal and any subsequent submittal will be at the Contractor's expense. Payment will be deducted from the Contract amount at a rate of 2.8 times direct labor cost plus expenses.

1.2 SUBMITTAL PROCEDURE

- A. All required submissions shall be made to the Engineer/Architect by the Prime Contractor(s) only. Any data prepared by subcontractors and suppliers and all correspondence originating with subcontractors, suppliers, etc., shall be submitted through the Contractor.
- B. Contractor shall review and approve all Shop Drawings prior to submission. Contractor's approval shall constitute a representation to Owner and Engineer/Architect that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents.
- C. Submittal Preparation: Mark each submittal with a permanent label or page for identification. Provide the following information on the label for proper processing and recording of action taken:
 - 1. Location
 - 2. Project Name
 - 3. Contract
 - 4. Name and Address of Engineer/Architect
 - 5. Name and Address of Contractor
 - 6. Name and Address of Subcontractor
 - 7. Name and Address of Supplier
 - 8. Name of Manufacturer
 - 9. Number and Title of appropriate Specification Section
 - 10. Drawing Number and Detail References, as appropriate.
 - 11. Submittal Sequence or Log Reference Number.
 - a. Provide a space on the label for the Contractor's review and approval markings and a space for the Engineer/Architect's "Action Stamp".
- D. Each Shop Drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor:

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

Signature

Date

Company

- E. Shop Drawings shall be submitted in not less than six (6) copies to the Engineer/Architect at the address specified at the Preconstruction Conference. Single mylar or sepia reproducible copies of simple Shop Drawings may be submitted with prior approval of the Engineer/Architect. Digital copies may be considered upon permission of the Engineer/Architect.
- F. At the time of each submission, Contractor shall in writing identify any deviations that the Shop Drawings or samples may have from the requirements of the Contract Documents.
- G. Drawings shall be clean, legible and shall show necessary working dimensions, arrangement, material finish, erection data, and like information needed to define what is to be furnished and to establish its suitability for the intended use. Specifications may be required for equipment or materials to establish any characteristics of performance where such are pertinent. Suitable catalog data sheets showing all options and marked with complete model numbers may, in certain instances, be sufficient to define the articles which it is proposed to furnish.
- H. For product which require submittal of samples, furnish samples so as not to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted. Properly label samples, indicating the material or product represented, its place of origin, the names of the vendor and Contractor and the name of the project for which it is intended. Ship samples prepaid. Accompany samples with pertinent data required to judge the quality and acceptability of the sample, such as certified test records and, where required for proper evaluation, certified chemical analyses.

1.3 REVIEW PROCEDURE

- A. Engineer/Architect will review with reasonable promptness all properly submitted Shop Drawings. Such review shall be only for conformance with the design concept of the Project and for compliance with the information given in the plans and specifications and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
- B. The review of a separate item as such will not constitute the review of the assembly in which the item functions. The Contractor shall submit entire systems as a package.

- C. All Shop Drawings submitted for review shall be stamped with the Engineer/Architect's action and associated comments.
- D. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer/Architect will review each submittal, mark to indicate action taken, and return accordingly. Compliance with specified characteristics is the Contractor's responsibility.

Action Stamp: The Engineer/Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

1. If Shop Drawings are found to be in general compliance, such review will be indicated by marking the first statement.
 2. If only minor notes in reasonable number are needed, the Engineer/Architect will make same on all copies and mark the second statement. Shop Drawings so marked need not be resubmitted.
 3. If the submitted Shop Drawings are incomplete or inadequate, the Engineer/Architect will mark the third statement, request such additional information as required, and explain the reasons for revision. The Contractor shall be responsible for revisions, and/or providing needed information, without undue delay, until such Shop Drawings are acceptable. Shop Drawings marked with No. 3 shall be completed resubmitted.
 4. If the submitted Shop Drawings are not in compliance with the Contract Documents, the Engineer/Architect will mark the fourth statement. The Contractor will be responsible to submit a new offering conforming to specific products specified herein and/or as directed per review citations.
- E. No submittal requiring a Change Order for either value or substitution or both, will be returned until the Change Order is approved or otherwise directed by the Owner.

APPLICATION FOR USE OF SUBSTITUTE ITEM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

Page	Paragraph	Description
A.		The undersigned requests consideration of the following as a substitute item in accordance with Article 6.05 of the General Conditions.
B.		Change in Contract Price (indicate + or -) \$ _____
C.		Attached data includes product description, specifications, drawings, photographs, references, past problems and remedies, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified. For consideration of the attached data as SHOP DRAWINGS, submittal shall be in accordance with requirements of Section 013323.
D.		Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments are correct:

1. The proposed substitute does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other contractors, the construction schedule, or specified warranty requirements. (If proposed substitution affects construction schedule, indicate below using + or -)

_____ CONSECUTIVE CALENDAR DAYS

4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item, and agrees to reimburse the OWNER for the charges of the ENGINEER for evaluating this proposed substitute item.

E. Signature:

Firm:

Address:

Telephone:

Date:

Attachments:

For use by ENGINEER:

_____ Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp.

_____ Accepted as evidenced by included CHANGE ORDER.

_____ Not accepted as submitted. See Remarks.

_____ Acceptance requires completion of submittal as required for SHOP DRAWINGS.

_____ Not accepted. Do not resubmit.

By:

Date:

Remarks:

APPLICATION FOR USE OF "OR-EQUAL" ITEM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

Page	Paragraph	Description
------	-----------	-------------

A. The undersigned requests consideration of the following as an "or-equal" item in accordance with Article 6.05 of the General Conditions.

B. Change in Contract Price (indicate + or -) \$ _____

C. Attached data includes product description, specifications, drawings, photographs, references, past problems and remedies, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified. For consideration of the attached data as SHOP DRAWINGS, submittal shall be in accordance with requirements of Section 013323.

D. Signature:

Firm:

Address:

Telephone: _____ Date: _____

Attachments: _____

For use by ENGINEER:

_____ Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp.

_____ Accepted as evidenced by included CHANGE ORDER.

_____ Not accepted as submitted. See Remarks.

_____ Acceptance requires completion of submittal as required for SHOP DRAWINGS.

_____ Not accepted. Do not resubmit.

By: _____ Date: _____

Remarks: _____

END OF SECTION 013323

SECTION 013543 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 UNNECESSARY NOISE, DUST AND ODORS

- A. The Contractor's performance of this contract shall be conducted so as to eliminate all unnecessary noise, dust and odors.

1.2 SEWAGE, SURFACE AND FLOOD FLOWS

- A. The Contractor shall take whatever action is necessary to provide all necessary tools, equipment and machinery to adequately handle all sewage, surface flows and flood flows which may be encountered during the performance of the work. The entire cost of and liability for handling such flows is the responsibility of the Contractor and shall be included in the price for the appropriate item.

1.3 WORK IN FREEZING WEATHER

- A. Written permission from the Engineer shall be obtained before any work is performed which, in the judgment of the Engineer, may be affected by frost, cold, or snow. When work is performed under such conditions, the Contractor shall provide facilities for heating the materials and for protecting the finished work.

1.4 POLLUTION CONTROL

- A. It shall be the responsibility of the Contractor to prevent or limit pollution of air and water resulting from his operations.
- B. The Contractor shall perform work required to prevent soil from eroding or otherwise entering onto all paved areas and into natural watercourses, ditches, and public sewer systems. This work shall conform to all local ordinances and/or regulations, if any, and if not otherwise regulated by local ordinances or regulations shall at a minimum conform to the Ohio EPA General Storm Water NPDES Permit for Construction Activities and the Ohio Department of Natural Resources Rainwater and Land Development manual. This work may consist of but not be limited to construction and continual maintenance of silt fence, bio bag filters, sedimentation traps, stilling basins, check dams, temporary seeding, temporary mulching, erosion mats and other means to clarify waters containing suspended materials from excavations, embankments, cleared and grubbed or stripped areas, stockpiles, well points, and disposal sites and shall be commensurate with the contractor's schedule, sequence of work, means and methods. If a SWPPP plan is not required for the project, the contractor shall at a minimum submit a plan of his proposed erosion control prevention methods for approval by the Owner and/or other regulatory authorities having jurisdiction prior to starting any construction activities which may cause erosion.

- C. The Contractor shall perform work required to prevent dust attributable to his operations from entering the atmosphere. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with water and/or calcium chloride dust palliative as needed.
- D. Any material removed from sanitary or storm sewers shall be disposed in accordance with all applicable regulations.

END OF SECTION 013543

SECTION 014126 - GENERAL REGULATIONS AND PERMITS

PART 1 - GENERAL

1.1 REGISTRATION

All Contractors and subcontractors shall be registered with the Building Department having jurisdiction. Contact the Building Department for additional registration information.

1.2 PERMITS

The Contractor shall apply for all permits from authorities having jurisdiction. The Owner will waive all permit fees for permits under their jurisdiction; however, the Contractor must pay all inspection fees for permits issued by the Owner and all permit and inspection fees for permits issued by other authorities having jurisdiction.

1.3 ARCHAEOLOGICAL DISCOVERIES

Contractors and subcontractors are required under O.R.C. Section 149.53, to notify the Ohio Historical Society and the Ohio Historic Site Preservation Board of Archaeological Discoveries located in the project area, and to cooperate with those entities in archaeological and historic surveys and salvage efforts if such discoveries are uncovered within the project area.

Contact: Department Head
 Resource Protection and Review
 Ohio Historic Preservation Office
 800 E. 17th Avenue
 Columbus, Ohio 43211-2497
 614-298-2000

Should archaeological discoveries or other activities delay progress of the work, an adjustment in contract time will be made.

END OF SECTION 014126

SECTION 014223 - INDUSTRY STANDARDS

PART 1 - GENERAL

1.1 ABBREVIATIONS

- A. Abbreviations, as used, designate the following:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
AIEE	-	American Institute of Electrical Engineers
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASTM	-	American Society of Testing and Materials
AWWA	-	American Water Works Association
CMS	-	Construction and Material Specifications
NEMA	-	National Electrical Manufacturers Association
ODOT	-	Ohio Department of Transportation
ORC	-	Ohio Revised Code
UL	-	Underwriters Laboratories, Inc.

1.2 REFERENCE TO OTHER SPECIFICATIONS

- A. Where reference is made to specifications such as ASTM, AWWA or AASHTO, the latest edition shall be used, unless otherwise noted on the plans or in the specifications.

1.3 CODES AND STANDARDS

- A. All work provided for by these specifications must be installed according to the provisions of the State and local building codes, subject to inspection and acceptance by the State and local inspectors.

END OF SECTION 014223

SECTION 015136 - TEMPORARY WATER AND DISTRIBUTION

PART 1 - GENERAL

1.1 WATER

- A. The Contractor shall be responsible for an adequate supply of water suitable for his use for construction and drinking. At his own expense, he shall provide and maintain adequate supplies and supply lines in such locations and installed in such a manner as may be satisfactory to the Engineer.

END OF SECTION 015136

SECTION 015526 - TEMPORARY TRAFFIC CONTROL DEVICES

PART 1 - GENERAL

1.1 BARRICADES, SIGNS AND LIGHTS

- A. The Contractor shall employ watchmen on the work when and as necessary. The Contractor shall erect and maintain such strong and suitable barriers and such lights as will effectively prevent the occurrence of any accident to health, limb or property. Lights shall be maintained between the hours of one-half (1/2) hour after sunset and one-half (1/2) hour before sunrise.
- B. No manhole, trench, excavation will be left open awaiting connection or removal at a later date by the Contractor's forces or others but shall be temporarily backfilled and resurfaced if applicable with a temporary pavement passable to traffic at no additional cost to the Owner.
- C. In addition to other safety requirements, a minimum of four (4) foot high fence will be incorporated around any shaft or manhole or other excavation left open at the end of a day's work.

1.2 MAINTENANCE OF TRAFFIC

- A. The Contractor is required to provide maintenance of traffic in conformance with the Ohio Manual of Uniform Traffic Control Devices and Item 614 of the current Construction and Material Specifications of the Ohio Department of Transportation.
- B. This work shall include providing suitable and satisfactorily trained and properly attired flagmen for use at any location where existing roadway is narrowed to a width of less than 2 full lanes (18 feet).
- C. The Contractor is also responsible for maintaining local access to all residences and businesses along the route of the construction and to provide whatever temporary materials are necessary to provide a safe, adequate drive surface.
- D. At all boring locations, Contractor shall provide suitable flashers, barricades, and traffic control devices as may be deemed necessary by the Engineer or the responsible authority in the case of the Department of Transportation, Turnpike Commission, or affected railroad. This may extend to maintain facilities on a 24-hour basis until such time as the areas are completely backfilled.

END OF SECTION 015526

SECTION 015713 - TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnishing all labor, materials, tools, equipment and services for the temporary soil erosion and sediment control work as indicated.
- B. Coordinating the temporary pollution and erosion control with work of all other trades.
- C. Reducing to the greatest extent practicable the area and duration of exposure of readily erodible soils.
- D. Protecting the soils by use of temporary vegetation or mulch or by accelerating the establishment of permanent vegetation.
- E. Mechanically retarding the rate of runoff from the construction site and control disposal of runoff.
- F. Trapping all sediment resulting from construction in temporary or permanent debris basins.
- G. Using temporary measures to keep erosion under control if construction is suspended for any appreciable length of time.
- H. Providing protection against chemical, fuel, or lubricant spills, and sewage pollutants.
- I. Protecting project and existing structures from surface water damage due to utility line excavations.
- J. Controlling soil erosion and sedimentation by use of silt fences, dikes, ditches, slope protection, sediment pits, basins, dams, slope drains, coarse aggregate, mulches, sod, grasses, filter fabrics, and other erosion control devices or methods.

1.9 SUBMITTALS

- A. Product Data
 - 1. Filter fabric
 - 2. Mull Sock
 - 3. Inlet Protection Devices

- B. Shop Drawings
 - 1. SWPP Plan
- C. Samples
- D. Quality Control Submittals
 - 1. Design Data
 - 2. Test Reports
 - 3. Certificates
 - a. Seed
 - b. Fertilizer
 - c. Limestone
 - 4. Manufacturers Instructions
- E. Contract Closeout Submittals
 - 1. Project Record Documents

1.10 QUALITY ASSURANCE

- A. Qualifications
- B. Regulatory Requirements
- C. Certifications
- D. Field Samples
- E. Mock-ups
- F. Pre-Installation Conference

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping
 - 1. Deliver grass seed, fertilizer and limestone in original containers labeled with content analysis.
- B. Acceptance at Site
- C. Storage and Protection

1.12 PROJECT CONDITIONS

- A. Environmental Requirements
- B. Existing Conditions

C. Field Measurements

1.13 SEQUENCING AND SCHEDULING

- A. All temporary control measures as shown on the Drawings, called for in these Specifications or ordered by the Engineer shall remain in effect during the life of the contract to control soil erosion, sedimentation and water pollution.

1.14 MAINTENANCE

A. Maintenance Service

Erosion and sedimentation control devices shall be inspected after rainfall events and shall be cleaned, maintained, repaired or replaced as needed.

B. Extra Materials

Extra materials shall be stored by the Contractor on-site and available for repairing damaged erosion and sedimentation controls and best management practices.

PART 2 - PRODUCTS

2.1 SEED

- A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.
- B. All areas of temporary seeding shall be seeded with grass as shown in the following table:

March 1 - August 15	Per 1000	
	Square Feet	Per Acre
Oats	3 lbs.	4 bu.
Perennial Ryegrass	1 lb.	40 lbs.
Tall Fescue	1 lb.	40 lbs.

August 16 - November 1*	Per 1000	
	Square Feet	Per Acre
Rye	3 lbs.	2 bu.
Wheat	3 lbs.	2 bu.
Perennial Ryegrass	1 lb.	40 lbs.
Tall Fescue	1 lb.	40 lbs.

* After November 1, use mulch only

2.2 ORGANIC MULCH

- A. Select mulch material based on site requirements, availability of materials and availability of labor and equipment. The following are the minimum rates:

Rates		Notes
Mulch	Per Acre	
Straw (temporary only)	2 tons	90 lbs. Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Wood Chips (permanent or temporary)	400 yds. ³	9 - 10 yds. ³ Apply approx. 3" deep. Treat with 12 lbs. of nitrogen per ton. Do not use on firm turf areas. Apply with mulch blower, chip handler, or by hand.
Bark Chips or Shredded Bark (temporary mulch only)	70 yds. ³	1½ - 2 yds. ³ Do not use in fine turf areas. Apply about ½" thick. Apply with a mulch blower or by hand.

2.3 FERTILIZER

- A. All fertilizer shall be manufactured from cured stock and organic sources. Chemical elements shall be accurately proportioned, uniformly mixed, and delivered to the site in factory-sealed containers fully labeled, bearing the name or trademark and warranty of the manufacturer. Commercial fertilizer for lawn sodding shall be dry or liquid compounds of 12-12- 12 analysis, meeting applicable requirements of State and Federal laws.

2.4 LIMESTONE

- A. All limestone shall be ground agricultural grade dolomitic limestone containing at least 10 percent magnesium oxide with a minimum total neutralizing power of 90, with at least 40 percent passing a No. 100 sieve and at least 95 percent passing a No. 8 sieve.

2.5 WATER

- A. All irrigation water shall be clean and free from injurious amounts of oil, acid, alkali, or other deleterious substances.

2.6 DITCH CHECKS

- A. Temporary ditch checks shall consist of coarse aggregate dikes.

2.7 INLET FILTERS

- A. Temporary inlet filters and silt fences shall be adequately supported as detailed on the drawings.

2.8 SLOPE DRAINS

- A. Temporary slope drains shall consist of pipe, coarse aggregate, riprap, rock channel protection, mats, plastic sheets or other materials approved by the Engineer. Sediment pits may be included as part of slope drain protection.

2.9 FILTER FABRIC

- A. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the following requirements:

Physical Property	Requirements
Filtering Efficiency	75% (min.)
Tensile Strength	at Extra Strength - 20% (max.) Elongation 50 lbs./lin. in. (min.)
	* Standard Strength - 30 lbs./lin. in. (min.)
Flow Rate	0.3 gal./sq.ft./min. (min.)

*Requirements reduced by 50 percent after 6 months of installation.

- B. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0° F to 120° F.

2.10 BURLAP

- A. Burlap shall be 10 ounce per square yard fabric.

2.11 FILTER SUPPORTS AND REINFORCING

- A. Posts for silt fences shall be either 4" diameter wood or 1.33 pounds per linear foot steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them.

- B. Stakes for filter barriers shall be 1" x 2" wood (preferred) or equivalent metal with a minimum length of 3 feet.
- C. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

- A. The Contractor shall limit the surface area of erodible earth material exposed by clearing and grubbing; the surface area of erodible earth material exposed by excavation; borrow; and fill operations; and provide immediate permanent or temporary control measures to prevent contamination of adjacent streams or other areas of water impoundment. Such work will involve the construction of temporary ditch checks, filters, benches, dikes, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods necessary to control erosion and sedimentation.
- B. The Contractor shall incorporate all permanent erosion control features into the Work at the earliest practicable time. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. This will require the establishing of final grades as shown on the Drawings and application of agricultural limestone, commercial fertilizer, seeding and mulching or sodding . When directed by the Engineer, temporary fertilizer, seeding and mulching materials shall be used. In general, the Contractor shall temporarily seed all disturbed areas within seven (7) days if they are to remain dormant for more than forty- five (45) days. Permanent soil stabilization shall be applied to disturbed areas within seven (7) days after final grade is reached on any portion of the site.. Temporary control measures will be used when and as directed by the Engineer to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion control measures will be required between successive construction stages.

- D. The Engineer will limit the area of excavation, borrow and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Mulching, seeding, and other such permanent control measures shall be applied after completion of a vertical eight (8) feet of embankment or cut, unless otherwise directed by the Engineer. Should seasonal limitations or embankment make such coordination unrealistic, temporary erosion control measures shall be taken immediately.
- E. The Engineer may increase or decrease the allowable amount of surface area or erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions. Factors such as soil erodibility, slope, cut or fill height, exposed area contributing to a watercourse and weather will be considered in this determination.
- F. In the event of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State or local agencies, the more restrictive laws, rules or regulations shall apply.
- G. Temporary seeding areas shall be fertilized at a rate of 12-15 pounds per 1000 square feet of 10-10-10 or 12-12-12 analysis or equal.
- H. When directed by the Engineer, the seed bed shall be thoroughly watered to maintain adequate moisture in the upper four (4) inches of soil, necessary to promote proper root growth.
- I. When directed by the Engineer, temporary seeded areas shall be mowed when grass exceeds four (4) inches in height.
- J. Temporary erosion control features shall be acceptably maintained and shall subsequently be removed or replaced when directed by the Engineer.
- K. Removed materials shall become the property of the Contractor and shall be disposed of off the site at the Contractor's expense.

3.2 PERFORMANCE

- A. If, in the opinion of the Engineer and Owner, proper control of soil erosion and sedimentation is not being provided by the Contractor, the Owner may take all necessary steps to provide corrective measures and the cost of such services will be deducted from any money which may be due or become due the Contractor.
- B. Control work performed for protection of construction areas outside the construction site, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites shall be considered as a subsidiary obligation of the Contractor, with all necessary control costs included in the contract price.

- C. In the event that temporary erosion and sediment control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled, and are ordered by the Engineer, such temporary work shall be performed by the Contractor at his expense.

3.3 SILT FENCE

- A. The height of a silt fence shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).
- B. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum six (6) inches overlap and securely sealed.
- C. Posts shall be spaced a maximum of ten (10) feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed six (6) feet.
- D. A trench shall be excavated approximately four (4) inches wide and four (4) inches deep along the line of posts and upslope from the barrier.
- E. When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one (1) inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two (2) inches and shall not extend more than 36 inches above the original ground surface.
- F. The standard strength filter fabric shall be stapled or wired to the fence, and eight (8) inches of the fabric shall be extended into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.
- G. When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of Subparagraph F above applying.
- H. The trench shall be backfilled and soil compacted over the filter fabric.
- I. Silt fences shall be removed when they have served their purpose, but not before the upslope area has been permanently stabilized.
- J. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

- K. Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.
- L. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
- M. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

3.4 TEMPORARY MULCHING

A. Application

- 1. Mulch materials shall be spread uniformly, by hand or machine.
 - a. When spreading straw mulch by hand, divide the areas to be mulched into approx. 1000 sq. ft. sections and place approx. 90 lbs. of straw in each section to facilitate uniform distribution.

B. Mulch Anchoring

- 1. Straw mulch shall be anchored immediately after spreading to prevent windblow. One of the following methods of anchoring straw shall be used:
 - a. Mulch anchoring tool
 - 1. This is a tractor-drawn implement (mulch crimper, serrated straight disk or dull farm disk) designed to punch mulch approximately two(2) inches into the soil surface. This method provides maximum erosion control with straw. It is limited to use on slopes no steeper than 3:1, where equipment can operate safely. Machinery shall be operated on the contour.
 - b. Liquid mulch binders
 - 1. Application of liquid mulch binders and tackifiers should be heaviest at edges of areas and at crests of ridges and banks, to prevent windblow. The remainder of the area should have binder applied uniformly. Binders may be applied after mulch is spread; however, it is recommended to be sprayed into the mulch as it is being blown onto the soil. Applying straw and binder together is the most effective method.
 - 2. The following type of binder may be used:
 - a.) Asphalt - any type of asphalt thin enough to be blown from spray equipment is satisfactory. Recommended for use are rapid curing (RC-80, RC-250, RC-800), medium curing (MC-250, MC-800) and emulsified asphalt (SS-1, MS-2, RS-1 and RS-2). Apply asphalt at 4 gal./1000 ft.², 600 gal./acre. Do not use heavier applications as it may cause the straw to "perch" over rills.

- b.) Wood Fiber - wood fiber hydroseeder slurries may be used to tack straw mulch.
 - c. Mulch nettings
 - 1. Lightweight plastic, cotton or paper nets may be stapled over the mulch according to manufacturer's recommendations.
- C. Chemical Mulches
 - 1. Chemical mulches may be used alone only in the following situations:
 - a. Where no other mulching material is available.
 - b. In conjunction with temporary seeding during the times when mulch is not required for that practice.
 - 2. Chemical mulches may be used to bind other mulches or with wood fiber in a hydroseeded slurry at any time. Manufacturer's recommendations for application of chemical mulches shall be followed.
- D. Nets and Mats
 - 1. Nets may be used alone on level areas, on slopes no steeper than 3:1, and in waterways.
 - 2. When mulching is done in late fall or during June, July and August, or where soil is highly erodible, net should only be used in conjunction with an organic mulch such as straw.
 - 3. When net and organic mulch are used together, the net should be installed over the mulch except when the mulch is wood fiber. Wood fiber may be sprayed on top of the installed net.
 - 4. Excelsior blankets are considered protective mulches and may be used alone on erodible soils and during all times of the year.
 - 5. Other products designed to control erosion shall conform to manufacturer's specification and should be applied in accordance with manufacturer's instructions provided those instruction are at least as stringent as this specification.
 - 6. Staples will be made of plain iron wire, No. 8 gauge or heavier, and will be six (6) inches or more in length.
 - 7. Prior to installation:
 - a. Shape and grade as required the waterway, channel, slope or other area to be protected.
 - b. Remove all rocks, clods or debris larger than two (2) inches in diameter that will prevent contact between the net and the soil surface.
 - c. When open-weave nets are used, lime, fertilizer and seed may be applied either before or after laying the net. When excelsior matting is used, they must be applied before the mat is laid.
 - 8. Laying the Net:
 - a. Start laying the net from top of channel or top of slope and unroll down-grade.
 - b. Allow to lay loosely on soil - do not stretch.

- c. To secure net: Upslope ends of net should be buried in a slot or trench no less than six (6) inches deep. Tamp earth firmly over net. Staple the net every twelve (12) inches across the top end.
 - d. Edges of net shall be stapled every three (3) feet. Where two strips of net are laid side by side, the adjacent edges shall be overlapped three (3) inches and stapled together.
 - e. Staples shall be placed down the center of net strips at 3-foot intervals. Do not stretch net when applying staples.
- 9. Joining strips
 - a. Insert new roll of net in trench, as with upslope ends of net. Overlap the end of the previous roll eighteen (18) inches, turn under six (6) inches and staple across end of roll just below anchor slot and at the end of the turned-under net every twelve (12) inches.
- 10. At bottom of slopes
 - a. Lead net out onto a level area before anchoring. Turn ends under six (6) inches and staple across end every twelve (12) inches.
- 11. Check slots
 - a. On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every fifteen (15) feet. Insert a fold of net into a six (6) inch trench and tamp firmly. Staple at twelve (12) inch intervals across the downstream portion of the net.
- 12. Rolling
 - a. After installation, stapling and seeding, net should be rolled to ensure firm contact between net and soil.
- 13. All mulches should be inspected periodically, in particular after rainstorms, to check for rill erosion. Where erosion is observed, additional mulch should be applied. Net should be inspected after rainstorms for dislocation or failure. If washouts or breakage occur, re- install net as necessary after repairing damage to the slope. Inspections should take place up until grasses are firmly established. Where mulch is used in conjunction with ornamental plantings, inspect periodically throughout the year to determine if mulch is maintaining coverage of the soil surface; repair as needed.

3.5 TEMPORARY SEEDING

- A. Site Preparation
 - 1. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring.
 - 2. Install the needed erosion control practices prior to seeding such as diversions, temporary waterways for diversion outlets and sediment basins.
- B. Seedbed Preparation
 - 1. Lime (in lieu of a soil test recommendation) shall be applied on acid soil (pH 5.5 or lower) and subsoil at a rate of 100 pounds per 1000 square feet or two tons per acre of agricultural ground limestone. For best results, make a soil test.

2. Fertilizer (in lieu of a soil test recommendation) shall be applied at a rate of 12-15 pounds per 1000 square feet or 500-600 pounds per acre of 10-10-10 or 12-12-12 analysis or equivalent.
3. Work the lime and fertilizer into the soil with a disk harrow, springtooth harrow or similar tools to as depth of two inches. On sloping areas, the final operation shall be on the contour.

C. Seeding

1. Apply the seed uniformly with a cyclone seeder, drill, cultipacker seeder or hydroseeder (slurry may include seed and fertilizer) preferably on a firm, moist seedbed. Seed wheat or rye no deeper than one (1) inch. Seed ryegrass no deeper than one-fourth ($\frac{1}{4}$) inch.
2. When feasible, except where a cultipacker type seeder is used, the seedbed should be firmed following seeding operations with a cultipacker, roller or light drag. On sloping land, seeding operations should be on the contour wherever possible.

D. Mulching

1. Mulch shall be applied to protect the soil and provide a better environment for plant growth.
2. Mulch shall consist of small grain straw (preferably wheat or rye) and shall be applied at the rate of two tons per acre or 100 pounds (two to three bales) per 1000 square feet.
3. Spread the mulch uniformly by hand or mechanically so the soil surface is covered.
4. Mulch Anchoring Methods
 - a. Mechanical - use a disk, crimper or similar type tool set straight to punch or anchor the mulch material into the soil.
 - b. Asphalt Emulsion - apply at the rate of 160 gallons per acre into the mulch as it is being applied.
 - c. Mulch Nettings - use according to the manufacturer's recommendations. Use in areas of water concentration to hold mulch in place.

E. Irrigation

1. If soil moisture is deficient, supply new seedings with adequate water for plant growth until they are firmly established. This is especially true when seedings are made late in the planting season, in abnormally dry or hot seasons, or on adverse sites.

END OF SECTION 015713

SECTION 016600 - PRODUCT HANDLING AND PROTECTION

PART 1 - GENERAL

1.1 DELIVERY AND STORAGE OF MATERIALS

- A. The Contractor shall be responsible for delivery and storage of all materials.
- B. The Contractor shall coordinate with the Engineer on the arrangement for storing construction materials and equipment. Deliveries of all construction materials and equipment should be made at suitable times.
- C. The Contractor shall store all materials required for the performance of this contract at sites designated by the Engineer.
- D. All stockpiles shall be neat, compact, completely safe, and barricaded with warning lights if necessary.
- E. Precautions shall be taken so that no shade trees, shrubs, flowers, sidewalks, driveways or other facilities will be damaged by the storage of materials. The Contractor shall be responsible for the restoration of all stockpile sites to their original condition.
- F. Materials, tools and machinery shall not be piled or placed against shade trees, unless they shall be amply protected against injury therefrom. All materials, tools, machinery, etc. stored upon public thoroughfares must be provided with red lights at night time so as to warn the traffic of such obstruction.
- G. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, shall again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the construction site may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefore must be provided by the Contractor at his expense. Private property shall not be used for storage purposes without written permission of the property owner or lessee, and copies of such written permission shall be furnished the Engineer. All storage sites shall be restored to their original condition by the Contractor at his expense.

END OF SECTION 016600

SECTION 017800 - FINAL COMPLIANCE AND SUBMITTALS

PART 1 - GENERAL

- 1.1 The following forms and related sign-offs shall be documented in accordance with provisions of the contract. These forms shall be completed by the Contractor and approved by the Owner before final retainer is approved for release. Forms for Items A to E will be attached to the Contractor's executed copy of the contract.
- A. Certificate of Substantial Completion (To be submitted at time of Substantial Completion).
 - B. Contractor's Certification of Completion.
 - C. Contractor's Affidavit of Prevailing Wage.
 - D. Consent of Surety Company for Final Payment.
 - E. Affidavit of Final Acceptance Date and Correction Period.
 - F. Before the OWNER will approve and accept the work and release the retainer, the CONTRACTOR will furnish the OWNER a written report indicating the resolution of any and all property damage claims filed with the CONTRACTOR by any party during the construction period. The information to be supplied shall include, but not be limited to, name of claimant, date filed with CONTRATOR, name of insurance company and/or adjuster handling claim, how claim was resolved and if claim was not resolved for the full amount, a statement indicating the reason for such action.
 - G. DBE Subcontractor Participation Forms SR-EPA.7-8 (Applicable for WPCLF & WSRLA funded projects only).

END OF SECTION 017800

SECTION 017821 - CLEANING AND PROTECTION

PART 1 - GENERAL

1.1 GENERAL

- A. On or before the completion date for the work, the Contractor shall tear down and remove all temporary structures built by him, all construction plant used by him, and shall repair and replace all parts of existing embankments, fences or other structures which were removed or injured by his operations or by the employees of the Contractor. The Contractor shall thoroughly clean out all buildings, sewers, drains, pipes, manholes, inlets and miscellaneous and appurtenant structures, and shall remove all rubbish leaving the grounds in a neat and satisfactory condition.
- B. As circumstances require and when ordered by the Engineer, the Contractor shall clean the road, driveway, and/or sidewalk on which construction activity under this contract has resulted in dirt or any other foreign material being deposited with an automatic self-contained mechanical sweeper with integral water spray, vacuum and on-board or supplementary containment.
- C. Failure to comply with this requirement when ordered by the Engineer or his representative, may serve as cause for the Engineer to stop the work and to withhold any monies due the Contractor until such order has been complied with to the satisfaction of the Engineer.
- D. As the work progresses, and as may be directed, the Contractor shall remove from the site and dispose of debris and waste material resulting from his work. Particular attention shall be given to minimizing any fire and safety hazard from form materials or from other combustibles as may be used in connection with the work, which should be removed daily.
- E. The Contractor shall wash all windows and other glass surfaces, leaving all areas free from putty marks, paint, etc.
- F. During and after installation, the Contractor shall furnish and maintain satisfactory protection to all equipment against injury by weather, flooding or breakage thereby permitting all work to be left in a new condition at the completion of the contract.

END OF SECTION 017821

SECTION 312323.13 – COMPACTED BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor shall furnish, place and compact all the materials needed from select excavated materials or furnish additional suitable material if the excavated material is deemed unsuitable or the moisture content is not or can not be made to be within acceptable tolerances of optimum moisture to achieve the specified compaction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Suitable excavated material as specified in ODOT Item 203.

PART 3 - EXECUTION

3.1 PLACING

- A. Compacted backfill shall be properly placed in layers sufficient to meet the compaction requirement of 95% of maximum laboratory dry density per ASTM D 698 throughout the entire layer and thoroughly compacted with mechanical compaction equipment with moisture adjustment as needed. Should after settlement occur, the Contractor must add and compact additional material, and he must maintain the backfill at the required finished grade or sub-grade until the project is satisfactorily completed and during the correction period.
- B. Approved mechanical compaction equipment shall be used for tamping backfill. Flooding, jetting or puddling of backfill will not be permitted.

END OF SECTION 312323.13

SECTION 312323.14 – COMPACTED GRANULAR BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor shall furnish, place and compact all the materials needed.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Aggregate shall be ODOT 304 crushed limestone. Crushed gravel or slag products are unacceptable.
- B. Contractor shall submit current test reports for the lot(s) of the material to be supplied.

PART 3 - EXECUTION

3.1 PLACING AND COMPACTING

- A. Compacted granular backfill shall be properly placed in layers sufficient to meet the compaction requirement of 100% of maximum laboratory dry density per ASTM D 698 throughout the entire layer and thoroughly compacted with mechanical compaction equipment with moisture adjustment as needed. Should after settlement occur, the Contractor must add and compact additional material, and he must maintain the backfill at the required finished grade or sub-grade until the project is satisfactorily completed and during the correction period.
- B. Approved mechanical compaction equipment shall be used for tamping backfill. Flooding, jetting or puddling of backfill will not be permitted.

END OF SECTION 312323.14

SECTION 312323.33 - LOW STRENGTH MORTAR BACKFILL MATERIAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. This work shall consist of the placement of a flowable low strength mortar for backfilling conduits or at other locations as shown on the plans or as specified. The work shall be in accordance with ODOT Item 603 and 499 unless otherwise specified.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and application instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement

- 1. ODOT 701.01 or ODOT 701.04.

- B. Fly Ash

- 1. Fly Ash shall come from a source approved by the Engineer.

- C. Fine Aggregate

- 1. Fine Aggregate shall be natural sand consisting of mineral aggregate particles. The gradation of the sand shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/4"	100
200	0 - 10

2. It is intended that the sand be fine enough to stay in suspension in the mixture to the extent required for proper flow. The Engineer reserves the right to reject the sand if a flowable mixture cannot be produced.

2.2 MORTAR MIX PROPORTIONING

- A. The initial trial mixture shall be as follows:

Quantity of Dry Materials per Cubic Yard

Cement	100 lbs.
Fly Ash	250 lbs.
Sand (SSD)*	2700 lbs.
Water	500 lbs.

* saturated-surface dry

- B. These quantities of materials are expected to yield approximately 1 cubic yard of mortar of the proper consistency. Adjustments of the proportions may be made providing the total absolute volume of the materials is maintained.

PART 3 - EXECUTION

3.1 TRIAL BATCH

- A. To expedite consolidation of the mortar, it will be necessary for bleed water to appear on the surface immediately after the mortar is struck off.

A delay in bleeding indicates there are too many fines in the mixture, so the fly ash quantity shall be reduced in increments of 50 lbs. until mixture is bleeding freely. Approximately 60 lbs. of sand shall be added to replace each 50 lbs. of fly ash to maintain the original yield.

- B. Fluidity of the mortar mixture shall be measured by the Corps. of Engineers' Flow Cone Method according to CRD-C611. Prior to filling the flow cone with mortar, the mixture shall be passed through a 1/4-inch screen. Time of efflux shall be approximately 12 seconds.
- C. Prior to the first placement, the Contractor shall make one or more trial batches of mortar of the size to be hauled to job site and shall cast one or more test samples equivalent to the approximate dimensions of the trench to be backfilled (either in a form or trench). Amount of bleeding, settlement rate and time required to support pavement replacement shall be determined from these full-size tests. The Contractor shall furnish the required materials and samples.

3.2 MIXING EQUIPMENT

- A. Sufficient mixing capacity of mixers shall be provided to permit the mortar to be placed without interruption.

3.3 PLACING MORTAR

- A. Flowable mortar shall be discharged from the mixer by any reasonable means into the space to be filled. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed by the Engineer.

END OF SECTION 312323.33

SECTION 312333 - UNDERGROUND CONDUIT INSTALLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Construction Drawings and General Provisions of this Contract including the General and Supplementary Conditions, Specific Project Requirements, Proposal, and all referenced standard specifications apply to work defined in this section.

1.2 DESCRIPTION

- A. This work shall consist of the construction or reconstruction of underground pipe conduits in accordance with these specifications and in reasonable close conformance to the lines and grades shown on the detailed plans or as otherwise established by the Engineer.
- B. This work shall include excavating for the conduit, fittings, and appurtenances; clearing and grubbing and removal of all materials necessary for placement of the conduit except any items paid for separately; furnishing and placing bedding and backfill as required; constructing and subsequently removing all necessary cofferdams, cribs and sheeting; pumping and dewatering; making all conduit joints as required; installing all necessary conduit; joining to existing and proposed appurtenances as required; performing leakage tests as required; restoration of all disturbed facilities and surfaces. The work shall also include the maintenance of existing flow and service to facilities being modified. Procedures for such maintenance shall be as approved by the Engineer prior to any work commencing.

PART 2 - MATERIALS

2.1 CONDUIT

- A. All conduit utilized shall be of one type and size specified in the proposal meeting the requirements of the detailed material specification.
- B. Shop drawings, catalog cuts, and test certifications may be required by the Engineer for all conduit, fittings, and appurtenances.
- C. Aggregate for the bedding and backfill shall conform to the requirements of the plan detail or as modified in writing by the Engineer. All aggregates shall conform to ODOT 703 for soundness and gradation.
- D. All other materials utilized as part of this work shall meet their respective ASTM requirements.

PART 3 - EXECUTION

3.1 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

A. Pavement, Sidewalks, and Curbing

1. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat, and free from chipped or damaged edges.
2. For non-reinforced concrete, the saw cut shall be completely through concrete.
3. For reinforced concrete, the saw cut shall be completely through the steel and concrete.
4. If the concrete is coated with a bituminous surface or other material, the saw cut shall be as specified above.

B. Manholes, Catch Basins, and Inlets

1. Existing drainage structures and sanitary manholes designated by the Engineer to be removed shall be completely removed.
2. Manholes designated to be abandoned shall be removed to an elevation of at least 3 ft. below the finished subgrade or ground surface. The remaining void shall be filled with backfill material in accordance with Section 312323.13 - Compacted Backfill.
3. Live sewers connected to structures removed or abandoned shall be rebuilt through the area with new conduit. Sewer flow shall be maintained between removal and replacement operations. Abandoned sewers shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.
4. All castings salvaged from abandoned or removed structures shall remain the property of the Owner and shall be cleaned and transported by the Contractor to a nearby site designated by the Owner or incorporated in the work where called for on the drawings.

C. Guardrail and Fence

1. Where necessary, existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner.
2. Posts and other materials not considered salvageable by the Engineer shall be disposed of by the Contractor.
3. The Contractor will be required to replace, at no cost to the Owner, material lost or damaged by negligence or by the use of improper methods.

3.2 METHOD OF EXCAVATION

- A. All excavation shall be in open cut unless otherwise permitted by the Engineer. Loosening of material by blasting will not be permitted without written authorization by the Owner specifying both the extent and location of the blasting to be done. If permission is granted the Contractor shall submit in writing his means and methods of blasting to the Owner for approval. Blasting shall not begin until the Owner issues written approval of the means and method of blasting.

- B. Excavation shall be made to undisturbed finish subgrade to the depth below the bottom of the conduit or structure as shown on the Contract Drawings details.
- C. Trenches shall be excavated with vertical sides from the bottom of the trench to one (1') foot above the top of the conduit from which point sides may slope to ground surface, except that, in streets or roadways, trenches shall be excavated with near vertical sides to the top of the trench. Width of trench in the vertical section shall be excavated only as wide as necessary to accommodate a safety box and to provide free working space on each side of the conduit or structure according to the size of the conduit or structure and the character of the ground. In every case there shall be sufficient space between the conduit or structure and the sides of the trench to make it possible to thoroughly ram the bedding around the conduit or structure and to secure tight conduit joints, but in no case more than twelve inches on either side of conduit. In no case, however, shall the width of the trench at the top of the conduit exceed the dimensions as shown on the contract drawings. In no case will it be permitted to excavate conduit trenches with sides sloping to the bottom.
- D. The trench bottom shall be firm and uniform for its full length. Should unstable material be encountered below plan subgrade, it shall be removed to a depth directed by the Engineer. Replacement of the additional excavation shall be with the specified bedding material or as otherwise directed by the Engineer.
- E. In the case the flow line is changed not to exceed one (1) foot or it becomes necessary to remove unstable material in an amount not to exceed one (1) foot, the same shall be done at one contract bid price or amount. When the flow line is lowered more than (1 foot) or if it becomes necessary to remove more than (1 foot) of unsuitable material below the bottom of the trench, compensation will be provide therefore in a supplemental agreement for the excavation and backfill beyond (1 foot).

3.3 UNAUTHORIZED EXCAVATIONS

- A. All excavations carried outside of the lines and grades given or specified, together with the disposal of such material, and all excavations and other work resulting from slides, cave-ins, swellings or upheavals shall be at the Contractor's own cost and expense. All spaces resulting from unauthorized excavations or from slides or cave-ins shall be refilled at the Contractor's expense with suitable material as specified in ODOT Item 203, "Roadway Excavation and Embankment" or Section 312323.13, "Compacted Backfill" in designated areas shown on the contract drawings or specified under this Section. Compaction requirements shall be in accordance with these specifications.

3.4 SHEETING AND SHORING

- A. The Contractor shall be responsible for supporting and maintaining all excavations required even to the extent of sheeting or shoring the sides and ends of excavations with timber or other satisfactory supports. If the sheeting, braces, shores, stringers, waling timbers, or other supports are not properly placed or are insufficient, the Contractor shall provide additional or stronger supports. The requirements of sheeting or shoring or of the addition of supports shall not relieve the Contractor of his responsibility for their sufficiency. All trench protection and sheeting and shoring must conform to the regulations of both the

Ohio State Industrial Commission (OSIC) and the Federal Occupational Safety and Health Act (OSHA) and will be subject to their respective inspections. All orders of OSIC and OSHA representatives must be complied with by the Contractor.

- B. All sheeting and shoring shall be removed where and when required and, upon its removal, all voids filled. If any sheeting or shoring is ordered to be left in place, it shall be cut-off as directed. In compensation for the sheeting and shoring left in place, if any, shall be by prior written change order.

3.5 REMOVAL OF WATER

- A. All conduit shall be installed in a dry and stable trench. The Contractor may pump or otherwise remove any water, sewage, or other liquid that may be found or may accumulate in the trench.
- B. If, in the opinion of the Contractor, dewatering pumps and equipment are required to maintain a dry and stable trench, suitably sized pumps shall be provided to meet the requirements. The manner and spacing of well points shall be at the Contractor's discretion.
- C. Excess water shall not be considered reason for undercut of trench bottom.
- D. The Contractor shall maintain the pumps for the duration of their need including a satisfactory discharge outlet. Power for the pumps shall be electric unless otherwise approved by the Engineer. Noise abatement may be required for any on-site generators in residential areas.

3.6 BEDDING FOR LAYING CONDUIT

- A. Bedding shall conform to the requirements of the plan detail unless otherwise modified by the Engineer.
- B. All granular bedding material shall be compacted to 95 percent of maximum laboratory dry density.
- C. All pipe bedding shall be of the gradation(s) specified and be limestone. Slag may not be used and gravel may be used with permission of the Engineer.

3.7 LAYING CONDUIT

- A. Except as otherwise permitted by the Engineer, all conduit shall be laid starting at the outlet end. Pressure conduits may be laid from either direction however the joints shall be such that the bell is upgrade or toward normal pressure.
- B. Line and grade for gravity conduits shall be established by the use of sufficient means to maintain acceptable installation tolerances and allow for reasonable checking observation by the Engineer.

- C. Line and grade shall be established and maintained over a length of fifty (50) feet minimum. Cut sheets establishing grade at fifty (50) foot intervals shall be provided to the Engineer prior to beginning work.
- D. The Contractor shall provide sufficient equipment and workers to safely handle and lay all conduit included as part of this work. All storage of materials shall be in a manner as to avoid damage to either surface prior to placement.
- E. The Contractor shall inspect each piece of conduit prior to placement in the trench and any unsatisfactory conduit shall be rejected.
- F. Conduit shall not be laid in water, mud, or any otherwise unsuitable trench. The conduit shall not be pushed into or allowed to fall to the bottom of the trench. Handling of the conduit shall be in conformance to the manufacturer's recommendations.
- G. The conduit shall be kept clean and any open ends of installed conduit shall be closed when work is not in progress.
- H. Jointing of the conduit shall be in accordance to the requirements of the manufacturers and as required by the specification material type. Any deviation from these acceptable methods requires approval of the Engineer.
- I. Testing of joints, where required, shall be done in accordance with the Specification for Testing. Should any section fail to meet test requirements, the Contractor shall make suitable corrections, at their cost, until the requirements are met.

3.8 SERVICE CONNECTIONS

- A. In general, and as called for on the drawings, as required or as ordered, provision shall be made in the sewers for service connections by inserting a wye branch for each service connection with a branch size called for by the contract drawings but never less than six (6) inch, in the sewer at location shown, where required or ordered, for sewers to ten (10) feet in depth. For sewers exceeding ten (10) feet in depth, or indicated on the plans, the Contractor shall construct a riser, as per detail, in such manner, that the top of the riser shall be not less than seven (7) feet below grade or at such elevation as to properly receive the required service connection, with full regard to elevation of service sewer and slope from building or structure to the sewer which shall not be less than one percent (1%). Risers are to be encased in sonotube filled with No. 57 Limestone as shown on the contract drawings.
- B. The location of service connections is shown in a general way on the contract drawings. The Owner may also increase the number of connections or delete some connections as the sewer is being built, or increase the size of connections when it deems such advisable.

3.9 FINAL BACKFILL

- A. Final backfill shall be installed from the top of the Pipe Embedment to the final grade. Final backfill of all conduit trenches shall conform to the requirements of the plans and details, Section 312323.13 "Compacted Backfill", and Section 312323.14 "Compacted Granular Backfill". All final backfill under existing or proposed pavement or structures or within the 1:1 zone of influence of existing or proposed pavement or structures shall be "Compacted Granular Backfill". All final backfill not under existing or proposed pavement or structures or within the 1:1 zone of influence of proposed pavement or structures shall be "Compacted Backfill".
- B. Unless otherwise directed, all forms, bracing and lumber shall be removed during backfilling and the cavities and voids resulting from the removal shall be backfilled and compacted to 100% of Standard Proctor.
- C. The Contractor must use special care in placing backfill so as to avoid injuring or moving the conduit or structure when compacting the backfill.
- D. In areas used for temporary maintenance of traffic the top layer of final backfill from the elevation of the existing subbase base interface to the existing or proposed surface(s), shall be ODOT Item 304 Aggregate Base to provide a temporary surface traffic course.
- E. Should after settlement occur, the Contractor must add and compact additional material.
- F. Machine mounted mechanical tamper shall be used for backfill compaction. Flooding, jetting or puddling of backfill will not be permitted.
- G. Excavated material in excess of that needed for backfilling and all unsuitable material shall be disposed of by the Contractor at his own expense and the cost of such disposal shall be included in the unit or lump sum prices bid.

3.10 TESTING AND ACCEPTANCE

- A. Prior to final acceptance of the conduit or the placing of the conduit into service, testing and/or televising may be required.
- B. For all sanitary, water, or other pressured conduits, pressure testing shall be required in accordance to the specifications contained herein. Televising shall be required for all sanitary sewer and may be required for storm sewers as outlined or required by plan note.
- C. Final television inspection of conduit shall be performed by an experienced company and in a format satisfactory to the Owner. Televising shall be done in the presence of the Engineer unless so waived. The Engineer shall be provided with unedited video tapes and two (2) copies of the video log.
- D. Televising shall not be done until all known repairs are completed and the line has been suitably flushed.

3.11 SITE RESTORATION

- A. Restoration of the disturbed project area shall begin immediately after backfilling has been completed. All excess material, debris, and excavation shall be disposed of by the Contractor.
- B. Restoration of paved surfaces and of seeded areas shall be done as soon as conditions permit. The manner in which this work shall be done is defined in other specifications or the contract plans.
- C. While payment for site restoration may be included in other items, final acceptance of the underground conduit shall not occur until all work is complete. Where no separate pay items exist for restoration work, the Engineer may determine an appropriate value for this work to be retained until its completion.

END OF SECTION 312333

SECTION 320116.71 - PAVEMENT PLANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. This work shall consist of planing the existing pavement and disposing of the cuttings in accordance with these specifications in areas designated on the plans or established by the Engineer. When provided for in the contract, the work shall also consist of patching the planed surface.

1.3 JOB CONDITIONS

- A. Existing Pavement Type
 - 1. The item description indicates the predominate type of pavement. All pavement encountered in the areas designated on the plans shall be planed, measured, and paid for under the item unless a separate item is provided in the contract.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Planing equipment shall be self-propelled with sufficient power and stability to consistently and efficiently produce the required results. The cutting element may be made of the grinding, sawing, or milling type. Bituminous surfaces also may be planed using the blade type cutter of the heater planer, unless otherwise specified.
- B. Planing cutters shall be mounted rigidly to the carrier and shall be adjustable and controllable as to depth of cut and cross-slope.

Longitudinal planing action may be produced either by means of a suitable carrier wheelbase or by means of an automatic control system having an external reference. Cross-slope adjustments or automatic controls shall be capable of producing either a variable or a constant cross-slope as required.

- C. Planing cutters shall be designed, maintained and operated so as to produce a surface free from grooves, ridges, gouges or other irregularities detrimental to the safe operation of vehicles in traffic routed onto the planed surface, temporarily or permanently.

- D. When heaters are used, adequate provisions shall be made for the safety of persons in the vicinity of the equipment and for preventing damage to adjacent property and facilities, public or private.
- E. Suitable supplemental equipment or methods, approved by the Engineer, may be used in small or confined areas.

PART 3 - EXECUTION

3.1 PLANING

- A. One or more planing passes shall be made over the designated area as necessary to remove such irregularities as bumps, corrugations, and wheel ruts, and when required, as necessary to establish a new pavement surface elevation or cross-slope.
- B. Cuttings shall be removed from the surface following each pass of the equipment. Before opening the completed area to traffic, the surface shall be cleaned thoroughly of all loose material that would create a hazard, a nuisance, or would be redeposited into the surface texture. Cuttings shall become the property of the Owner and shall be delivered to a site as directed by the Engineer.
- C. Effective measures shall be taken to control dust, smoke, contamination of the pavement, and the scattering of loose particles during planing and cleaning operations.
- D. Where sound pavement has been gouged, torn, or otherwise damaged during planing operations, the damaged area shall be repaired at no additional cost in a manner satisfactory to the Engineer to conform to the adjacent pavement in smoothness and durability.

3.2 SURFACE PATCHING

- A. Areas of the planed surface to be patched due to spalling or dislodgement of unsound pavement will be designated by the Engineer. The areas shall be cleaned of loose material, coated with ODOT 407.02 tack coat material, ODOT 702.02 or ODOT 702.04, and filled with asphalt concrete, ODOT 404, leveled and compacted to conform to the adjacent pavement.

3.3 SURFACE TOLERANCES

- A. When the contract provides for planing without resurfacing, the surface shall be planed to a smoothness of plus or minus 1/8 inch in 10 feet and the surfaces at the edges of adjacent passes shall be matched within plus or minus 1/8 inch. When the contract includes resurfacing, these tolerances shall be plus or minus 1/4 inch. The cross-slope of the planed surface shall conform to the specified cross-slope within plus or minus 3/8 inch in ten feet.

3.4 METHOD OF MEASUREMENT

- A. The quantity of pavement planing including the removal and disposal of cuttings shall be the number of square yards planed.
- B. The quantity of surface patching shall be the number of square yards patched including tack coat and asphalt concrete.

3.5 PAYMENT

- A. See "Basis of Payment."

END OF SECTION 320116.71

SECTION 321216 - ASPHALT CONCRETE PAVING AND MATERIALS

SECTION 1 - MATERIALS

- 1.1 The asphalt concrete mixture and installation thereof shall meet Ohio Department of Transportation (ODOT) Specifications except as modified in these specifications.
- 1.2 In the ODOT Specifications substitute "Engineer" for "Department" (except as stated below in reference to ODOT 403 for Department VA testing and acceptance).
- 1.3 No steel slag shall be used as coarse or fine aggregate for any asphalt concrete.
- 1.4 All asphalt cement utilized on this project shall meet AASHTO Provisional Standard MP1 or any superseding AASHTO specification for performance graded asphalt cement binder in conformance with PG 64-22.
- 1.5 The following exceptions shall be made for the Asphalt Concrete:
 - A. The coarse aggregate material shall be only limestone
 - B. No Recycled Asphalt Product (R.A.P.) will be permitted
- 1.6 Except where designated otherwise in the plans or specifications all asphalt concrete mixes shall be designed for medium traffic volumes. Where light or heavy traffic pavements are designated in the plan, the contractor shall use an asphalt concrete mix designed for such traffic conditions.
- 1.7 Acceptance of the mixture will be based upon the certification that the mixture was produced according to the approved JMF within the production control and composition tolerances of the specifications. The Contractor shall hire and pay for an independent testing lab approved by the Engineer to perform all sampling, testing, monitoring, analysis and certification required by the Laboratory, Monitoring Team or Department in ODOT 403 and 441. All work by the independent laboratory shall be performed by personnel with ODOT Level II Bituminous Concrete certification.
- 1.8 ODOT 401.20 - "Asphalt Binder Price Adjustment" shall not apply to this contract.
- 1.9 Monument box and valve box risers shall be East Jordan Iron Works No. 8626, No. 8631, or approved equal. The Contractor shall follow the manufacturer's recommended installation procedure. New manhole frames and grate or frame and cover shall be EJIW 1710.
- 1.10 Brick used for manhole, catch basin, or inlet basin castings adjusted to grade under ODOT 611.10 Method D.1. shall be red shale or clay sewer brick meeting the requirements of ASTM C32 sewer brick, grade SM.
- 1.11 Risers used for manhole castings adjusted to grade under ODOT 611.10 Method D.2. shall be manufactured by Manhole Systems, Model MS-101TB, or approved equal.

- 1.12 All inlets and manholes shall be adjusted to grade after installation of the intermediate course(s), if any and prior to installation of the surface course.
- 1.13 All materials delivered to this project must have been weighed on a platform scale with electronic imprinter to show gross, tare, and net weights. No payment will be made for materials which are not correctly weighed as necessary. Material weight shall not exceed the current legal allowable limit.
- 1.14 Unless specified elsewhere in the specifications, material for berms shall be limestone only. Recycled concrete and asphalt concrete will not be permitted.

SECTION 2 - PAVING EQUIPMENT

- 2.1 All spreading equipment shall be self propelled. The Contractor shall identify the make and model of the paving machine that will be used for the intermediate and surface courses for approval prior to the pre-construction meeting.
- 2.2 All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. The Contractor shall be prepared to furnish proof of certification that all equipment to be used on the project has been calibrated within the past six (6) months.

SECTION 3 - GENERAL - PAVING

- 3.1 All paving shall be done on a single-lane basis.
- 3.2 If traffic loop detectors are encountered and broken, the Contractor is to repair as per local specifications. The cost for this work will be paid under the loop detector replacement bid item, if any; at negotiated unit prices; or by time and materials as directed by the Engineer.
- 3.3 Tack Coat, Item 407, shall be applied at the rate of from 0.05 to 0.15 gallons per square yard as appropriate for the surface conditions with sand cover if required.
- 3.4 Asphalt driveway aprons shall be matched to new pavement with 24" transition sections or as shown on the drawings or required by the Engineer. The Contractor shall install apron wedge as required in the detailed drawings.
- 3.5 Unless otherwise shown on the drawings, jointing of new to existing pavement shall be by milled butt joints six (6) feet in width (or as shown on the plans) from edge of pavement to edge of pavement. Depth of this milled area shall equal the total of subsequent intermediate course and surface course as specified.
- 3.6 One (1) copy of each hauled/weighed material truck load ticket (plant ticket) for materials incorporated in this project shall be provided to the project representative daily. All bulk

materials delivered to this project must have been weighed on a platform scale with electronic imprinter to show gross, tar and net weights. No payment will be made for materials which are not correctly weighed as necessary. Material weight shall not exceed the current legal allowable limit. If a partial load is used, the Contractor's foreman and the project representative shall confer and come to an agreement as to what portion of the product was used. The percent of material of this load, as reported by the project representative, is what shall be recorded as utilized.

- 3.7 For variable depth courses where tonnage tickets are used for determining quantities for payment, the conversion to cubic yards shall be number of tons verified and approved by the Engineer divided by 2.00 regardless of the actual density of the mix.
- 3.8 Positive drainage is to exist subsequent to the completion of the surface course. The Contractor shall take any necessary measures to assure positive drainage of the surface course. It shall be the responsibility of the Contractor to repair any low/puddled areas at his own cost by milling out the affected areas to a minimum depth equal to the nominal depth of the course being repaired and replacing with the specified asphalt concrete to grades that will correct the drainage problem.
- 3.9 Surface tolerances for all completed surface courses shall be as noted in ODOT 401.19. This tolerance shall apply regardless of whether or not an intermediate course is installed.
- 3.10 At the direction of the Engineer, periodic weight checks of asphalt concrete in loaded trucks shall be made by the Contractor and verified by the Engineer.
- 3.11 All quality control testing data performed on material incorporated into this project shall be forwarded to the Engineer for review as soon as it is available.
- 3.12 Quantity verification (but not necessarily payment quantity) for all asphalt concrete incorporated into the work shall be by weight tickets as produced by the plant or supplier or other means approved by the Engineer. Tack coat shall be verified by a ticket filled out and signed by the Contractor's tack truck driver based on weights taken or observations of level indicators. All verification tickets are required to be submitted to the Engineer on the day the material is incorporated into the work; however, the Engineer may, at his sole discretion, accept verification tickets for any items up to seven (7) calendar days subsequent to the work being performed. **After that date additional verification tickets for material will not be accepted for consideration of payment.**
- 3.13 No work is to be performed without the presence of the Engineer or his designated Project Representative. Forty-eight (48) hour advance notice of work shall be given to the Engineer and Owner by the Contractor.
- 3.14 All edges of surface courses abutting curbs or other appurtenances shall be sealed with hot AC-20.
- 3.15 The asphalt concrete, intermediate or surface course work will conform to ODOT Items

448-1 – Intermediate and Surfaces Courses and 448-2 – Intermediate Course. The paving foreman, at the Engineer's request, will be required to correctly calculate the asphalt concrete "yield." "Yield" is defined as the rate of material used, in cubic yards, in proportion to the area paved. The Contractor must be aware if he is under or over plan quantities for the area in question.

END OF SECTION 321216

SECTION 330110.80 - ABANDONMENT OF PIPELINES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. The following Detailed Specifications are specifically referenced and apply to the work as may be required:
 - 1. Section 331413 - Waterline Construction

1.2 DESCRIPTION OF WORK

- A. This work shall consist of the permanent abandonment of existing pipelines noted on the drawings to be abandoned in place by filling pipelines with Low Strength Mortar (LSM). This includes cutting pipes, plugging ends with concrete, providing necessary equipment, and completely filling existing pipelines with LSM flowable fill.

1.3 SUBMITTALS

- A. Comply with the requirements of Section 013323 Shop Drawings, Product Data and Samples.
- C. Flowable Fill mix design report, comply with requirements of ODOT Item 613.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Concrete for end plugs, Class C.
- B. Grout
 - 1. ODOT Item 613, Type 2 Low Strength Mortar (LSM), flowable fill.
 - 2. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days, as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
 - 3. Placement characteristics: self-leveling.
 - 4. Shrinkage characteristics: non-shrink.
 - 5. Water bleeding for fill to be placed by grouting method in pipes: not to exceed 2 percent according to ASTM C940.
 - 6. Minimum wet density: 90 pounds per cubic foot.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Do not begin cut, plug and abandonment operations until replacement waterlines have been constructed, disinfected, and tested and services have been transferred to replacement waterline.
- B. Notify Inspector at least 24-hours in advance of filling with flowable fill.
- C. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portions of the work, new or existing.
- D. Cut and cap portions of the piping system to remain, as shown on the Drawings.
- E. Drain water main to be abandoned.
- F. Perform demolition work prior to starting fill placement. Clean placement area pipes as needed of debris that may hinder fill placement. Remove and dispose of debris in accordance with applicable codes and regulations.
- G. Plug or cap ends or openings in abandoned water mains with concrete plug bulkheads, providing two-inch PVC pipes through bulkhead for fill and vent pipes needed to place LSM.
- H. Remove and dispose of surface identifications such as valve boxes and hydrants as required for this project.

3.2 EQUIPMENT FOR FLOWABLE FILL

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.3 INSTALLATION OF FLOWABLE FILL

- A. Abandon pipelines by completely filling with flowable fill.
- B. Perform operation with experienced crews with equipment to monitor density of flowable fill and to control pressure.
- C. Temporarily plug or cap pipe segments which are to remain in operation during filling to keep lines free of flowable fill.

- D. Place flowable fill to full volume inside pipelines being abandoned. Continuously place flowable fill with no intermediate pour points, but not exceeding 500 feet in length.
- E. Pump flowable fill through fill pipes provided for this purpose. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump with sufficient pressure to overcome friction and to fill pipelines from downstream end to discharge at upstream end.
- F. Backfill excavation as required.
- G. Collect and dispose of excess LSM material and debris.

3.4 QUALITY CONTROL

- A. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.
- B. Check flow characteristics and workability of fill as placement proceeds.
- C. Obtain at least three test cylinders for each placement area for determination of 56-day compressive strength and bleeding. Acceptance of placement will be based on average strength of three tests.
- D. Record volume of flowable fill placement to demonstrate that pipe and voids have been filled. If voids exceed 10% of pipeline volume, injection grouting may be required at the direction of the ENGINEER.

3.5 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the Work.

END OF SECTION 330110.80

SECTION 330130 - MISCELLANEOUS TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 MAINTENANCE OF SANITARY FLOWS

- A. The Contractor for this contract shall be responsible for maintaining all sanitary flows through the existing sanitary sewerage systems. Provisions shall be made for temporary pumping and/or storage of sanitary flows during periods of sewer and manhole reconstruction, or when flows must be interrupted to make connections to the new facilities as directed by the Engineer.

END OF SECTION 330130

SECTION 330130.01- SEWER COLLECTION SYSTEM REHABILITATION DEFINITIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The work covered by this project shall include the furnishing of all labor, equipment, materials, and supervision; and performing all work necessary to investigate, rehabilitate, and/or replace the designated sewer lines, manholes, etc., all in accordance with the specifications. The work shall consist of, but not necessarily be limited to, performing the following work tasks where specified:

1. Sewer Line Cleaning
2. Sewer Flow Control
3. Television Inspection
4. Sewer Pipe Joint Testing
5. Sewer Pipe Joint Sealing
6. Sewer Manhole Rehabilitation
7. Sewer Manhole Replacement
8. Sewer Manhole Separation
9. Sliplining of Sewers
10. Cured-in-Place Pipe Installation
11. Fold-and-Formed Pipe Installation
12. Sewer Point Repairs
13. Service Lateral Sealing and Televising

- B. The area of work and the type of repair/rehabilitation to be performed shall be at those locations shown on the tables or drawings in the Specific Project Requirements section of these specifications.

1.3 DEFINITIONS

- A. Wherever used in these specifications, the following words and terms shall have the meanings indicated:
 1. AREAWAY: A paved surface, serving as an entry area to a basement or subsurface portion of a building, which is provided with some form of drainage device that may be connected to a sewer line.
 2. AVAILABLE WATER: Water necessary for the performance of work, which may be taken only from fire hydrant(s) approved by the Owner, given conditions of traffic and terrain which are compatible with the use of the hydrant for performance of work.

3. **BUILDING SEWER:** The conduit which connects building wastewater sources to the public or street sewer (referred to also as "house sewer," "building connection," "lateral," or "service connection"), including lines serving homes, public buildings, commercial establishments, and industry structures. In this specification, the building sewer is referred to in two sections:
 - a. The section between the building and the property line, right-of-way line, or to a point specified and supervised by the Owner's designated representative.
 - b. The remaining section to the collector sewer, including the connection thereto.
4. **BYPASS:** An arrangement of pipes, conduits, gates, and valves whereby the flow may be passed around a hydraulic structure or appurtenance. Also, a temporary setup to route flow around a specified part of a sewer system.
5. **BYPASS PUMPING:** The transportation of sewage flows around a specific sewer pipe line section or sections via any conduit for the purpose of controlling sewage flows in the specified section or sections without flowing or spilling onto public or private property.
6. **CELLAR DRAIN:** A pipe or series of pipes which collect wastewater which leak, seep, or flow into subgrade parts of structures and discharge them into a building sewer, or by other means dispose of such wastewater into sanitary, combined or storm sewers.
 - a. Referred to also as a "basement drain."
7. **CHANGE ORDER:** A written order to the Contractor authorizing an addition, deletion, or revision in the work within the general scope of work of the agreement, or authorizing an adjustment in the agreement price or agreement time.
8. **COLLECTOR SEWER:** A sewer located in the public way which collects the wastewater discharged through building sewers and conducts such flows into larger interceptor sewers and pumping and treatment works.
 - a. Referred to also as "street sewer."
9. **COMBINED SEWER:** A sewer intended to serve as both a sanitary sewer and a storm sewer, or as both an industrial sewer and a storm sewer.
10. **COMPRESSION GASKET:** A device which can be made of several materials in a variety of cross sections and which serves to secure a tight seal between two pipe sections (e.g., "O"-rings).
11. **CORBEL OR CONE:** That portion of a manhole structure which slopes upward and inward from the barrel of the manhole to the manhole cover frame.
12. **CREW:** The number of persons required for the performance of work at a site as determined by the Contractor in response to task difficulty and safety considerations at the time or location of the work
13. **DEBRIS:** Soil, rocks, sand, grease, roots, etc., in a sewer line excluding items mechanically attached to the line such as protruding service connections, protruding pipe, joint materials, and the like.

14. **EASEMENT:** A liberty, privilege, or advantage without profit which the owner of one parcel of land may have in the land of another. In this agreement, all land, other than public streets, in which the Owner has sewer system lines or installations and right of access to such lines or installations.
15. **EASEMENT ACCESS:** Areas within an easement to which access is required for performance of work.
16. **ENGINEER:** The engineer (a person, joint venture, firm, or corporation) who works for or under a contract or subagreement with the Owner and is designated by the Owner as the Engineer of Record under the prime contract.
17. **EXFILTRATION:** The leakage or discharge of flows being carried by sewers out into the ground through leaks in pipes, joints, manholes, or other sewer system structures; the reverse of "infiltration".
18. **EXISTING LINEAR FEET:** The total length of existing sewer pipe in place within designated sewer systems as measured from center of manhole to center of manhole from maps or in the field.
19. **FLOW CONTROL:** A method whereby normal sewer flows or a portion of normal sewer flows are blocked, retarded, or diverted (bypassed) within certain areas of the sewer collection system.
20. **FOUNDATION DRAIN:** A pipe or series of pipes which collect groundwater from the foundation or footing of structures and discharge it into sanitary, storm, or combined sewers, or to other points of disposal for the purpose of draining unwanted waters away from such structures.
21. **GROUTING:** The joining together of loose particles of soil in such a manner that the soil so grouped becomes a solid mass which is impervious to water (see also **SEWER PIPE JOINT SEALING**).
22. **HYDRAULIC CLEANING:** Techniques and methods used to clean sewer lines with water, e.g.; water pumped in the form of a high-velocity spray and water flowing by gravity or head pressure. Devices include high-velocity jet cleaners, collapsible dams, etc.
23. **INFILTRATION:** The water entering a sewer system, including building sewers, from the ground, through such means as, but not limited to, defective pipes, pipe joints, connections, or manhole walls. Infiltration does not include, and is distinguished from, inflow.
24. **INFILTRATION/INFLOW:** A combination of infiltration and inflow wastewater volumes in sewer lines, with no way to distinguish either of the basic sources, and with the same effect of usurping the capacities of sewer systems and other sewer system facilities.
25. **INFLOW:** The water discharged into a sewer system, including service connections, from such sources as, but not limited to, roof leaders; cellar, yard, and area drains; foundation drains; cooling water discharges; drains from springs and swampy areas; manhole covers; cross connections from storm sewers, combined sewers, catch basins; storm waters; surface runoff; street washwater; or drainage. Inflow does not include, and is distinguished from, infiltration.
26. **INSPECTOR:** The Owner's on-site representative responsible for observation and recording of quantities of work performed as set forth in these specifications.
27. **INTERCEPTOR SEWER:** A sewer which receives the flow from collector sewers and conveys the wastewater to treatment facilities.

28. **INTERNAL PIPE INSPECTION:** The television inspection of a preselected sewer line section. A television camera is moved through the line at a slow, uniform rate and a continuous picture is transmitted to an aboveground monitor.
29. **INVERT:** The floor, bottom or lowest point of a conduit.
30. **INVERT LEVEL (ELEVATION):** The level (elevation) of the lowest portion of a liquid - carrying conduit, such as a sewer, which determines in part the hydraulic gradient available for moving the contained liquid
31. **JOINTS:** The means of connecting sectional lengths of sewer pipe into a continuous sewer line using various types of jointing materials. The number of joints depends on the lengths of the pipe sections used in the specific sewer construction work.
32. **LINEAR FOOT:** Being one foot as measured along the centerline of a sewer line.
33. **LONG-TERM MODULUS OF ELASTICITY:** The modulus of elasticity of the material after 50 years of service. This value may be extrapolated from a 10,000 hour test of the material.
34. **MAJOR BLOCKAGE:** A structural defect, collapse, or blockage which prohibits manhole-to-manhole cleaning with commercially available hydraulic or mechanical cleaning equipment.
35. **MANHOLE SECTION:** The length of sewer pipe connecting two manholes.
36. **MECHANICAL CLEANING:** Techniques and methods used to clean sewer lines of debris mechanically with devices such as power rodding machines, winch-pulled brushes, bucket machines, etc.
37. **OVERFLOW:**
 - a. The excess water that overflows the ordinary limits such as the stream banks, the spillway crest, or the ordinary level of a container.
 - b. To cover or inundate with water or other fluid.
38. **PHYSICAL PIPE INSPECTION:** The crawling or walking through manually accessible pipe lines. The logs for this inspection technique record the information of the kind detailed under Internal Pipe Inspection. This inspection technique is only undertaken when field conditions offer minimal hazard or jeopardy to personnel.
39. **PIPE JOINT SEALING:** A method of correcting leaking or defective pipe joints which permit infiltration of extraneous water into the sewers by means of applying chemical materials into and/or through the joint area from within the pipe.
40. **REGULATOR:** A device or apparatus for controlling the quantity of admixtures of sewage and storm water admitted from a combined sewer collector line into an interceptor sewer, or pumping or treatment facilities, thereby determining the amount and quality of the flows discharged through an overflow device to receiving waters or other points of disposal.
41. **ROOF LEADER:** A drain or pipe that conducts storm water from the roof of a structure downward and thence into a sewer for removal from the property, or onto the ground for runoff or seepage disposal.
42. **SANITARY SEWER:** A sewer intended to carry only sanitary or sanitary and industrial wastewater from residences, commercial buildings, industrial parks, and institutions.
43. **SERVICE CONNECTION:** see Building Sewer.

44. SEWER CLEANING: The utilization of hydraulic or mechanical techniques and/or devices to dislodge, transport, and remove debris from sewer lines.
45. SEWER PIPE: A length of conduit, manufactured from various materials and in various lengths, that when joined together can be used to transport wastewater from point of origin to a treatment works. Materials include, but are not limited to: Acrylonitrile-butadiene-styrene (ABS); Asbestos-Cement (AC); Brick Pipe (BP); Concrete Pipe (CP); Cast Iron Pipe (CIP); Ductile Iron Pipe (DIP); Polyethylene (PE); Polyvinylchloride (PVC); Reinforced Concrete Pipe (RCP); Reinforced Plastic Mortar (RPM); Steel Pipe (SP); Vitrified Clay Pipe (VCP).
46. SITE: Any location where work has been or will be done.
47. SITE ACCESS: An adequately clear area of a size sufficient to accommodate personnel and equipment required at the location where work is to be performed, including roadway or surface sufficiently unobstructed to permit conveyance of vehicles from the nearest paved roadway to the work location.
48. SPRING LINE: The horizontal midpoint of a sewer pipe.
49. STORM SEWER: A sewer intended to carry only storm waters, surface runoffs, street washwater, and drainage.
50. STREET ACCESS: Areas normally used for public vehicular traffic (including roads, streets, or areas within existing rights-of-way or easements) to which safe access is required for performance of work.
51. SUBCONTRACTOR: An individual, firm, or corporation having a direct contract with the Contractor for performance of part of the work.
52. SURCHARGE: When the sewer flow exceeds the hydraulic carrying capacity of the sewer line.
53. SURCHARGE CONDITION: When the sewer flow depth equals or exceeds the diameter of the discharging sewer line or lines.
54. SWALE (DIP, SAG): A significant deviation in pipe grade such as to cause entrapment of solids, semisolids, and liquids, thereby impeding the accuracy and/or effectiveness of flow measurements, cleaning, and internal inspection.

END OF SECTION 330130.01

SECTION 330130.02 - SEWER LINE CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.

Note to Designer: The following Sections must be included in the spec book if this section is used. This paragraph may be deleted from the spec depending on the overall format of the book.

- B. Other Sections Referenced:

- 1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions

1.2 DESCRIPTION OF WORK

- A. The intent of sewer line cleaning is to remove foreign materials from the lines and restore the sewer to a minimum of 95% of the original carrying capacity or as required for proper lining of the pipe or seating of internal pipe joint sealing packers. Since the success of the other phases of work depends a great deal on the cleanliness of the lines, the importance of this phase of the operation is emphasized. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. If in the course of normal cleaning operations, damage does result from pre-existing and unforeseen conditions such as broken pipe, the Contractor will not be held responsible.
- B. The intent of chemical root treatment is to kill tree roots in sanitary/storm sewer lines and to inhibit root regrowth without damaging the trees, the environment, or the treatment plant.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Equipment Data: Submit a listing of equipment to be used on the project. Provide equipment operating instructions if requested by the Owner.
- B. Chemical Root Removal Data:
 - 1. Submit manufacturer's technical data and application instructions.
 - 2. Submit Material Safety Data Sheet(s) for the chemicals to be used in the root removal process.

3. Submit a specimen product label of foaming material to be used in chemical root treatment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and material shall be of a type that has been in general use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 CLEANING EQUIPMENT

- A. **Hydraulically Propelled Equipment:** The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.
- B. **High-Velocity Jet (Hydrocleaning) Equipment:** All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.
- C. **Mechanically Powered Equipment:** Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To insure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

2.3 CHEMICAL FOAM ROOT REMOVAL

- A. The chemical root treatment material shall be EPA registered and labeled for use in sewer lines and acceptable to the state agencies having jurisdiction over its use.

- B. The active ingredient for killing roots shall be a nonsystemic herbicide which will kill roots at low concentrations but will not permanently affect parts of the plant distant from the treated roots. The active ingredient must be spontaneously detoxified by natural chemical/biochemical processes following its use. The active ingredient shall not adversely affect the performance of wastewater treatment plants.
- C. The active ingredient for inhibiting root regrowth in sanitary sewers shall inhibit root cell growth on contact but shall not be transported so as to damage other portions of the plant. The material shall form a persistent chemical barrier suppressing the growth of root tips. The material shall be sufficiently stable under conditions of use to provide protection for 12 months but shall be subject to decomposition in wastewater treatment plants without disturbing plant processes.
- D. The root treatment material shall contain emulsifiers to degrease root masses and remove fatty acids from root tissue and surfactants to convert an aqueous solution of the root treatment agent into a volatile foam.

PART 3 - EXECUTION

3.1 CLEANING PRECAUTIONS

- A. During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer.
- B. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily.
- C. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

3.2 SEWER CLEANING

- A. The designated sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. 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. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes.
- B. If 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. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed that a major blockage may exist, the cleaning effort shall be suspended, and the Engineer shall be notified.

3.3 ROOT REMOVAL

- A. Roots shall be removed in the manhole sections where root intrusion occurs. Special attention should be used during the cleaning operation to assure complete removal of roots from the joints. Any roots which could prevent proper lining of the pipe, prevent the seating of a pipe joint packer, or prevent the proper application of chemical sealants shall be removed.
- B. Mechanical procedures may include the use of equipment such as rodding machines, bucket machines and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners.
- C. Chemical root treatment shall be used when directed by the Owner.
 - 1. The Contractor's attention is directed to the safety requirements and precautions associated with the use of the root treatment material. The Contractor shall use precautions for the protection of all persons, vegetation, animals and property. The Contractor is responsible for damage to private property and vegetation.
 - 2. The Contractor is required to be knowledgeable of and in compliance with federal and state requirements relative to the root treatment material and its use. Compliance with federal and state law shall supersede compliance with the provisions of this contract.
 - 3. All mixing/application procedures for chemical root treatment shall be consistent with the latest standards, requirements and recommendations of the manufacturer of the chemical root treatment material used. Mixing and application of the root treatment material shall be done under the supervision of a state-certified pesticide (herbicide) applicator as required by law.
 - 4. When the root tips are damaged or removed by sewer line cleaning, chemical treatment will be less effective. Consequently, no mechanical cleaning is recommended in lines prior to chemical root treatment unless extensive grease, root masses, or debris preclude proper application of the material.
 - 5. Sewer service shall generally not be interrupted during root treatment. In situations where it is necessary to shut down upstream pumping stations of block/bypass upstream flows, the Contractor shall coordinate his activities with the Engineer and Owner and do the work at night or during periods of low flow.
 - 6. All materials shall be delivered to the site in undamaged, unopened containers bearing the manufacturer's original label. Mixing of the root treatment material shall be done no more than 12 hours prior to use. The water used shall be clear and free of acid, alkali, oxidizing agents, oil, or other organic materials. Mixing water temperature shall be between 40°F and 80°F.
 - 7. Where conditions permit, the volume of foam shall be sufficient to completely fill the air space above the flow, manhole to manhole. In all cases, the volume of foam delivered to the sewer line shall be sufficient to attach to and permeate all root masses.
 - 8. The foam shall be applied at sufficient pressure to penetrate a minimum of 5 feet into service connections.
 - 9. Root Removal: The Contractor shall wait a minimum of 90 days from application of the foam to removal of roots unless otherwise directed by the Engineer.

- D. All roots must be removed prior to grouting or lining. If roots are detected during either of grouting or lining, the Contractor shall remove his equipment and reclean the line to ensure root removal. This work shall be performed at no additional cost to the Owner if the manhole section was previously cleaned as a pay item.

3.4 MATERIAL REMOVED

- A. All sludge, dirt, sand, rocks, grease, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned.
- B. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.
- C. When necessary or when directed by the Engineer, an approved dam or weir shall be constructed in the downstream manhole in such a manner that solids and debris will be trapped and retained. The cost of such a dam or weir shall be included in the cost of cleaning.

3.5 DISPOSAL of MATERIALS

- A. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of at a location approved by the Owner.
- B. Trucks hauling solids or semisolids from the site shall be watertight so that no leakage or spillage will occur.
- C. All materials shall be removed from the site no less often than at the end of each workday.
- D. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as approved by the Owner.

3.6 FINAL ACCEPTANCE

- A. Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner.
- B. If TV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to reclean and reinspect the sewer line at no additional expense to the City.
- C. In areas where television inspection is not performed, the Engineer may require the Contractor to pull a double squeegee (with each squeegee the same diameter as the sewer) through each manhole section as evidence of adequate cleaning.

END OF SECTION 330130.02

SECTION 330130.03 - SEWER FLOW CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this Section.

Note to Designer: The following Sections must be included in the spec book if this section is used. This paragraph may be deleted from the spec depending on the overall format of the book.

- B. Other Sections Referenced:

- 1. Section 330130.01 - Sewer Collection System Rehabilitation Definition

1.2 DESCRIPTION OF WORK

- A. The intent of this work is to control the flow in the sewer to enable the successful inspection, rehabilitation or replacement of the pipe.
- B. Depth of flow shall not exceed that shown below for the respective pipe sizes when performing television inspection, joint testing and/or sealing.

Pipe Diameter Maximum Depth of Flow

- | | | | |
|----|----------------|---|----------------------|
| 1. | 6" - 10" Pipe | - | 25% of pipe diameter |
| 2. | 12" - 24" Pipe | - | 33% of pipe diameter |
| 3. | 27" & up Pipe | - | 40% of pipe diameter |

- C. Flow shall be controlled or bypassed from sewer sections being lined or replaced. The methods used shall be in accordance with the work being performed.

1.3 QUALITY ASSURANCE

- 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. Further, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

1.4 SUBMITTALS

- A. The Contractor shall submit a written request for Sewer Flow Control, specify the method and equipment to be used, and receive approval from the Owner prior to performing the work.
- B. For bypass pumping, submit shop drawings in accordance with the General Requirements showing pumps, piping layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, and any special provisions required for assembly. Provide a wet weather operation plan which describes what procedures will be followed when flow exceeds pumping capacity.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Sewer plugs shall be so designed that all or any portion of the sewage can be quickly released.
- B. Pumping and bypassing:
- C. Pumps bypass pipe, fittings, and joining methods shall be suitable and of a type normally used for raw sanitary sewage.
 - 1. The bypass system shall be of sufficient capacity to handle existing peak dry weather flow plus additional flow that may occur during a rainstorm unless otherwise provided for by an approved wet weather operation plan.
 - 2. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to keep noise to a minimum.
 - 3. Bypass piping to be furnished and installed shall include, but not limited to all pipe, fittings, specials, bends, beveled pipe, adapters, bulkheads, stoppers, plugs, joint restraints, joints and jointing materials, and pipe supports. Bypass piping shall be rated to twice the system operating pressure.
- D. Hydrocleaning equipment shall be equipped with high-velocity nozzles capable of pulling flow away from the pipe section being televised. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. The Contractor shall continuously supervise the level of water in the upstream and downstream sewers to ensure that harmful surcharging does not occur. The Contractor shall be responsible for any damage to the system and/or to public or private property resulting from improper execution of flow control measures.

3.2 PLUGGING OR BLOCKING

- A. A sewer line plug shall be inserted into the line upstream of the section being worked. During TV inspection, testing and sealing operations, flow shall be reduced to within the limits specified above. After the work has been completed, flow shall be restored to normal.

3.3 PUMPING AND BYPASSING

- A. When pumping and bypassing is required, the Contractor shall supply and install the pumps, conduits, and other equipment to divert the flow around the section in which work is to be performed. Under no circumstances will the discharge of raw sewage to other than sanitary sewers be allowed.
- B. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system.
- C. The proposed bypassing system shall be set up to allow traffic flow to local residents and businesses.
- D. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- E. Make connections to all existing force mains being bypassed.
- F. Install temporary bypass piping with restrained joints at horizontal and vertical changes in direction.
- G. Provide granular material for bedding and encasement of temporary piping when buried below pavement.
- H. Field test bypass piping and obtain approval from the Engineer prior to placing bypass system in service.
- I. Do not remove pumping and bypass system until it is no longer needed and can be replaced by authorized use of completed permanent facilities.

3.4 HYDRAULIC FLOW CONTROL

- A. This method shall be used for sewer televising only. The Contractor shall position the high-velocity nozzle no less than five (5) feet ahead of the television camera. Pressures shall be just sufficient to reduce the flow level in front of the camera to the specified depth. The jet nozzle shall be reeled in at the same rate as the forward movement of the television camera to maintain the separation distance.

END OF SECTION 330130.03

SECTION 330130.04 - SEWER POINT REPAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions
 - 2. Section 330130.02 - Sewer Line Cleaning
 - 3. Section 330130.17 - Television Inspection
 - 4. Section 329200.19 - Seeding and Mulching
- C. Drawings
 - 1. See Section 011100 – Drawing Schedule
- D. Other documents which shall be considered part of and included in these specifications
 - 1. ASTM A 48 Specification for Gray Iron Castings.
 - 2. ASTM A 536 Specification for Ductile Iron Castings.
 - 3. ASTM C 12 Recommended Practice for Installing Vitrified Clay Pipe Lines.
 - 4. ASTM C 76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 5. ASTM C 270 Specification for Mortar for Unit Masonry.
 - 6. ASTM C 425 Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - 7. ASTM C 443 Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 8. ASTM C 478 Specification for Precast Reinforced Concrete Manhole Sections.
 - 9. ASTM C 700 Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
 - 10. ASTM C 923 Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 - 11. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 12. ASTM D3034 Specification for Type PSM Poly(VinylChloride)(PVC) Sewer Pipe and Fittings.

13. ASTM D3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
14. ODOT Construction and Material Specifications.
 - a. Item 603 Pipe Culverts, Sewers and Drains.
 - b. Item 604 Manholes, Catch Basins, Inlets, Inspection Wells, Junction Chambers or Monuments.
 - c. Item 613 Low Strength Mortar Backfill.
 - d. Item 642 Traffic Paint.
15. Ohio Manual of Uniform Traffic Control Devices.

1.2 DESCRIPTION OF WORK

- A. Under this section, the Contractor shall replace existing sections of sewers and/or manholes necessary to restore the capacity, structural integrity and functional capabilities of the sewer system. Minimum sewer repairs are six (6) feet in length and may be longer depending on the conditions encountered. Manhole replacement will include sufficient lengths of sewer to reconnect the pipe to the manhole. Defects that could require point repairs include but are not necessarily limited to:
 1. Partial collapse where the pipe has broken and threatens to block the flow.
 2. Broken or protruding tap-in connections that cannot be repaired or cut from within the sewer pipe.
 3. Utility relocation where a utility line may have been constructed through the sewer pipe.
 4. Manhole replacement where the structural condition is too deteriorated for rehabilitation.
 5. Manhole separation where a common access manhole is removed and two separate manholes installed.
 6. Service connection test-tee replacement or new installation.
 7. Service connection pipe replacement.
- B. Point repairs are normally performed in established urban areas where the construction work is an inconvenience to the residents, business owners and traveling public. Therefore, the means and methods to be employed by the Contractor and the conduct of the Contractor's employees are important to the Owner. Any means, methods, or employee used in the execution of Point Repair work that is too disruptive to the public in the opinion of the Owner shall be modified by the Contractor to the satisfaction of the Owner at no additional cost to the Owner.
- C. Any point repair work performed by the Contractor shall be scheduled such that the excavation will be backfilled within two (2) days of the start of the work, unless additional time is granted by the specifications or granted in writing by the Engineer.
- D. Sewer Point Repairs will only be performed and paid for when the work is authorized in writing by the Engineer.

1.3 QUALITY ASSURANCE

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of sanitary and/or storm system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Installer's Qualifications:** Firms with at least 3 years of successful installation experience on projects with sanitary and/or storm work similar to that required for project.
- C. **Codes and Standards:**
 - 1. **Plumbing Code Compliance:** Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of sanitary and/or storm system's materials and products.
 - 2. **Environmental Compliance:** Comply with applicable portions of local Environmental Agency regulations pertaining to sanitary and/or storm systems.
 - 3. **Utility Compliance:** Comply with applicable portions of protection, installation and/or inspection requirements for each utility encountered during the construction of the point repair.

1.4 SUBMITTALS

- A. **Product Data:** Submit manufacturer's technical product data and installation instructions for sanitary and/or storm system materials and products.
- B. **Record Drawings:** At project closeout, submit record drawings of installed sanitary and/or storm sewage piping and products, in accordance with requirements of Division 1.
- C. **Submit a description of the equipment proposed for the control of the sewer grade.** When requested, include catalog data describing the function and the conditions of operation of the equipment. The Engineer shall have the right to disapprove the use of the proposed equipment if in his opinion such equipment will not provide a reliable control system.

1.5 SUBSURFACE CONDITIONS

- A. **The Contractor shall make whatever test holes he deems necessary to determine the subsurface ground conditions, including the presence of water and rock. No extra compensation shall be allowed the Contractor as the result of subsurface conditions encountered within the project. All proposed test holes shall be approved by the Owner prior to digging.**

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **Pipe, fittings, and specials shall be of the size and material being replaced.**

1. Vitrified Clay Pipe shall conform to ASTM C 700, with ASTM C 425 joints.
 2. Reinforced Concrete Pipe shall conform to ASTM C 76, with ASTM C 443 joints for sanitary sewers or ASTM C 990 joints for storm sewers.
 3. PVC pipe and fittings shall conform to ASTM D 3034, with ASTM D 3212 joints.
- B. Manholes shall be precast concrete and shall conform to ASTM C 478.
1. Joints between sanitary manhole sections shall conform to ASTM C 443. Flexible connections for sanitary pipes shall conform to ASTM C 923, "A-Lok" Type as manufactured by A-Lok Products; or an approved equivalent.
 2. Joints between storm manhole sections shall conform to ASTM C 990. Cut-out openings for connecting pipes shall be made immediately after the pipe is removed from the casting form.
 3. Where pressure tight manhole frames and covers are called for, threaded inserts shall be cast in cones or flat slab tops and holes formed or cored in the adjusting rings to match bolt size and spacing specified for the manhole casting.
- C. Precast concrete collars shall conform to ASTM C 478.
- D. Mortar shall conform to specifications for mortar for Unit Masonry, ASTM C 270 Type S, containing no masonry cement.
1. Mortar shall be composed of one (1) part Portland cement, Type II, to two (2) parts sand by volume.
- E. Materials for nonshrinking grout shall conform to CRD-C "Corps of Engineers Specifications for Non-Shrink Grout". Approved products are "Sauereisen F-100 Grout" by Sauereisen Cements Co.; "Five Star Grout" by U.S. Grout Corporation; "Masterflow 713" by Master Builders; "Euco N-S" by Euclid Chemical Company.
- F. Manhole frames and covers shall comply with the type specified on the manhole typical detail.
1. Ferrous castings shall be of uniform quality free from blowholes, shrinkage or other defects.
 2. Metal shall conform to ASTM A 48, Class 35 for gray iron or ASTM A 536, Grade 65-45-12 for ductile iron.
 3. Castings shall be smooth and well cleaned by shot blasting.
 4. Castings shall be manufactured true to pattern.
- G. Round frames and covers shall have continuously machined bearing surfaces to prevent rocking and rattling.
- H. Other utility conduits, thrust blocks, and other appurtenances shall be of the size and kind being replaced or as approved by the governing utility company and the Engineer.
- I. Low Strength Mortar Backfill shall conform to ODOT 613.03 Type 2.

PART 3 - EXECUTION

3.1 GENERAL

- A. **Public Notification:** The Contractor shall notify nearby residents and business owners forty-eight (48) hours in advance of beginning each point repair. The notification shall briefly describe the work to be performed, state the reason for the work, provide emergency phone numbers, and give a time estimate as to when the work will be completed. The language of the notification shall be approved by the Engineer.
- B. **Utility Notification:** Before any excavation work is started, the Contractor shall call the "Ohio Utilities Protection Service", at 1-800-362-2764, 48 hours in advance of the work. Non-member utilities must be contacted directly. The Contractor shall take all necessary precautions, at no additional expense to the Owner, to avoid damage to existing underground and overhead utility lines during the entire project. In the event of damage to existing public and/or private utilities, the agency concerned shall be notified immediately and all repair work shall be executed in accordance with the specifications of the respective agency at no additional expense to the Owner, including any inspection fees or maintenance crews.
- C. **Inspection Scheduling:** The Contractor shall notify the Engineer forty-eight (48) hours in advance of beginning work which requires compaction testing. Work will not begin until testing and/or inspection arrangements have been completed and approved by the Engineer.
- D. **Blasting** will not be permitted.
- E. **Unauthorized Excavations:** All excavations made outside of the lines, grades and replacement limits established by the Engineer, including the excavation, handling, rehandling, backfilling and disposal of such material shall be performed at the Contractor's own expense. This shall include that work caused by cave-ins, slides, swellings or upheavals. All spaces beneath foundations of structures, utilities, pipes or other existing facilities shall be filled with concrete or other acceptable material.
- F. **Noise, Dust and Odor Control:** The Contractor's performance of this Contract shall be conducted so as to eliminate all unnecessary noise, dust and odors. Dust control shall be performed at the Contractor's own expense whenever directed by the Engineer.
- G. The word "rock" wherever used as the name of an excavated material, shall mean boulders and solid masonry larger than one-half cubic yard in volume, of solid ledge rock and masonry which, in the opinion of the Engineer, required for its removal drilling and blasting, wedging, sledging or barring, or breaking up with a power-operated hand tool. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel; no loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere; and no rock exterior to the minimum limits of measurement, which may fall into the excavation, will be measured or allowed when extra payment for rock excavation is set forth.

3.2 PREPARATORY WORK OUTSIDE PAVED AREAS

- A. The Contractor shall clear the work areas of all trees less than six (6) inch caliper, shrubs, hedges, plants and flowers as directed by the Engineer.
- B. Shrubs and hedge plants shall be set aside, appropriately stored, and replanted after backfilling the excavation. Any shrub or hedge plant that dies prior to expiration of the warranty period shall be replaced with new nursery stock.
- C. All refuse and rubbish shall be cleared from the work area and all tree stumps shall be grubbed out. All cleared material and stumps shall be removed from the work area and disposed of in a manner approved by the Engineer.
- D. After clearing, but prior to starting main excavations, the Contractor shall remove from the work area all loam, topsoil and sand found suitable for future top dressing or use.
- E. Such material shall be removed in such a manner that it is clearly separated from the underlying material and shall be stored in such a manner and location as directed by the Engineer.
- F. No extra compensation will be allowed the Contractor for Clearing and Grubbing.

3.3 PREPARATORY WORK WITHIN PAVEMENT AREAS

- A. The Contractor shall set up traffic control in accordance with Ohio Manual of Uniform Traffic Control Devices to the satisfaction of the Owner.
- B. The existing pavement shall be neatly saw cut, excavated and disposed of at a location approved by the Owner.

3.4 PROTECTION OF EXISTING UTILITIES

- A. Where existing utilities are indicated as being in the line of the point repair section, the Contractor shall carefully expose them so as to cause no damage to them or interruption of their intended use. Existing pipes or conduits crossing the sewer trench, or otherwise exposed shall be adequately braced and supported to prevent any disruption to the line or grade of the utility.
- B. The Contractor shall keep fire hydrants accessible at all times.
- C. Utility services broken or damaged shall be repaired at once to avoid inconvenience to customers. Storm sewers shall not be interrupted overnight. Temporary arrangements, as approved by the Engineer, may be used until any damaged items can be permanently repaired. All items damaged or destroyed by Point Repair construction must be subsequently repaired to the satisfaction of the governing utility company.

3.5 INSTALLATION

- A. Where the sewer is located adjacent to, or within any pavement area, the Contractor shall be required to maintain vertical sides on all trenches using full sheeting and bracing if necessary. Maximum top width of trench permitted under such conditions shall be four (4)

feet, plus the inside diameter of the pipe unless otherwise specified on the plans or prior approval has been received from the Engineer. In no case will the Contractor be permitted to excavate pipe trenches with sides sloping to the bottom.

- B. All material excavated in trenching and all materials used in construction of the work shall be deposited so as not to endanger the work or create unnecessary annoyance to the public. During the progress of the work, all material piles shall be kept trimmed up and maintained in a neat workmanlike manner. Excavated material in excess of that needed for backfilling shall be disposed of in areas approved by the Owner.
- C. Construction shall be in accordance with ODOT Item 603 Pipe Culverts, Sewers and Drains and with ODOT Item 604 Manholes, Catch Basins, Inlets, Inspection Wells, Junction Chambers or Monuments with the following exceptions:
 - 1. Excavated soil suitable for reuse shall be stockpiled on plywood sheets or other suitable means which will prevent spillage of undesirable subgrade material onto the surrounding lawn area.
 - 2. Bedding material shall be crushed limestone only.
 - 3. Pipe lengths shall not be deflected at the joint to any greater degree than recommended by the manufacturer of the particular joint being used. All pipe deflections shall be performed only with the Engineer's approval.
 - 4. Under pavement areas, Low Strength Mortar Backfill Material shall be placed from the top of the bedding up to the bottom of the pavement. The excavation shall then be plated and reopened to traffic until the low strength mortar obtains sufficient strength to support vehicle loads. In no event shall traffic be permitted on Low Strength Mortar Backfill for less than forty-eight (48) hours after the trench has been backfilled.
 - 5. Near pavement areas, Low Strength Mortar Backfill Material shall be placed from the top of the bedding up to a depth equal to the distance from the edge of the pavement.
 - 6. Outside pavement influence areas, minimum compaction requirements shall be 100% of the maximum dry density of the backfill material.
- D. The replacement pipe shall be laid at a uniform grade between the two points of connection with the existing pipe using the equipment and methodology approved for the control of the sewer grade.

3.6 SERVICE CONNECTIONS

- A. In general, where service connections are in the point repair limits or as ordered, provision shall be made in the sewers for service connections by inserting a tilted-up "T" Branch for each service connection with a branch size equivalent to the existing connection where necessary, the Contractor shall construct a riser in such manner, that the top of the riser shall meet and properly receive the existing service connection. Risers are to be encased in Low Strength Mortar Backfill Material.
- B. The Contractor shall connect the new tee or wye branch to the existing service lateral so as to provide a leak free serviceable connection to the building owner.

3.7 MANHOLE SEPARATION

- A. Where directed by the Engineer, the Contractor shall remove the existing common (storm and sanitary access) manhole and construct two (2) new manholes as per the typical details.
 - 1. When feasible, the sanitary sewer shall be constructed at the same line and grade as the existing sewer. The storm sewer shall be offset from its existing alignment a sufficient distance to clear the outside wall of the new sanitary manhole.
 - a. The offset shall be achieved by using two (2) foot lengths of pipe and deflecting joints.
 - b. The required deflection shall be accomplished in the minimum length possible without exceeding the allowable tolerances.
- B. The bottoms of all manholes shall be channeled to conduct flow in the planned direction. Channels shall be the true shape of the lower half of the sewer pipe and shall match inverts of the connecting pipe at the manhole wall.
- C. In integral base sections (only) channels may be constructed using brick and Portland cement mortar. Mortar shall be 3/4-in. thick minimum between bricks and between bricks and concrete and 1-in. thick minimum on all exposed surfaces.
- D. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the cone section or flat slab top.

3.8 SERVICE LATERAL POINT REPAIRS AND TEST TEE INSTALLATION

- A. When authorized by the Engineer, the Contractor shall perform a Point Repair to excavate service connections, replace existing pipe or install new pipe, and/or construct a new or replacement test tee to be used for rehabilitation of the service connection.
- B. The Contractor shall determine the alignment of the service connection. The excavation shall be made at a distance from the main line sewer as designated by the Engineer.
 - 1. Perform the excavation and remove six (6) feet of service connection pipe to allow access for video inspection.
 - 2. Clean and televise the service connection to the main line sewer in accordance with Service Connection Televising and Rehabilitation.
 - 3. A snow fence type of barricade shall be placed around every open excavation at the end of each work day.
 - 4. Each excavation may be left open for a maximum of two (2) working days unless an extension of time is granted by the Engineer.
 - 5. Reconnect the service connection with a test tee and cap to a height six (6) inches below grade, or as determined by the Engineer.
- C. Based on the results of the television inspection of the service connection, and/or as otherwise authorized by the Engineer, the Contractor shall install or replace additional service connection pipe. Additional service connection replacement may extend to but shall not include the wye or tee on the main line sewer.

3.9 CLEANING SITE AND RESTORING DAMAGED SURFACES

- A. Upon completion of the backfill work, the Contractor shall immediately remove and dispose of all surplus materials including dirt and rubbish to the satisfaction of the Engineer.
- B. Unless otherwise called for on the plans, the Contractor shall replace in-kind all damaged or disturbed pavement and sidewalks to a condition equal to or better than that existing before the work was started as a part of performing the Point Repair work. Concrete sidewalks and pavement shall be replaced in whole blocks.
- C. All restoration of lawns, planting beds, and shrubbery shall be performed in accordance with Sodding, Seeding and Mulching as a part of performing the Point Repair work. The Contractor shall maintain the lawn and correct any settlement that occurs during the one-year maintenance period.
- D. Upon completion of the foregoing work, all tools and other property belonging to the Contractor shall be removed, and the site shall be left in good condition.

3.10 TRAFFIC PAINT

- A. The Contractor shall replace all existing pavement markings in the style and at the locations that existed prior to this work. The Contractor shall make records of these markings as they exist and shall supply these records to the Engineer prior to the start of any work. In the absence of such documentation, the Owner's discretion shall prevail.

3.11 INSPECTION BEFORE ACCEPTANCE

- A. In addition to work being observed by the Engineer during construction, each section of sewer on which a point repair is made shall be inspected in accordance with Television Inspection before final acceptance by the Owner. The point repair shall be true to both line and grade, free from cracks, broken bells, and protruding joint materials and shall show no leaks. The hydraulics of the sewer shall be in no ways be impaired. There shall be no projections of connecting pipe into the sewer. Any deposits of sand, dirt, mortar, or other materials shall be removed from the pipe in accordance with Sewer Line Cleaning at no additional cost to the Owner.
- B. If, as the result of any inspection, before final acceptance of the work, it is found that any section of any sewer has unduly settled, that joints have opened up or when the jointing material has come loose and projects into the sewer, or if pipes or bells are found cracked, broken or misshaped beyond accepted standards, or if any other defects are found in the sewers or in any of their appurtenances which might impair the satisfactory performance of the sewer or which show non-conformance with the drawings or Specifications, the Contractor shall cause such effective or inferior work to be promptly removed and replaced or satisfactorily repaired by proper material and workmanship without extra compensation for the labor, equipment and materials required.
- C. Should the Engineer require that any work be uncovered because of suspected failure or non-conformance or for inspection or other cause, and if such work is subsequently found

satisfactory, the cost involved for such work will be paid for at the unit price bid for the respective items of work involved.

END OF SECTION 330130.04

SECTION 330130.11 - SEWER TELEVISION INSPECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Technical Specification sections apply to work of this section.

1.2 SUMMARY

- A. The Contractor shall clean the sewer and trap all debris downstream for removal off-site. The Contractor may not flush the debris downstream in the sewer system.
- B. After cleaning, the manhole sections shall be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time. Final acceptance of the sewer will be given only after the DVD(s) are reviewed and approved by the Engineer.

1.3 QUALITY ASSURANCE

- A. The television inspection shall be done by a responsible commercial firm known to be skilled and regularly engaged in the business of sewer color DVD documentation. The firm shall furnish such information as the Owner deems necessary to determine the ability of that firm to perform the work in accordance with these specifications.

1.4 SUBMITTALS

- A. Submit a sample DVD of a television inspection similar to this project to verify picture and audio quality. When approved, this DVD will be the standard on which quality will be based and judged.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EQUIPMENT

- A. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative.
- B. The DVD with audio shall be shall provide the highest quality picture and sound that is capable of being played back on conventional equipment **without special software**.

3.2 PROCEDURE

- A. Prior to televising, the sewer shall be charged with water until it begins to discharge at the downstream end so any depressions and low points that may be in the sewer will be filled.
- B. The camera will be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
- C. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two (2) manholes of the section being inspected to insure good communications between members of the crew.
- D. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Engineer.
- E. The following information shall be provided on the DVD:
 - 1. The beginning of each DVD shall contain: project name, contract number, Contractor's name, firm doing filming, date of televising, manhole numbers or sections televised, direction of flow, location, distance between manholes, and distance to wyes, and total tape counter number for the end of the DVD. The DVD counter shall be set at zero at the beginning of the DVD.
 - 2. The beginning of each section of pipe shall have a narrative describing; street locations, the manhole numbers and stationing at the beginning and end of this section, which direction the camera is traveling, the condition of the beginning manhole, size and material of pipe, and plan length of this section of pipe. Manhole numbers (from-to) shall be continuously displayed along with footage.
 - 3. During televising of each pipe section, there shall be a brief report as to findings, such as service connections, defects in pipe, water infiltration, dips in the line, debris, mud, etc. The footage of the finding from the beginning manhole shall also be called out.
 - 4. The end of each section of pipe shall have a narrative describing; the as-built length of this pipe section center-to-center of manholes, the length of the pipe between joints, the overall condition of the pipe, the manhole number and stationing at the end of the section, and the condition of this manhole.
- F. The DVD shall be accompanied by a video log report. The format of the report shall be approved by the Engineer. The report shall contain a table of contents and a separate report page for each section of pipe between manholes or structures, or between a manhole and the end of a run of pipe.

- G. While the Engineer may have a representative on-site during televising, a separate review of the DVD(s) will be performed within ten (10) working days of receipt of the DVD(s). DVD recording playback shall be at the same speed as it was recorded. Slow motion and stop motion playback features shall be supplied.

END OF SECTION 330130.11

SECTION 330130.13 - SEWER PIPE JOINT TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions
 - 2. Section 330130.02 - Sewer Line Cleaning
 - 3. Section 330130.03 - Sewer Flow Control
 - 4. Section 330130.17 - Television Inspection

1.2 DESCRIPTION OF WORK

- A. The intent of sewer pipe joint testing is to identify those sewer pipe joints that are defective thereby allowing extraneous water to enter the sewer system.
- B. Testing cannot be performed and will not be required on cracked or broken pipe, service connections, or sections of pipe between joints. Testing will not be required on joints which are visibly leaking.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Equipment Data: Submit equipment manufacturer's technical data and operation instructions for the testing equipment to be used.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and material shall be of a type that has been generally been in use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 MATERIAL

- A. Test Medium: Both water and air are acceptable, but the test procedure is different for each.

2.3 EQUIPMENT

- A. The basic equipment used shall consist of a television inspection equipment, joint testing device (such as a packer), and test monitoring equipment.
 - 1. The equipment shall be constructed in such a way as to provide means for introducing the test medium, under pressure, into the void area created by the expanded ends of the joint-testing device and means for continuously measuring the actual static pressure of the test medium at and within the void area only.
 - 2. Void pressure data shall be transmitted to the televising recording equipment via an electrical pressure transducer located at the void.
 - 3. The recording equipment shall be capable of recording on the video tape the manhole section being tested, the footage from the beginning manhole, and a real-time image of the void pressure.
- B. Test monitoring equipment shall be housed in a suitable vehicle and arranged to allow for simultaneous and continuous observation of the television monitor and test monitoring equipment by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Prior to testing a section of sewer, the pipe shall be cleaned and the flow controlled to allow a suitable depth. See Sewer Line Cleaning and Sewer Flow Control. The cost of this work shall be considered incidental to Sewer Pipe Joint Testing and included in the price bid thereof.

3.2 CONTROL TEST

- A. Prior to starting the pipe joint testing phase of the work, a two-part control test shall be performed.
 - 1. To insure the accuracy, integrity, and performance capabilities of the testing equipment, a demonstration test will be performed in a test cylinder constructed in such a manner that a minimum of two known leak sizes can be simulated. This technique will establish the test equipment performance capability in relationship to the test criteria and insure that there is no leakage of the test medium from the system or other equipment defects that could affect the joint testing results. If this test cannot be performed successfully, the Contractor shall be instructed to repair or otherwise modify his equipment and re-perform the test until the results are satisfactory to the Engineer. This test may be required at any other time during the

joint testing work if the Engineer suspects the testing equipment is not functioning properly.

2. After entering each manhole section with the test equipment, but prior to the commencement of joint testing, the test equipment shall be positioned on a section of sound sewer pipe between pipe joints, and a test performed as specified. This procedure will demonstrate the reliability of the test equipment and the soundness of the pipe material. Should it be found that the barrel of the sewer pipe will not meet the joint test requirements, the requirements will be modified as necessary.

3.3 TESTING

- A. Each sewer pipe joint which is visibly leaking shall be considered as having failed the test.
- B. Each sewer pipe joint which is not visibly leaking shall be individually tested at a test pressure equal to $1/2$ psi per vertical foot of pipe depth (not exceeding a test pressure of 10 psi) in accordance with one of the following procedures:

1. Water Test Procedure:

- a. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
- b. The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the void without leakage past the expanded ends.
- c. Water shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test.
- d. The flow rate of the test water shall then be regulated to a rate at which the void pressure is observed to be the required test pressure. A reading of the test water flow meter shall then be taken. If the flow rate exceeds $1/4$ gallon per minute (due to joint leakage), the joint will have failed the test.

2. Air Test Procedure:

- a. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
- b. The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the void without leakage past the expanded ends.
- c. Air shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test.

- d. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decays by more than 2 psi within 15 seconds (due to joint leakage), the joint will have failed the test.

3.4 TEST RECORDS

- A. Video tape and written records shall be kept of the joint testing on each manhole section. The records shall include:
 - 1. Identification of the manhole section tested.
 - 2. Location (footage) of each joint tested.
 - 3. The test pressure used.
 - 4. A statement indicating the test results (passed or failed) for each joint tested.
- B. The complete test of each joint shall be recorded from the beginning of the pressure buildup in the void, through the pressure holding period, to the time of pressure release.
- C. A copy of the written records and title to the videotape records shall be given to the Owner prior to payment for Sewer Pipe Joint Testing.

END OF SECTION 330130.13

SECTION 330130.17 - TELEVISION INSPECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 330130.01 - Sewer Collection System Rehabilitation
 - 2. Section 330130.02 - Sewer Line Cleaning
 - 3. Section 330130.03 - Sewer Flow Control

1.2 DESCRIPTION OF WORK

- A. After cleaning or when otherwise specified, the manhole sections shall be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Equipment Data: Submit equipment manufacturer's technical data and operation instructions for the televising and recording equipment to be used.
- B. Product Data: Submit brand name and specifications of video tape to be used for the recording of the televising data.
- C. Report: Submit sample televising log report for review and approval of content and format.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative, and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

2.2 MATERIAL

- A. The video cassette tapes shall be virgin, high-quality name brand stock.
- B. Digital pictures shall be submitted on a virus free DVD or flash drive.

2.3 EQUIPMENT

- A. The television camera used for the inspection shall be one specifically designed and constructed for such closed-circuit sewer pipe inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera shall televise and transmit the image in color and shall have pan and tilt capabilities.
- B. The propulsion system shall be either a tractor, skid and winch arrangement, or with special approval from the Owner, a float.
- C. The recording system shall be VHS with capability for annotating and narrating the video image, and for producing digital photographs of the television picture.

PART 3 - EXECUTION

3.1 PROCEDURE

- A. Normally, the camera will be set up in the upstream manhole. Where the setup causes the camera lens to be positioned a distance upstream or downstream of the manhole wall, the operator shall make a visual observation of that portion of the sewer pipe not captured on the video tape and record the observations by voice over on the video tape.
- B. The height of the camera shall be adjusted so that the lens is at the center of the pipe.
- C. The camera will be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
- D. The camera will be moved to the far manhole and the recording shall show the condition of the manhole trough. The operator shall make a visual observation of the far manhole. Connecting pipes and manhole defects not captured on the video shall be recorded by voice over on the video tape and written in the television inspection log.
- E. Connections to the sewer shall be televised using the pan and tilt capabilities of the camera. The camera shall be positioned in the sewer at a location which maximizes the sight distance up the connecting pipe. The acceptable length of televising shall be a distance of 6 feet, or to the end of the pipe (if capped), or to the first bend (if a wye).

- F. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall perform a reverse setup (set up his equipment so that the inspection can be performed from the opposite manhole). If, again, the camera fails to pass through the entire manhole section, the manhole section will be referred to the Engineer for evaluation.
- G. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.
- H. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be by means of a footage counter with the value displayed on the video tape. The footage counter shall be set such that zero is the center of the beginning manhole. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the footage counter shall be checked above ground by use of a walking meter, roll-a-tape, or other suitable device. The footage counter shall be calibrated to an accuracy that is satisfactory to the Engineer.
- I. Documentation of the television results shall be as follows:
 - 1. Television Inspection Logs: Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features will be recorded and a copy of such records will be supplied to the Owner. Each feature called out on the inspection log shall be identified as to its location on the videotape by means of a footage counter. When more than one manhole section is recorded on a video tape, the television inspection log shall record the elapsed tape time from the beginning of the tape to the beginning of the manhole section.
 - 2. Photographs: Digital photographs of the television picture of problems shall be taken by the Contractor upon request of the Engineer, as long as such photographing does not interfere with the Contractor's operations.
 - 3. Videotape Recordings: The purpose of tape recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Videotape recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Title to the tape shall be given to the Owner upon completion of the project. The Contractor shall have all videotapes and necessary playback equipment readily accessible for review by the Owner during the project.

END OF SECTION 330130.17

SECTION 330130.18 - SEWER LINE TELEVISION AND LATERAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. The Contractor shall perform sufficient tests to determine which house lateral to connect to the new sanitary sewer. For the purpose of this specification, all existing laterals which will be cut by the mainline sewer trench will be called "intercepted laterals". All laterals not cut by the mainline sewer trench will be called "far-side laterals".

1.3 JOB CONDITIONS

- A. In the course of excavation, the Contractor will intercept storm and sanitary laterals.
- B. The Contractor shall determine which laterals are storm and which are sanitary.
- C. The Contractor shall televise the sewers to determine which laterals are storm and which are sanitary.
 - 1. The video shall be narrated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The video shall be on a virus free DVD or flash drive.
- B. The following dye may be used:
 - 1. Fluorescent yellow/green

PART 3 - EXECUTION

3.1 INTERCEPTED LATERALS

- A. During the excavation of the mainline sewer trench, all intercepted storm and sanitary laterals shall be exposed in the mainline sewer trench.

- B. The Contractor shall perform a downspout test at each house, running water in each downspout for a sufficient amount of time to produce a stream of water at one or more of the exposed laterals in the trench.
- C. If the homeowner is on the premises, she or he shall be instructed not to use any water during the testing procedure and the Contractor shall perform a toilet flush test using dyed water to help determine which exposed lateral in the mainline trench is the sanitary lateral.
- D. Based on downspout and toilet flush testing results, a sanitary lateral shall be chosen to the satisfaction of the Engineer and connected to the new sanitary sewer.
- E. Storm laterals shall be reconnected across the mainline sewer trench.

3.2 FAR-SIDE LATERALS

- A. Prior to construction, the Contractor shall simultaneously televise and narrate on VHS video cassette tapes both the storm and sanitary sewers, stopping the camera at every far-side lateral connection. With the camera properly positioned at each lateral connection, a downspout test shall be performed on the house tributary to that lateral connection. The Contractor shall run water in each downspout for a sufficient amount of time to either produce a stream of water flowing from the connection or no water whatsoever.
- B. If the homeowner is on the premises, she or he shall be instructed not to use any water during the testing procedure. Without moving the camera from the lateral connection where the downspout test was just performed, the Contractor shall perform a toilet flush test, using enough water to prove beyond reasonable doubt that the lateral being tested is or is not the sanitary lateral.
- C. Videos shall be examined by the Contractor. The Contractor shall determine which laterals are the sanitary laterals.
- D. During construction, the Contractor shall excavate the far-side treelawn at the location of the sanitary lateral as determined by him from the televising and testing results.
- E. The Contractor shall verify that the excavated lateral is the sanitary lateral by performing a dyed-water toilet flush test if the homeowner is on the premises. If the homeowner is not on the premises, the Contractor shall perform a downspout test while checking the excavated lateral to be assured that no downspout test water is present.
 - 1. If the excavated lateral passes the downspout/toilet flush tests to the satisfaction of the Engineer, the Contractor shall connect the excavated lateral to the new sewer.
- F. If the excavated lateral does not pass the downspout/toilet flush test to the satisfaction of the Engineer, this excavating and testing procedure shall be continued by the Contractor until an excavated lateral passes the downspout/flush tests to the satisfaction of the Engineer. Only at this time can the connection to the new sewer be performed.

G. The Contractor shall reconnect all storm lateral connections across the excavation.

END OF SECTION 330130.18

SECTION 330130.19 - SERVICE CONNECTION TELEVISIONING AND REHABILITATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

Note to Designer: The following Sections must be included in the spec book if this section is used. This paragraph may be deleted from the spec depending on the overall format of the book.

- B. Other Sections Referenced:

1. Section 330130.01 - Sewer Collection System Rehabilitation
2. Section 330130.02 - Sewer Line Cleaning
3. Section 330130.04 - Sewer Point Repairs
4. Section 330130.13 - Sewer Pipe Joint Testing
5. Section 330130.17 - Television Inspection
6. Section 330130.61 - Sewer Pipe Joint Sealing
7. Section 330130.63 - Chemical Sealing Materials

1.2 DESCRIPTION OF WORK

- A. Work includes televising and sealing service connections within the rehabilitation work limits. The pipe shall be sealed by either an internal pipe joint sealing process or lining with cured-in-place pipe. When structurally failed and/or when authorized by the Engineer, service connections shall be replaced under the Sewer Point Repairs section of these specifications.
- B. The service connection may be entered either through the mainline sewer or from a test tee outside the mainline sewer. If a test tee does not exist on the service connection, one will be constructed if authorized by the Engineer.
- C. The remainder of the service connection to and through the house to its terminus may be televised and video recorded, if authorized by the Engineer.
- D. When directed, work shall also include attaching a transmitter to the camera and tracking the location of the service connection on the ground surface.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Submit televising and rehabilitation equipment and product data in accordance with the respective sections of these specifications.

1.5 SERVICE CONNECTION REHABILITATION LIMIT

- A. Length of service connections to be rehabilitated shall be from the mainline sewer to the test tee, right-of-way line, or as authorized by the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The equipment and products used in Service Connection Televising and Rehabilitation shall be similar to the equipment and products used for the respective work in main line sewers. Allowances will be made for modifications necessary to work in the smaller diameter pipes associated with service connections.
- B. Cameras for televising the service connection from the mainline sewer shall be Cues Lateral Inspection System, or an approved equal.
- C. The pipe locating system shall use a transmitter and receiver capable of accurately location the service connection from above ground.

PART 3 - EXECUTION

3.1 GENERAL

- A. The execution of work in Service Connection Televising and Rehabilitation shall be similar to the respective work in main line sewers. Additional requirements are listed as follows.

3.2 HOMEOWNER NOTIFICATION

- A. The Contractor shall notify the homeowner at least 48 hours prior to commencement of any work on the service connection.
- B. The notification shall explain to the homeowner what work is to be done to the service connection, when the work is scheduled to be performed, and what precautions the homeowner must take to prevent backup of sewage into the house.

3.3 SERVICE CONNECTION TELEVISIONING

- A. The service connection televising shall be performed by closed circuit television equipment in accordance with Sewer Line Televising.

The storm service connection also will be televised to the main sewer if it is uncovered during the excavation for the test tee installation.

- B. When televising from the test tee, the service connection shall be cleaned and roots removed in accordance with Sewer Line Cleaning. The cost of this work shall be included in the cost of Service Connection Television Inspection.
- C. When directed to locate the service connection, the pipe locating system shall be used and the location of the service connection at the right-of-way line shall be marked on the surface of the ground and recorded with reference measurements approved by the Engineer.
- D. During service connection televising work, the following information shall be recorded on the video tape. The reference point from which distances are measured shall be approved by the Engineer.
 - 1. Address of the house served by the service connection.
 - 2. Type service connection, whether storm or sanitary.
 - 3. Location of cracked pipe, broken pipe, root intrusion and any other defects in the service connection.
 - 4. Location where the service connection changes size and or material.
 - 5. Location of any branch pipes.
 - 6. Location of any other significant feature observable in the service connection.

3.4 JOINT SEALING

- A. The Contractor shall locate and expose the homeowner's test tee. Where authorized by the Engineer, new test tees will be constructed over the existing service connection.
- B. Sealing via grouting by the pump full methods:
 - 1. Plug the service connection at the test tee and fill it with grout (root inhibitor added) from the mainline sewer.
 - a. Sealing pressure shall be 1/2 PSI per foot of depth plus 2 PSI (Maximum of 10 PSI).
 - b. The gel time shall be adjusted to enable filling the service connection prior to setting.
 - 2. Clean the pipe of all grout material that has set up in the barrel by auguring and jetting with service connection cleaning equipment.
 - 3. Air test service connection connections after the sealing operation. If the service connection fails the air test, it shall be regouted.
 - 4. Post televise the service connection and remove any residual grout.

5. Clean main sewer line after the service connection sealing operation to remove any excess grout sealing material.

C. Grouting by the joint packer method:

1. Insert the packer and television camera and seal each joint from the mainline sewer to the test tee in accordance with Sewer Pipe Joint Sealing.
2. Air test the joint after sealing in accordance with Sewer Pipe Joint Testing.
3. Post televise the service connection and remove any residual grout.
4. Clean the main line sewer after the service connection sealing operation to remove any excess grout sealing material.

3.5 CURED-IN-PLACE PIPE

- A. Any branch pipes on the service connection shall be brought to the attention of the Engineer. An investigation will be made and disposition determined for the branch prior to lining the service connection.
- B. After lining, seal the ends of the CIPP to the host pipe to prevent movement of groundwater along the periphery of the pipe.
- C. Where the liner does not cover the wye or tee joint, the service connection shall be grouted from the main line sewer to the end of the CIPP. This work shall be performed at no extra cost to the Owner.

3.6 RECORDS

- A. During the service connection televising and rehabilitation work, records shall be kept which will include:
 1. Identification of the sewer section containing the service connections.
 2. Location (footage) of each service connection as measured from the upstream manhole.
 3. Address of the building connected to the service connection.
 4. Details of the work performed on the service connection.

3.7 FINAL ACCEPTANCE

- A. After rehabilitation work is completed, the Contractor shall provide the Owner with a videotape showing both the before and after conditions.
- B. Any defects resulting from rehabilitation work which will affect, the intended use, integrity or strength of the service connection shall be repaired, at the Contractor's expense, in a manner mutually agreed by the Owner and the Contractor.
- C. Where CIPP is used for rehabilitation, sufficient portions of the trimmings of each end of the CIPP section shall be marked as to location and given to the Engineer for measurements of thickness and testing of structural properties.

- D. After the installation work has been completed and all testing acceptable, the Contractor shall clean up the entire project area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor.

END OF SECTION 330130.19

SECTION 330130.61 - SEWER PIPE JOINT SEALING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

Note to Designer: The following Sections must be included in the spec book if this section is used. This paragraph may be deleted from the spec depending on the overall format of the book.

- B. Other Sections Referenced:

1. Section 330130.01 - Sewer Collection System Rehabilitation Definions
2. Section 330130.02 - Sewer Line Cleaning
3. Section 330130.03 - Sewer Flow Control
4. Section 330130.13 - Sewer Pipe Joint Testing
5. Section 330130.17 - Television Inspection Section
6. Section 330130.63 - Chemical Sealing Materials

1.2 DESCRIPTION OF WORK

- A. A two-part chemical sealing material will be injected into the pipe joint. The chemicals will react to form a gelatinous material within and on the outside of the pipe. This gel will act as a flexible gasket to seal the joint and prevent groundwater from entering the pipe. An additive will be added to inhibit root growth through the gel material.
- B. It is the intent of the sewer pipe joint sealing work to seal all sewer pipe joints utilizing an internal joint sealing method. It is realized that this method may only be used on sewer pipe sections in sound physical condition. Longitudinally cracked or broken pipe will not be sealed. When bell cracks or chips are evident from pipe section offset, sealing may be undertaken where the offset is small enough to allow proper seating of the sealing packer on both sides of the joint to be sealed.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and application instructions.
- B. Submit Material Safety Data Sheets for the chemicals used in the grout and root inhibitor.
- C. Equipment Data: Submit equipment manufacturer's technical data and operating instructions for the joint packing equipment to be used.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and material shall be of a type that has been in general use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 MATERIAL

- A. Grout: The sealing material shall be formed from a two-part chemical grout that is mixed within the void area formed by the grouting packer. (See Chemical Sealing Materials).
- B. Root Inhibitor: A root inhibitor, such as dichlobenil or approved equal, shall be incorporated into every batch of grout.

2.3 EQUIPMENT

- A. The basic equipment shall consist of a television inspection system, necessary chemical sealant containers, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes.
 - 1. The equipment shall be constructed in such a way as to provide means for introducing the sealing materials, under pressure, into the void area created by the expanded ends of the joint-testing device and means for continuously measuring the actual static pressure of the materials at and within the void area only.
 - 2. Void pressure data shall be transmitted to the televising recording equipment via an electrical pressure transducer located at the void.
 - 3. The recording equipment shall be capable of recording on the video tape the manhole section being tested, the footage from the beginning manhole, and a real-time image of the void pressure.
- B. Sealing equipment shall be housed in a suitable vehicle and arranged to allow for continuous observation of the television monitor and sealing equipment by the Engineer and three (3) other representatives of the Owner.

- C. The packer shall be cylindrical and have a diameter less than the pipe size and have cables attached at each end to pull it through the line. The packer device shall be constructed in a manner to allow a restricted amount of sewage to flow. Generally, the equipment shall be capable of performing the specified operations in lines where flows do not exceed the maximum line flows for joint testing/sealing (see Sewer Flow Control).
- D. The pumping unit, metering equipment, and the packer device shall be designed so that the proportions and quantities of materials can be regulated in accordance with the type and size of the leak being sealed.
- E. The equipment shall be manufactured of materials suitable for the addition of the root inhibitor.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Prior to sealing a section of sewer, the pipe shall be cleaned and the flow controlled to enable a suitable depth for the sealing equipment (see Sewer Line Cleaning and Sewer Flow Control). The cost of this work shall be considered incidental to Sewer Pipe Joint Sealing and included in the price bid thereof.
- B. Root inhibitor shall be stored on the vehicle in unit doses (one dose per each batch of sealing material). Prior to starting the project, root inhibitor shall be transferred from bulk containers to individual containers. Bulk containers shall not be stored on the vehicle. Each dose shall be contained in a sealed container which shall not be opened until just prior to its inclusion in the batch.

3.2 JOINT SEALING PROCEDURE

- A. All joints, leaks or breaks shall be sealed. Sealing shall be accomplished by forcing the chemical sealing materials into or through joints, leaks or breaks by a system of pumps, hoses, and sealing packers.
- B. Jetting or driving pipes from the surface that could damage or cause undermining of the pipe lines shall not be allowed. Uncovering the pipe by excavation of pavement and soil (which would disrupt traffic, undermine adjacent utilities and structures, and cause further damage to the pipe lines being repaired) shall not be allowed.
- C. The packer shall be positioned over each joint, leak or break by means of a closed-circuit television camera in the line. It is important that the procedure used by the Contractor for positioning the packer be accurate to avoid over pulling the packer and thus not effectively sealing (grouting) the intended defect.
- D. The packer ends (end elements, sleeves) shall be expanded using controlled pressure. The expanded ends shall seal against the inside periphery of the pipe to form a void area at the joint, now completely isolated from the remainder of the pipe line.

- E. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures which are in excess of groundwater pressures.

3.3 SEAL VERIFICATION

- A. Upon completion of the sealing of each individual joint, leak or break, the packer shall be deflated until the void pressure meter reads zero pressure, then reinflated and the joint retested as specified (see Sewer Pipe Joint Testing). The cost of this testing shall be included in the cost of Sewer Pipe Joint Sealing.
- B. Should the void pressure meter not read zero, the Contractor shall clean his equipment of residual grout material or make the necessary equipment repairs/adjustments to produce accurate void pressure readings.
- C. Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met in order to receive payment.

3.4 RESIDUAL SEALING MATERIAL

- A. Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably "flush" with the existing pipe surface.
- B. If excessive residual sealing materials accumulate in the line and/or if directed by the Engineer the manhole section shall be cleaned to remove the residual materials. In no case shall excess grout material be flushed down the sewer.

3.5 RECORDS

- A. Videotape records shall be kept of the joint sealing performed in each manhole section. The following information shall be recorded on the videotape:
 - 1. Identification of the manhole section sealed.
 - 2. The footage location of each joint sealed, measured from the upstream manhole.
 - 3. Void pressure continuously recorded throughout the joint sealing procedure.
 - 4. Number of gallons of sealant used.
 - 5. A verbal statement indicating the sealing results (passed or failed) for each joint sealed.
 - 6. If a joint is not grouted, a verbal statement indicating the reasons for not sealing the joint.
- B. Written records also shall be kept of joint sealing performed in each manhole section. Written records shall include:
 - 1. Identification of the manhole section sealed.
 - 2. The footage location of each joint sealed, measured from the upstream manhole.
 - 3. Sealing pressure at refusal.
 - 4. Number of gallons of sealant used.

5. A statement indicating the sealing results (passed or failed) for each joint sealed.
- C. The complete sealing of each joint, leak or break shall be recorded on the video tape from the beginning of the pressure buildup in the void, through the pressure holding period, to the time of pressure release.
- D. A copy of the written records and title to the videotape records shall be given to the Owner prior to payment for Sewer Pipe Joint sealing.

3.6 GUARANTY

- A. All sewer pipe joint sealing work performed shall be guaranteed against faulty workmanship and/or materials for a period of one year after the completion of the work.
 1. Prior to the expiration of the guaranty period, an initial retest area consisting of specific manhole sections shall be selected by the Engineer/Owner. Manhole sections to be retested shall be randomly selected throughout the project area and shall be representative of the majority of the sealing work originally performed. The initial test area shall consist of at least 5%, but not exceed 10%, of the linear feet contained in the original project.
 2. Within the initial retest area, the Contractor shall retest all previously sealed joints as specified (see Sewer Pipe Joint Testing). Any joints failing the retest shall be resealed. If the failure rate of the retested joints is less than 1% of the joints retested, the work shall be considered satisfactory and no further retesting will be required. Payment for retesting the initial area shall be at the unit price bid for each item of work required (e.g.: cleaning, TV inspection, testing, etc.). No compensation shall be provided for resealing (grouting) joints that fail.
 3. If, in the initial retest area, the failure rate of the retested joints exceeds 1% of the joints retested, an additional retest area of equivalent size shall be selected and all previously sealed joints shall be retested. This additional testing and sealing, if necessary, will continue until a failure rate of less than 1% is met. Any additional testing/sealing required beyond the initial retest area shall be accomplished at no cost to the Owner.
 4. Should as much as 25% of the original project be retested and fail to meet the 1% requirement, the Contractor will be required to provide the same number of crews as utilized in the original project so that the retesting will proceed at a more rapid rate.

END OF SECTION 330130.61

SECTION 330130.62 - SEWER MANHOLE SEALING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. It is the intent to provide for the elimination of extraneous water leakage into manholes that are otherwise structurally sound. No sealing will be attempted in manholes where the leakage is unconfined such as in brick manholes or where the structural integrity of the manhole has been lost. All manhole sealing shall be done during high groundwater conditions, unless the points of leakage have been previously identified.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and application instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The basic equipment shall consist of chemical pumps, chemical containers, injection packers, hoses, valves, and all necessary equipment and tools required to seal manholes. The chemical injection pumps shall be equipped with pressure meters that will provide for monitoring pressure during the injection of the chemical sealants. When necessary, fluid bypass lines equipped with pressure-regulated bypass valves will be incorporated into the pumping system.

PART 3 - EXECUTION

3.1 MANHOLE SEALING PROCEDURES

- A. At each point of leakage within the manhole structure a hole shall be carefully drilled from within the manhole and shall extend through the entire manhole wall. In cases where there are multiple leaks around the circumference of the manhole, fewer holes may be drilled - providing all leakage is stopped from these holes. Into the previously drilled holes, chemical sealant injection devices shall be placed in such a way that they will provide a watertight seal between the holes and the injection device. A hose, or hoses, shall be attached to the injection device from an injection pump. Chemical sealing materials as specified (see Chemical Sealing Materials) shall then be pumped through the hose until material refusal is recorded on the pressure gage mounted on the pumping unit or a predetermined quantity of sealant has been injected. Care shall be taken during the pumping operation to insure that excessive pressures do not develop and cause damage to the manhole structure. Upon completion of the injection, the packers shall be removed and the remaining holes filled with mortar and troweled flush with the surface of the manhole walls or other surfaces. The mortar used shall be of the "fast-set" type with "nonshrinking" characteristics.
- B. Final Acceptance: After the manhole sealing operation has been completed, the manhole shall be visually inspected for the elimination of excessive infiltration by the Contractor in the presence of the Engineer and the work shall be found satisfactory to the Engineer. In addition, at the Owner's request, the Contractor may be required within one year to visually inspect the manholes that were sealed. Any sealing work that has become defective shall be resealed by the Contractor at no additional expense to the Owner.

3.2 MEASUREMENTS FOR PAYMENTS

- A. All measurements shall be as specified or made by conventional means with accuracies consistent with field conditions and common practice. Should a discrepancy in measurement exist which is greater than 10%, the item in question shall be remeasured by both the Contractor and the Engineer for verification.
- B. Measurements for payments shall be based on the following:
 - 1. Sewer Manhole Sealing, including all materials, shall be paid for at the unit price bid per manhole. Measurement shall be based on the actual number of manholes sealed in the various categories.

END OF SECTION 330130.62

SECTION 330130.63 - CHEMICAL SEALING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 330130.61 - Sewer Pipe Joint Sealing

1.2 DESCRIPTION OF WORK

- A. The intent of this section is to define the properties that a sealing material must have to perform effectively in the intended application and under expected field conditions.
- B. Generic chemical sealing materials currently in use are listed with the basic properties, performance standards, and mix ratios which are known to give acceptable performance.
- C. It is recognized that new and improved chemical sealing materials will become available from time to time. Sources, manufacturers, and product names of chemical sealing materials will thus change from time to time and therefore specific sources, manufacturers, and product names are not referred to in this specification.
- D. It should be understood that all of the generically classified chemical sealing materials can achieve desired long-lasting results when used in the proper application and properly applied. The knowledge and skill of the applicator has a greater effect on achieving the desired results than the specific sealing material applied.
- E. In every case, mixing and handling of chemical sealing materials shall be in strict accordance with the manufacturer's recommendations.

1.3 QUALITY ASSURANCE

- A. All chemical sealing materials used in the performance of the work specified must have the following properties and characteristics:
 - 1. While being injected, the chemical sealant must be able to react/perform in the presence of water.
 - 2. The cured material must be capable of withstanding submergence in water without degradation.
 - 3. The resultant sealant formation must prevent the passage of water.
 - 4. The sealant material, after curing, must be flexible as opposed to brittle or rigid.
 - 5. In place, the resultant sealant formation should be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.

6. The sealant formation must not be biodegradable. Additives may be used to meet this requirement.
7. The cured sealant should be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage.
8. Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.
9. Mixing of component materials must be compatible with field operations and not require precise measurements.
10. Clean-up must be done without inordinate use of flammable or hazardous chemicals.
11. Residual sealing materials must be removable from the sewer after injection to insure no flow reduction, restriction, or blockage of normal sewage flows.

PART 2 - PRODUCTS

2.1 CHEMICAL SEALING MATERIALS

- A. The following is a generic listing of chemical sealing materials currently in use and the basic requirements, properties and characteristics of each:

1. Acrylamide base gel chemical sealing material requirements, properties and characteristics:
 - a. A minimum of ten percent (10%) acrylamide base material by weight in the total sealant mix. A higher concentration of acrylamide base material may be used, when desirable, to increase strength or offset dilution during the induction period.
 - b. The ability to tolerate some dilution and react in moving water during the induction period.
 - c. A viscosity of approximately two (2) centipoise which can be increased with additives.
 - d. A constant viscosity during the induction period.
 - e. A controllable reaction time (induction period) from ten (10) seconds to one (1) hour.
 - f. A reaction (curing) which produces a homogeneous, chemically stable, nonbiodegradable, firm, flexible gel.
 - g. The ability to increase mix viscosity, density and gel strength by the use of additives, e.g.: diatomaceous earth.
2. Urethane base foam chemical sealing material requirements, properties and characteristics:
 - a. Approximately one (1) part of urethane prepolymer thoroughly mixed with one (1) part of water by weight (50% prepolymer).
 - b. A liquid prepolymer having a solids content of eighty-two percent (82%) to eighty-eight (88%), specific gravity of 1.1 (9.15 pounds per gallon), and flash point of 20°F.

- c. A liquid prepolymer having a viscosity of 300 to 500 centipoise at 72°F that can be pumped through 500 feet of one-half (1/2) inch hose with a 500 psi head at a one (1) ounce/second flow rate.
 - d. A cure time of 15.0 minutes at 40°F, 8.2 minutes at 70°F, and 4.6 minutes at 100°F when the prepolymer is reacted with water only.
 - e. A cure time of 5.5 minutes at 40°F, 3.5 minutes at 70°F, and 2.6 minutes at 100°F when the prepolymer is reacted with water containing 0.4% accelerator.
 - f. During injection; foaming, expansion, and viscosity increase take place.
 - g. Physical properties of the cured foam of approximately; fourteen (14) pounds per cubic foot density, 80 to 90 psi tensile strength, and 700% to 800% elongation when a mixture of fifty percent (50%) prepolymer and fifty percent (50%) water undergoes a confined expansion to five times its initial liquid volume.
3. Urethane base gel chemical sealing material requirements, properties and characteristics:
- a. One (1) part prepolymer thoroughly mixed with between five (5) and ten (10) parts of water by weight. The recommended mix ratio is one (1) part urethane prepolymer to eight (8) parts of water (11% prepolymer).
 - b. A liquid prepolymer having a solids content of seventy-seven percent (77%) to eighty-three percent (83%), specific gravity of 1.04 (8.65 pounds per gallon), and flash point of 20°F.
 - c. A liquid prepolymer having a viscosity of 600 to 1200 centipoise at 70°F that can be pumped through 500 feet of one-half (1/2) inch hose with a 1000 psi head at a one (1) ounce/second flow rate.
 - d. The water used to react the prepolymer should be in the pH range of five (5) to nine (9).
 - e. A cure time of eighty (80) seconds at 40°F, fifty-five (55) seconds at 60°F, and thirty (30) seconds at 80°F when one (1) part prepolymer is reacted with eight (8) parts of water only. Higher water ratios give longer cure times.
 - f. A cure time that can be reduced five (5) to ten (10) seconds for water temperatures of 40°F to 80°F when one (1) part prepolymer is reacted with eight (8) parts of water containing gel control agent.
 - g. A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about ten (10) to sixty (60) centipoise in the first minute for one (1) to eight (8) prepolymer to water ratio at 50°F.
 - h. A reaction (curing) which produces a chemically stable, nonbiodegradable, tough, flexible gel.
 - i. The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by the use of additives to the water.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 330130.63

SECTION 330130.72 - CURED-IN-PLACE PIPE LINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 330130.01 - Sewer Collection System Rehabilitation
 - 2. Section 330130.02 - Sewer Line Cleaning
 - 3. Section 330130.03 - Sewer Flow Control
 - 4. Section 330130.17 - Television Inspection
 - 5. Section 330130.04 - Sewer Point Repairs
- C. Other documents which shall be considered part of and included in these specifications
 - 1. ASTM D 543 - Test Method of Resistance of Plastics to Chemical Reagents
 - 2. ASTM D 638 - Test Method for Tensile Properties of Plastics
 - 3. ASTM D 790 - Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 4. ASTM E 132 - Test Method for Poisson's Ratio at Room Temperature
 - 5. ASTM F1216 - Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 - 6. ASTM F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

1.2 DESCRIPTION OF WORK

- A. The intent of cured-in-place pipe (CIPP) is to rehabilitate sewer lines by installing a flexible polyester felt tube saturated with a thermosetting resin into the existing pipe. When cured and complete, the installed pipe should extend the full length of the pipe section being rehabilitated and shall provide a structurally sound, continuous, tight-fitting, watertight pipe within a pipe. Deficiencies which will be corrected by the finished product include:
 - 1. Cracked and broken pipe caused by poor construction, unstable soil, earth movement, infiltration, roots, destructive loadings, cleaning tool damage, etc.
 - 2. Corrosion of pipe caused by acid attack above the flow line.
 - 3. Erosion of pipe caused by abrasion below the flow level.
 - 4. Degradation of brick pipe caused by loss of masonry.
 - 5. Infiltration of groundwater and soil through leaking pipe joints and structural defects.
 - 6. Exfiltration of transported fluid through leaking pipe joints and structural defects.

7. Inflow of surface water and infiltration of groundwater through unused or illegal connections.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.
- B. Installer's Qualifications: Firms with at least 5 successfully completed projects having installed an aggregate total of 10,000 linear feet of the submitted manufacturer's cured-in-place liner.

1.4 SUBMITTALS

- A. Submit the latest edition and any revisions thereto of the manufacturer's technical data and installation instructions.
- B. Submit Material Safety Data Sheet(s) for the resins, any other chemical additives, and any other chemicals used in the CIPP system.
- C. Submit certified copies of all test reports on the properties of the proposed resin materials prior to their use. Tests shall be performed by an approved independent testing laboratory or other approved source.
- D. Submit design calculations for the CIPP material thickness for each section of the pipe to be rehabilitated.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and material shall be of a type that has been generally been in use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.
- B. Products acceptable for cured-in-place pipe.
 1. Eco-Liner Epoxy/Felt
 2. Inliner
 3. Insituform
 4. Masterliner
 5. National Liner
 6. Spinello Liner

2.2 MATERIALS

- A. All materials used in the installation of CIPP shall be equal to or exceed the manufacturer's standards.
1. Resin: The thermosetting resin shall be specifically blended for use with the CIPP process.
 2. Tubing: The felt tubing shall be fabricated from material and suitable mechanical strengtheners as recommended by the manufacturer for each specific installation. The tubing shall be properly sized to the actual diameter of the sewer pipe and to the length of the sewer section to be rehabilitated. The Contractor shall be responsible for sizing the liner through field verification of the actual pipe diameter and length. The uncured tubing shall be designed to withstand the insertion stresses, and to be able to negotiate pipe joint offsets, gaps, and angular changes up to and including forty-five degrees (45°).
 3. The nominal specified thickness for each pipe section shall be designated in the Proposal section or Specific Project Requirements section of the specifications or as shown on the plans. The cured material thickness tolerance shall be plus or minus twenty-five percent ($\pm 25\%$) of the specified thickness. The thickness of any inner and/or outer membrane shall not be included.
 4. Where specific thicknesses are not provided the following values shall be used to calculate a minimum value.
 - a. All pipe shall be considered fully deteriorated.
 - b. All pipe shall be subjected to soil loads of 120 pounds per cubic foot.
 - c. All pipe shall be subject to AASHTO HS-20 highway loading.
 - d. The water table shall be assumed to be five (5) feet below the ground surface.
 - e. All pipe shall be assumed to have five percent (5%) ovality.
 5. The cured pipe material shall conform to the minimum structural standards as listed below. Evidence shall be presented to demonstrate that the long-term modulus of elasticity of the cured product is no less than fifty percent (50%) of the herein specified Modulus of Elasticity (Short-term).

<u>Cured Pipe Material Test</u>	<u>Test Method</u>	<u>Minimum Value</u>
a. Chemical Resistance	ASTM D 543	< allowed loss
b. Tensile Strength	ASTM D 638	3,000 psi
c. Flexural Strength	ASTM D 790	4,500 psi
d. Flexural Modulus of Elasticity	ASTM D 790	250,000 psi
e. Poisson's Ratio	ASTM E 132	0.3

6. Any material failing to meet any of the structural standards of this specification may be rejected or may be cause for changing the material thickness if approved by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATORY PROCEDURES

- A. The Contractor shall notify all homeowners on the manhole section to be lined forty-eight (48) hours in advance of the work to be done. The Contractor shall inform the homeowner of precautions necessary to prevent backup of sewage into the house. Notification shall include language that the work may extend beyond normal permitted working hours, if necessary to reinstate service laterals.
- B. The following preparatory procedures shall be adhered to unless otherwise approved by the Engineer:
 1. Cleaning of Sewer Line: Prior to any pipe installation in a designated section of sewer, the Contractor shall clean the sewer line as specified under Sewer Line Cleaning.
 2. Inspection of Sewer Line: In accordance with the Television Inspection requirements, the Contractor shall televise the pipe with experienced personnel specially trained in locating breaks, obstacles, and service connections. The interior of the sewer line shall be carefully inspected to determine the location and extent of any structural failures. The location of any conditions which may prevent proper installation of the CIPP shall be noted so that such conditions can be corrected.
 3. Connections: While televising the mainline sewer, the Contractor shall accurately measure and record the locations and positions of service connections using a fiberglass or other tape approved by the Engineer. Additionally, the Contractor shall utilize the pan and tilt capabilities of the televising equipment to determine which connections are live (active) and which are not in use.
 4. Bypassing Sewage: The Contractor shall bypass the sewage around the section or sections of sewer line that are to be rehabilitated. The bypass shall be made by plugging an existing upstream manhole and pumping the sewage into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. All bypassing of flow shall be performed as specified under Sewer Flow Control.

5. Line Obstructions: It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, protruding service connections, or collapsed pipe that will prevent installation. If the obstruction(s) could have been removed by bucket machines or by using conventional cleaning methods, no compensation will be granted.
 - a. Internal repairs are protruding service connections, dropped portions of pipe which can be removed or pushed back in place, and other obstructions which can not be cleared using conventional cleaning methods, but which can be cleared from within the pipe. Such internal repairs shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a pay item.
 - b. Point repairs are obstructions that cannot be removed by either conventional sewer cleaning equipment or by internal equipment. The Contractor shall make an excavation to expose and remove or repair the obstruction. Such excavation shall be approved in writing by the Engineer prior to the commencement of the work, shall be performed as specified under Point Repairs, and shall be considered as a pay item.
6. Pre-Insertion Television Inspection: The Contractor shall televise and record the sewer pipe immediately before installing CIPP. This televising is to assure that the pipe is clean and existing pipe conditions are acceptable for lining. Should additional cleaning be required, it shall be provided at no additional cost to the Owner. The cost of this televising shall be included in the cost of CIPP.

3.2 INSTALLATION PROCEDURES

- A. General: The Contractor shall designate a location where the uncured resin in original containers and the fiber felt tube will be impregnated prior to installation. The Contractor shall provide for the Owner's inspection of the materials and impregnation procedure. A resin/catalyst system compatible with the requirements of this method shall be used. The quantities of the liquid thermosetting material shall be sufficient to provide the thickness specified herein. When a proprietary lining technique is used and the licensor's procedures for proper installation differ from these specifications, the licensor's procedures shall govern.
- B. Handling: The Contractor shall exercise care during transportation, storage and handling of the liner system to ensure that it will not be torn, cut, or otherwise damaged. The tube shall be impregnated with resin not more than twenty-four (24) hours before the proposed time of installation. Prior to insertion, the tube shall be stored and transported to the site in a refrigerated truck. The insertion shall take place no later than thirty (30) minutes after the catalyst is placed into the resin mix.
- C. Insertion: The impregnated fiber felt tube shall be inserted through an existing manhole, through the pipe to be rehabilitated, to the designated rehabilitation location. The tube shall be inserted in accordance with the manufacturer's instructions.
- D. Inflation: The inflation/expansion pressure shall be sufficient to hold it tight to the pipe wall, to produce dimples at side connections and flared ends at manhole walls. Care shall be taken

not to over stress the felt tube at the elevated curing temperatures, which may cause damage or failure prior to cure.

- E. Curing: After insertion and inflation/expansion is completed, the Contractor shall supply a suitable heat source. The equipment shall be capable of delivering heat throughout the section to raise the curing medium temperature above the recommended minimum value. This minimum temperature shall be determined by the resin/catalyst system employed. The temperature shall be maintained within the manufacturer's recommended limits for the duration of the cure period. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the installation process.
- F. Cool down: The Contractor shall cool the hardened pipe to a temperature below 100°F before relieving the pressure in the liner. Care shall be taken in the release of the pressure so that a vacuum will not be developed that could damage the newly installed pipe.
- G. Sealing Pipe Ends: The Contractor shall seal both ends of the CIPP in accordance with the manufacturer's recommendations for the field conditions. If, due to broken or misaligned sewer pipe at manhole walls, the installed pipe fails to make a tight seal, the Contractor shall apply a sealant at that point. The sealant shall be of a resin mixture compatible with that used in the CIPP process. The end shall be sealed for a distance of at least (1) pipe diameter inside the host pipe.
- H. Testing: After the installation procedures have been performed and curing is complete, but before any service connections are reinstated, the Contractor shall conduct a leakage test on the sewer line to determine if it is watertight.
 - 1. For water cured liners, the test shall be conducted by using the existing hydrostatic head provided by the standpipe. The test time shall be fifteen (15) minutes, during which time no makeup water shall be added to the standpipe. If at the end of the test period, no significant water loss is observed in the standpipe, the watertightness of the cured-in-place pipe will be considered satisfactory.
 - 2. For air or steam cured liners, the test shall be conducted by removing the bladder and plugging both ends of the cured pipe. The pipe shall then be pressurized with air to a test pressure of one-half (1/2) psi per vertical foot of pipe depth (not exceeding a test pressure of ten (10) psi). The air flow shall be stopped. If the required pressure can be developed and if the pressure decays by less than one (1) psi within four (4) minutes, the watertightness of the liner pipe will be considered satisfactory.
- I. Service Connection Reinstatement: After testing, the Contractor shall reinstate the existing live service connections. This shall generally be done without excavation, from the interior of the pipe by means of a television camera and a remotely controlled cutting device. The work shall be performed by experienced operators so that no blind holes are made in the CIPP. The openings of the existing live service connections shall be cut to not less than ninety percent (90%) of their original size. All cuts shall be free of burrs, frayed edges, or any restriction preventing free flow of the sewage. Excessive cuts, wrong holes, or trial cuts shall not be made and must be repaired at no cost to the Owner to the full satisfaction of the Engineer.

3.3 FINAL ACCEPTANCE

- A. Finish: The finished pipe shall be continuous over the entire length of sewer run between two manholes and be free from significant defects.
 - 1. Any defects which will affect, the intended use, integrity or strength of the pipe shall be repaired, at the Contractor's expense, in a manner mutually agreed by the Owner and the Contractor.
- B. Inspection: After the work is completed, the Contractor shall provide the Owner with a videotape showing both the before and after conditions, including the reinstated service connections.
- C. Testing: Sufficient portions of the trimmings of each end of a CIPP section shall be marked as to location and given to the Engineer for measurements of thickness and testing of structural properties.
- D. Cleanup: After the installation work has been completed and all testing acceptable, the Contractor shall clean up the entire project area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor.
- E. Warranty: During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the Contractor's expense in a manner mutually agreed by the Owner and the Contractor.

END OF SECTION 330130.73

SECTION 330130.74 – CIPP CONNECTION WITH LATERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 330130.01 – Sewer Collection System Rehabilitation
 - 2. Section 330130.02 – Sewer Line Cleaning
 - 3. Section 330130.03 – Sewer Flow Control
 - 4. Section 330130.17 – Television Inspection
- C. Other documents which should be considered part of and include in these specifications
 - 1. ASTM F-2561 Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One-Piece Main and Lateral Cured-In-Place Liner.
 - 2. ASTM D-790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 3. ASTM D-792 Standard Test Methods for Density and Specific Gravity of Plastics by Displacement.
 - 4. ASTM D-2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
 - 5. MD5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe.

1.2 DESCRIPTION OF WORK

- A. This specification covers material requirements, installation practices, and test methods for the reconstruction of a sewer service lateral pipe and the main connection without excavation. The lateral pipe is renovated remotely from the main pipe to a sewer cleanout located within the public right of way. The pipe renovation shall be accomplished by the inversion and inflation of a resin impregnated, single-piece lateral and main connection liner assembly. The liner assembly is pressed against the lined main pipe by inflation of a bladder and held under pressure until the thermo-set resin has cured. When cured, the liner shall extend over a predetermined length of the service lateral and the full circumference of the main pipe connection forming a continuous, single-piece, tight fitting, corrosion resistant and verifiable non-leaking cured in-place pipe (CIPP) inclusive with gasket seals. The Materials and Installation practices shall adhere to the minimum requirements of ASTM F2561-11 “Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-in Place Liner.”

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Submit the latest edition and any revisions thereto of the manufacturer's technical data and installation instructions.
- B. Submit Material Safety Data Sheet(s) for the resins, any other chemical additives, and any other chemicals used in the CIPP system.
- C. Submit certified copies of all test reports on the properties of the proposed resin materials prior to their use. Tests shall be performed by an approved independent testing laboratory or other approved source.
- D. Submit design calculations for the CIPP material thickness for each section of the pipe to be rehabilitated.

1.5 QUALIFIED BIDDER

- A. 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 and the Manufactured System shall have performed a minimum of 10,000 successful installations during this time period in the U.S., including 300,000 feet of lateral lining. 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 GENERAL

- A. All equipment and material shall be of a type that has been generally been in use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.
- B. The reconstruction shall be accomplished using a non-woven textile tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The lateral tube located within a translucent inversion bladder is vacuum impregnated with the synthetic resin and is then placed inside of a protective carrying device. The mainline portion of the liner is physically attached to the lateral portion and is affixed around a rigid "T" launching device. The protective "T" launching device is winched into the existing sewer. When the "T" launching device is properly positioned at the lateral connection, the mainline bladder is inflated by pressurized air that presses the main liner against the host pipe. The lateral portion is then inverted up through the lateral service line by the action of the inversion bladder. Once the resin-saturated liner is cured, the inversion bladder and launching/carrying devices are removed.

2.2 MATERIAL

- A. **Liner Assembly** - 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 braided tubes that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. No intermediate or encapsulated elastomeric layers shall be in the textile that may cause de-lamination in the cured in-place pipe. 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. **Mainline Liner Tube** - 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 interior of the textile sheet shall be laminated with an impermeable, translucent flexible membrane. The textile sheet before insertion shall be permanently marked on the membrane as a "Lateral Identification" correlating to the address of the building the lateral pipe provides service.
- C. **Lateral Liner Tube** - The exterior of the lateral liner tube shall be laminated with an impermeable, translucent flexible membrane. Longitudinal seams in the tube shall be stitched and thermally sealed. 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, disfigured pipe sections and pipe diameter transitions up to 20% of the connection diameter.
- D. **Mainline Connection** - The main tube and lateral tube shall be formed as a one-piece assembly by stitching the lateral tube to the main sheet aperture. The connecting end of the lateral tube shall be shaped to match the aperture and curvature of the main tube. The lateral tube and main tube are connected by stitching and sealing the stitching using a flexible UV cured adhesive/sealant. The main and lateral tubes are assembled in the shape of a "T" or WYE with corresponding dimensions. Submittals for the liner assembly must include the manufacturers test protocol and tests data that certifies the connection between the liner tubes is leak-free, when subjected to a controlled vacuum leak test.
- E. **Gasket Seals** - The mainline connection shall include a seamless molded flange shaped end seal gasket attached to the main liner tube by use of stainless steel snaps. The lateral tube shall include an O-ring gasket attached six-inches from the upstream terminating end of the lateral tube.
- F. **End Seal Test Data** - The hydrophilic gaskets must include test data that reports substantial water-tightness at the terminating ends of a CIPP when subjected to hydrostatic loading that simulates subterranean conditions. Gasket seal submittals must include tests data simulating hydration/ dehydration conditions for a period of 10,000-hours and the test results must successfully demonstrate and document long-term performance without deterioration, loss of material, flexibility, and expansion of the gasket during repeated cycles of hydration and dehydration.

- G. Bladder Assembly - The liner assembly shall be surrounded by a second impermeable, inflatable, 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.

2.3 RESIN SYSTEM

- 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, vinyl ester, 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)

2.4 DESIGN CONSIDERATIONS

- A. The CIPP shall be designed per ASTM F1216, Appendix X1.
- B. The CIPP design for the lateral tube shall assume no bonding to the original pipe.
- C. Roughness Coefficient the liner must be smooth and have an average “n” factor of 0.013 or lower.

PART 1 - EXECUTION

3.1 INSTALLATION RECOMMENDATIONS

- 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 02751CT and 02753CT.
- C. Accessing the Lateral – The lateral pipe shall be remotely accessed from the main pipe for purposes of cleaning, pre-inspection, liner insertion and post inspection.

- 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. Where a partial obstruction is caused by the lateral pipe being cocked at the wye connection and protruding into the wye, the protruding portion of the lateral pipe shall be trimmed to provide a clear passage of at least 80% of the inside pipe diameter.

- G. Resin Impregnation – The liner assembly is encapsulated within the translucent bladder (liner/bladder assembly) shall be saturated with the resin system (wet-out) under controlled vacuum 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 a “T” launching device, and held firmly by pacing 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 remotely positioned by use of sewer cameras to be 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

distance of three (3) feet. The main/lateral bladder assembly shall extend past all ends of the liner, as no cutting and trimming shall be required.

3.2 CIPP PROCESSING

- A. Curing – After the liner has been fully deployed into the lateral pipe, pressure is maintained pressing the liner firmly against the inner pipe wall until the liner is 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 a uniform 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.
- B. 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. The curing process is complete when the temperature of the CIPP reaches 100 degrees Fahrenheit or less, the processing shall be finished.

3.3 FINISH

- A. The finished CIPP – CIPP Shall be a homogenous liner assembly located within a lateral service pipe for a specific length, and extending into the main pipe to renew 16-inches of the main pipe (5" on either side of a 6" lateral or 6" on either side of a 4" 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 include an engineered taper at each end providing a smooth transition to the host pipe for accommodating video equipment and maintaining proper flow in the mainline. After the work is completed, the installer will provide 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 INSPECTION AND TESTING PRACTICES

- A. Sampling – It is required by the Owner, that Contractor shall prepare a CIPP sample. 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 Owner and Contractor.
- G. Gravity Pipe Leakage Testing – It is required by the Owner that Contractor shall test five percent (5%) of the sealed connections. Contractor shall use 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. 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.

3.5 WARRANTY

- A. All CIPP liners shall be certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for ten (10) years from the date of acceptance. The Contractor guarantees the work to be free from defects caused by faulty workmanship and/or materials for a period of ten (10) Years. During the warranty period, any defects which affect the integrity, strength or water tightness of the pipe shall be repaired at the Contractor's expense.
- B. The Contractor shall carry Professional Liability Coverage and provide proof of insurance during the term of the contract.

END OF SECTION

SECTION 330130.81 - SEWER MANHOLE REHABILITATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Other Sections Referenced:
 - 1. Section 329200.19 - Seeding and Mulching
- C. Other documents which shall be considered part of and included in these specifications
 - 1. ASTM A 48 - Specification for Gray Iron Castings.
 - 2. ASTM A 240 - Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - 3. ASTM A 536 - Specification for Ductile Iron Castings.
 - 4. ASTM C 32 - Specification for Sewer and Manhole Brick (Made from Clay or Shale).
 - 5. ASTM C 78 - Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
 - 6. ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
 - 7. ASTM C 270 - Specification for Mortar for Unit Masonry.
 - 8. ASTM C 321 - Test Method for Bond Strength of Chemical-Resistant Mortars.
 - 9. ASTM C 478 - Specification for Precast Reinforced Concrete Manhole Sections.
 - 10. ASTM C 496 - Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - 11. ASTM C 579 - Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing.
 - 12. ASTM C 596 - Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
 - 13. ASTM C 923 - Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 - 14. ASTM D 638 - Test Method for Tensile Properties of Plastics.
 - 15. ASTM D 695 - Test Method for Compressive Properties of Rigid Plastics.
 - 16. ASTM D 790 - Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 17. ASTM D2566 - Test Method for Linear Shrinkage of Cured Thermosetting Casting Resins During Cure.

1.2 DESCRIPTION OF WORK

- A. Sewer manhole rehabilitation will repair deteriorated manholes and remove infiltration leaking into the sewer system. The work includes one or more of the following items.
 - 1. Replacement of manhole frames and lids.
 - 2. Replacement of manhole lids with self sealing lids.
 - 3. Installation of inflow protectors under manhole lids with holes.
 - 4. Installation of internal or external chimney seals to provide a seal between the manhole frame and adjusting rings, bricks or cone section.
 - 5. Reconstruction of manhole chimney.
 - 6. Installation of internal manhole joint seal on precast concrete manholes with leaking joints.
 - 7. Replacement/installation of manhole steps.
 - 8. Plugging or bulkheading of inflow or overflow pipe.
 - 9. Structural rehabilitation of manhole bases and walls.
 - 10. Sealing of manhole walls, bases, and pipe connections.
- B. The manholes requiring rehabilitation work are listed in tabular form in the Schedule of Work and/or Detailed Drawings section of the specifications. The form will identify and locate the manholes to be rehabilitated and the type of rehabilitation required for each manhole.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and application and installation instructions for each proposed product.
- B. Measurements: Submit a sufficiently detailed list of measurements necessary for each rehabilitation product being used on the project.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and material shall be of a type that has been generally been in use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 MANHOLE FRAMES AND LIDS

- A. Manhole frames and lids shall comply with the type specified in the Schedule of Work and Detailed Drawings.

1. Ferrous castings shall be of uniform quality free from blowholes, shrinkage or other defects.
 2. Metal shall conform to ASTM A 48, Class 35 for gray iron or ASTM A 536, Grade 65-45-12 for ductile iron.
 3. Castings shall be smooth and well cleaned by shotblasting.
 4. Castings shall be manufactured true to pattern.
- B. Round frames and lids shall have continuously machined bearing surfaces to prevent rocking and rattling.

2.3 SELF-SEALING MANHOLE LID

- A. Self-sealing manhole lids shall comply with the type specified in the Schedule of Work and Detailed Drawings.
1. Material shall comply with the requirements listed for Manhole Frames and Lids.
- B. Sealing shall be accomplished by the insertion of a manufacturer's recommended gasket into a machined dovetail groove.

2.4 INFLOW PROTECTOR

- A. Inflow protectors shall be manufactured from corrosion proof materials suitable for atmospheres containing hydrogen sulfide, dilute sulfuric acid, as well as other gases associated with wastewater collection systems.
- B. Products shall be inflow protectors as manufactured by FRW Industries, Inc.; sewer guard as manufactured by Methods Engineering Corporation; or an approved equivalent.
- C. Gaskets shall be made of closed cell neoprene.
- D. The gas relief valve shall operate at a pressure of one pound or less.
- E. The inflow protector shall not leak at a rate exceeding twelve (12) gallons in twenty-four (24) hours.
- F. The dish shall have a lift strap to facilitate manhole entry.

2.5 CHIMNEY SEALS

- A. Internal chimney seals shall be as manufactured by Cretex Specialty Products, or an approved equivalent.
1. Seals shall be made of high quality rubber meeting applicable requirements of ASTM C 923.
 2. Straight "S" sleeve shall be used where both the frame and masonry wall are vertical.
 3. Tapered "T-1" sleeve shall be used where the frame is tapered and the masonry wall is straight.

4. Tapered "T-3" sleeve shall be used where the frame is straight and the masonry surface has a 1:3 taper.
 5. Extensions shall be provided at specified manhole locations.
- B. Seals shall be double pleated with a minimum unexpanded vertical height of eight (8) inches.
 - C. Minimum thickness shall be 3/16-inch.
 - D. Minimum vertical expansion shall be two (2) inches.
 - E. Top and bottom shall contain an integrally formed expansion/contraction band recess and multiple sealing fins.
 - F. Any splices shall be hot vulcanized.
 - G. Seals shall be able to withstand a 180 degree bend with no visible separation.
 - H. Expansion bands shall be 16 gauge, minimum 1-3/4 inches wide, stainless steel meeting the requirements of ASTM A 240 Type 304.
 1. Expansion mechanism shall have the capacity to develop and hold the pressure necessary to make a watertight seal.
 2. Minimum adjustment range shall be not less than 2 inches of diameter (6.3 inches of circumference).
 - I. All fasteners shall be stainless steel.
 - J. Butyl caulk for the lower portion of the seal shall meet the seal manufacturer's recommendations.
- 2.6 MANHOLE CHIMNEY RECONSTRUCTION
- A. Precast concrete collars shall conform to ASTM C 478, and shall have an inside diameter equal to the clear opening of the manhole frame.
 - B. Mortar shall conform to specifications for mortar for Unit Masonry, ASTM Designation C 270 Type S, containing no masonry cement.
 1. Mortar shall be composed of one (1) part Portland cement, Type II, to two (2) parts sand by volume.

2.7 INTERNAL MANHOLE JOINT SEAL

- A. Internal manhole joint seals shall be as manufactured by Cretex Specialty Products or an approved equivalent.
- B. Seals and hardware shall meet the requirements listed for Chimney Seals, Paragraphs B through J.

2.8 MANHOLE STEPS

- A. Manhole steps shall be Type PSI-PF as manufactured by M.A. Industries or an approved equivalent.
 - 1. Steps shall be formed by a 1/2-inch Grade 60 deformed steel rod encased in copolymer polypropylene plastic.

2.9 PLUGS/BULKHEAD

- A. Sewer plugs shall be Model SR as manufactured by Cherny Industries or an approved equivalent.
 - 1. The plug body shall be cast aluminum.
 - 2. Seating surface shall be made of high quality rubber.
- B. Sewer brick shall be made of clay or shale and shall conform to specifications for sewer brick, ASTM C 32.
- C. Mortar shall conform to the requirements of Manhole Chimney Reconstruction, Paragraph B.

2.10 MANHOLE WALL STRUCTURAL REHABILITATION AND SEALING

- A. Severe active leaks shall be stopped with a cementitious grout or Strong-Seal Grout 250, Strong-Seal Grout 1000, 3M Scotch-Seal Chemical Grout 5600 or an approved equivalent. The type of grout to be used shall be compatible with the manhole rehabilitation system and approved by the Engineer. Cementitious grout shall meet the following requirements:
 - 1. Compressive Strength (ASTM C-579B): 1 day, 50 psi; 28 day, 250 psi.
- B. Minor leaks shall be stopped with ThoRoc Plug, IPA Ipanex-R, Strong-Seal Strong Plug, Vandex Plug, or an approved equivalent, which shall meet the following requirements:
 - 1. Compressive Strength (ASTM C-579B): 1 hr., 600 psi; 24 hr., 1,000 psi.
 - 2. Bond (ASTM C-321): 1 hr., 30 psi; 24 hr., 80 psi.
- C. Patching mix shall be ThoRoc Patch, IPA Octocrete, Strong-Seal QSR, Vandex Uni Mortar 1Z, or an approved equivalent, which shall meet the following requirements:

1. Compressive Strength (ASTM C-579B): 15 min., 200 psi; 6 hr., 1,400 psi.
2. Shrinkage (ASTM C-596): 0.1% @ 90% Relative Humidity.
3. Bond (ASTM C-321): 28 day, 150 psi.
4. Cement: Sulfate resistant.
5. Applied Density: 98 to 110 pcf.

D. Structural lining shall be either a cementitious-based product, a urethane resin based material, a cast-in-place seamless plastic lined wall, or an approved equivalent, which shall meet the following requirements:

1. Strong-Seal type MS-2A, Quadex QM-1s, for no or very mild sulfide conditions pH>3.0:
 - a. Compressive Strength (ASTM C109): 28 day, 6,000 psi
 - b. Tensile Strength (ASTM C496): 90 day, 600 psi
 - c. Flexural Strength (ASTM C78): 90 day, 700 psi
 - d. Shrinkage (ASTM C-596): 28 day, 0% @ 90% Relative Humidity.
 - e. Bond (ASTM C-321): 28 day, 130 psi.
 - f. Applied Density: 115 to 140 pcf.
 - g. Cement: Type I or Type III Portland Cement.
2. APM Permaform Permacast CR-5000, Quadex Aluminaliner, Strong-Seal type MS-2C, or an approved equivalent for mild sulfide conditions pH>2.0:
 - a. Compressive Strength (ASTM C109): 28 day, 5,000 psi
 - b. Tensile Strength (ASTM C496): 90 day, 580 psi
 - c. Flexural Strength (ASTM C78): 90 day, 700 psi
 - d. Shrinkage (ASTM C-596): 28 day, 0% @ 90% Relative Humidity.
 - e. Bond (ASTM C-321): 28 day, 130 psi.
 - f. Applied Density: 115 to 125 pcf.
 - g. Cement: Calcium Aluminate Cement.
3. Lafarge SewperCoat 2000 HS for harsh sulfide conditions in sanitary sewers:
 - a. Compressive Strength (ASTM C109): 28 day, 9,000 psi
 - b. Tensile Strength (ASTM C496): 90 day, 800 psi
 - c. Flexural Strength (ASTM C78): 90 day, 1,200 psi
 - d. Shrinkage (ASTM C-596): 28 day, 0% @ 90% Relative Humidity.
 - e. Bond (ASTM C-321): 28 day, 130 psi.
 - f. Applied Density: 145 to 155 pcf.
 - g. Content: Calcium Aluminate Cement and fused calcium aluminate aggregate.
4. Sprayroq SprayWall Urethane Resin Material:
 - a. Compressive Strength (ASTM D695): 10,500 psi
 - b. Tensile Strength (ASTM D638): 5,000 psi
 - c. Flexural Strength (ASTM D790): 10,000 psi
 - d. Shrinkage (ASTM D2566): 0.5%

- e. Bond: > tensile strength of substrate
- f. Flexural Modulus (ASTM D790): 550,000 psi.
- g. Applied Density: 81 pcf
- h. Chemical resistance to: Hydrogen Sulfide 20%
Sulfuric Acid 17%
Nitric Acid 5%

5. AP/M Permaform cast-in-place manhole systems with Amer-Plate 95Y T-Lock white, high-polymer, vinyl chloride sheeting erected and installed per the manufacturer's instructions.

- a. Concrete Compressive Strength: 4,000 psi
- b. Sheeting thickness: 0.065 inch

E. Wall coatings shall be as specified in the Schedule of Work and/or Detailed Drawings, and shall be either a cementitious-based product, epoxy, fiberglass, polyurea, urethane resin based material, or an approved equivalent:

- 1. Cementitious coatings shall be IPA Drycon, or Xypex Chemical Corp. Xypex Concrete Waterproofing by Crystallization, Vandex Super, or an approved equivalent.
- 2. Epoxy coatings shall be Fosroc Epoxy Liner HBS100, or an approved equivalent and have chemical resistance to 10% Sulfuric Acid.
- 3. Fiberglass linings shall be FiberLine System, or an approved equivalent.
- 4. Polyurea coatings shall be Caraylon Spray-Seal or an approved equivalent.
- 5. Urethane coatings shall be Sprayroq Spray-Wall or an approved equivalent.

2.11 MANHOLE CHANNEL AND SHELF

- A. Concrete for channel and shelf construction shall be 2,500 PSI and made with limestone aggregate and Portland cement, Type II.

PART 3 - EXECUTION

3.1 MEASUREMENTS

- A. The Contractor shall make all field measurements necessary to supply and install properly sized products.
- B. Prior to construction, the Engineer shall meet with the Contractor at each existing manhole site to prepare a final list of rehabilitation item quantities and measurements.

3.2 MANHOLE FRAME AND LID REPLACEMENT

- A. Excavated material shall be removed and replaced as follows:

1. Excavation and restoration for replacement in pavement:
 - a. The removal of the manhole frame shall be accomplished by making a square saw cut in the pavement.
 - b. Material in the exposed area shall be dug out to a depth to expose the entire frame and stockpiled.
 - c. Suitable materials (stockpiled) shall be tamped in place to form the subbase for the pavement. If additional material is needed, suitable material shall be added before the pavement is replaced.
 - d. The surfacing used to lid the exposed area (concrete or asphalt) shall conform to the existing pavement. It shall be placed to the same elevation and grade as the existing pavement. Seams shall be appropriately sealed.
 - e. Pavement replacement not satisfactorily done by the Contractor shall be reworked at no expense to the Owner.
2. Excavation and restoration for replacement in unpaved areas:
 - a. No unnecessary excavation of materials from around the manhole shall be done.
 - b. Materials suitable for reuse shall be stockpiled on plywood sheets or other suitable means which will prevent spillage of undesirable subgrade material onto the surrounding lawn area.
 - c. Backfill shall be replaced and compacted to prevent settlement and to restore the setting to a condition equal to or better than that found. Backfill shall not lid the manhole.
 - d. Restoration of all tree lawns and grassed areas disturbed during construction shall be performed by a Landscape Contractor approved by the Owner. Grass areas to be restored shall be seeded in accordance with Sodding, Seeding and Mulching.
 - e. Any private property which has to be removed for access to the manhole shall be replaced by the Contractor in the same or better condition than found. If this replacement is not to the satisfaction of the Owner or Engineer, it shall be redone at no cost to the property owner or Owner.
- B. Existing manhole frames and lids to be reused shall be carefully removed and cleaned. Existing manhole frames and lids which will not be reused shall be disposed of, as directed by the Owner.
- C. Replacement manhole frames and lids shall be equivalent to those being replaced unless otherwise specified.
- D. Installation of manhole frames and lids shall be in accordance with the following procedures:
 1. The Contractor shall raise the elevation of the existing manhole as directed by the Engineer. The manholes shall be raised by adding a sufficient number of precast collars and mortar rings to obtain the desired elevation.
 2. The Contractor shall then install the manhole frame and lid of the type specified.

3. After installation of the frame and lid, a layer of elastic compound able to withstand sewer gases and approved by the Engineer shall be applied to the interior joint of the frame and the wall of the manhole. This material shall be applied all around the joint to a thickness of 1/4-inch. It shall extend 1-inch to either side of the joint, or a total width of 2 inches. The thickness and width of any substitute material shall be determined when said substitute material is approved by the Engineer.
4. It shall be the responsibility of the Contractor, at no additional cost to the Owner, to replace any portion of the brick and mortar ring of the existing manhole which is damaged when the existing frame and lid are removed or the new manhole frame and lid are installed.

3.3 SELF-SEALING LID

- A. Remove the existing manhole lid and dispose of it as directed by the Owner.
- B. Carefully clean the frame of all dirt and debris.
- C. Install the new manhole lid making sure it is firmly seated in the frame.

3.4 INFLOW PROTECTOR

- A. Remove the existing manhole lid and carefully clean the frame of all dirt and debris.
- B. Place the inflow protector upon the rim making sure it is fully seated around the perimeter.
- C. Replace the lid making sure it does not disturb the seal created by the inflow protector.
- D. Testing shall be performed on ten percent (10%) of the inflow protectors as selected by the Owner's representative.
 1. Testing shall be performed as recommended by the inflow protector manufacturer and approved by the Owner's representative.
 2. Leakage rates shall not exceed twelve (12) gallons in twenty-four (24) hours.
 3. Inflow protectors failing the test shall be reinstalled and retested until they pass the specified leakage rate.
 - a. These locations shall not be counted toward the ten percent (10%) passing requirement.
 - b. Additional test sites will be selected until ten percent (10%) of the initial installations pass the test.

3.5 CHIMNEY SEALS

- A. Carefully clean the inside of the manhole frame of all dirt and debris.
- B. Install seals in strict accordance with the manufacturer's instructions including the use of the butyl caulk on the lower portion of the seal.

3.6 MANHOLE CHIMNEY RECONSTRUCTION

- A. The existing manhole frame and lid shall be removed as per the requirements of Manhole Frame and Lid Replacement, Paragraphs A and B.
- B. Remove and dispose of the specified number of courses of brick and reset any loose brick below the specified level.
- C. Each new precast collars shall be set on a bed of mortar one-half (1/2) inch thick. The thickness of the bottom bed shall be adjusted to provide a level surface for the first collar. The collars shall be placed concentrically. The contractor shall strike a neat joint on each bed of mortar. The top bed of mortar shall be one (1) inch thick for the casting.
- D. The existing manhole frame and lid (or new if so specified) shall be installed as per the requirements of Manhole Frame and Lid Replacement, Paragraphs C and D.
- E. Restoration shall be performed as per the requirements of Manhole Frame and Lid Replacement, Paragraph A.

3.7 INTERNAL MANHOLE JOINT SEAL

- A. Carefully clean the inside of the manhole wall on both sides of the joint of all dirt and debris.
- B. Install seals in strict accordance with the manufacturer's instructions.

3.8 MANHOLE STEPS

- A. Remove existing steps and grind any protruding remnants of steps flush with the manhole wall.
- B. Drill necessary holes for the new steps.
- C. Install the new steps in accordance with the manufacturer's instructions.

3.9 PLUGS/BULKHEAD

- A. Sewer plugs shall be installed in strict accordance with manufacturer's instructions.
- B. Bulkheads shall be constructed of sewer brick laid longitudinally in line with the sewer centerline.
 - 1. Bricks shall be wetted before laying.
 - 2. Bricks shall be laid up, with one-half (1/2) inch mortar joints.
 - 3. Joints shall be neatly struck upon completion of the construction of the bulkhead.

3.10 MANHOLE WALL STRUCTURAL REHABILITATION and/or SEALING

- A. Prior to any other work inside a manhole, all interior wall and invert surfaces shall be cleaned and prepared.
 - 1. Place covers over all pipe openings to prevent extraneous material from entering the sewer system.
 - 2. Cleaning shall be accomplished by water blasting using a minimum 1,500 psi water pressure. Existing incompatible or poorly bonded coatings, curing compounds, toppings, waxes, oils and greases shall be removed in a manner compatible with the rehabilitation system to be used.
 - 3. When appropriate for the rehabilitation system, a ten percent (10%) muriatic acid solution may be applied by spraying from above the manhole.
 - a. After the acid solution is used, the surface shall be thoroughly washed and allowed to dry.
 - b. Mixing, application, removal, and safety precautions shall be done in strict accordance with the manufacturer's specifications and recommendations.
 - 4. All material resulting from the cleaning and preparation operation shall be removed from the manhole being cleaned and disposed of by the Contractor in a manner approved by the Engineer.
- B. Visible leaks shall be sealed with the approved rapid setting product.
 - 1. The surfaces shall be prepared in accordance with the manufacturer's instructions prior to application of the sealing material.
 - 2. The sealing material shall be mixed and applied in strict accordance with the manufacturer's instructions.
 - 3. When necessary, 5/8-inch diameter temporary weep holes may be drilled in the wall to divert water from the flowing leak until it is sealed. After the leak has been sealed, the temporary weep holes shall be sealed in the same manner as flowing leaks.
- C. Patching, filling of voids, and smoothing out of the interior walls shall be performed with the approved products.
 - 1. All cracked, loose, or disintegrating material shall be removed from the source to expose a sound substrate.
 - 2. The material shall be mixed and applied in strict accordance with the manufacturer's instructions.
- D. Manhole wall rehabilitation shall be applied with the approved products.
 - 1. Contractor shall prepare the surfaces as necessary to assure the specified bonding strength.
 - 2. Product shall be applied when ambient temperatures are within the manufacturer's specified range.

3. Rehabilitation material shall be mixed and applied in strict accordance with the manufacturer's instructions.
 4. Product shall be applied uniformly to the walls and manhole shelf to form a monolithic liner.
 - a. Work shall be performed by a manufacturer's licensed installer or under the direct supervision of an experienced manufacturer's representative approved by the Engineer.
 - b. Product shall be sprayed under sufficient pressure to achieve the specified density.
 - c. The thickness of the liner shall be measured in a manner acceptable to the Engineer.
 - d. Thickness of any layer shall not exceed the manufacturer's recommendations.
 5. Product shall be applied to the thickness specified in the Contract documents.
- E. Surface sealing shall be performed with the approved products.
1. The manhole surfaces shall be prepared in accordance with the manufacturer's directions.
 2. Surface sealing material shall be applied in strict accordance with the material manufacturer's recommendations. Epoxy coatings shall be applied in a minimum of two layers with the second coat being applied after the first coat has dried.
 3. The thickness of the applied material shall be in accordance with the Contract documents.

3.11 MANHOLE CHANNEL AND SHELF

- A. Provide and install a temporary flume to control the flow during the channel and shelf construction.
- B. Remove all loose material and clean the bottom of the manhole in accordance with Manhole Wall Structural Rehabilitation and/or Sealing, Paragraph A.
- C. The bottom of the manhole shall be channeled to conduct flow from all inlet pipes to the outlet pipe.
 1. Channels shall be the true shape of the lower half of the sewer pipe and shall have vertical sides from the spring line upward.
 2. Extend the channel from wall to wall of the manhole providing a long radius smooth curve where the flow changes direction.
 3. Match inverts of the connecting pipes at the manhole wall.
 4. The height of the shelf shall be the top of the outlet pipe or four (4) inches above any existing bottom masonry, whichever is higher.
- D. Slope the shelf from the top of the channel to the manhole wall at a 12:1 pitch.

3.12 MANHOLE REHABILITATION ACCEPTANCE

- A. After the manhole rehabilitation work has been completed, the manhole shall be visually inspected by the Contractor in the presence of the Engineer and the work shall be found satisfactory to the Engineer. In addition, at the Owner's request, the Contractor may be required within one year to visually inspect the manholes that were rehabilitated. Any work that has become defective shall be redone by the Contractor at no additional expense to the Owner.

END OF SECTION 330130.81

SECTION 330130.84 - SEWER MANHOLE LINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. It is the intent of this portion of the work to provide for the installation of 42-inch or 48-inch diameter manhole liners with reducer cone sections (see Standard Drawing).

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and application instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The materials recommended for lining manholes shall be equal to that manufactured by Owens-Corning Fiberglass and shall be engineered to a standard of 16,000-pound vertical dynamic wheel load (AASHTO H-20). The manhole shall be fitted with a fiberglass reducer cone with no sidewall joints, seams or sections. The manhole liner shall meet all requirements of ASTM Specification D 3753 for Glass Fiber-Reinforced Polyester Manholes.

PART 3 - EXECUTION

3.1 INSTALLATION PROCEDURES

- A. The following procedures shall be followed for the installation of manhole liners:
 - 1. Excavate an area round the top of the existing manhole sufficiently wide and deep for removal of old castings, ring and cover, and reducer cone section.
 - 2. The bottom of the manhole liner shall be cut to fit existing manhole base as closely as possible. Cutouts in manhole liner shall be made to accommodate existing inlets,

drops, and cleanouts. Cuts should be precisely made with a power saw fitted with masonry-type blade or with a special jigsaw.

3. The manhole liner shall be lowered into the existing brick or concrete manhole and set into a quick-setting grout mixture. Good bottom seal shall be obtained in order to prevent loss of grout from the annular space between the outside of the manhole liner and the interior of the old manhole. A 6-inch height of a quick-setting grout shall be placed above the initial bottom seal in the annular void area between the manhole liner and the existing brick or concrete manhole to insure adequacy of the bottom seal. The gap from drops, cleanouts, laterals, and existing piping between the existing manhole wall and the new manhole liner wall shall be bridged with short lengths of PVC, clay, or other corrosion-resistant pipe approved by the Engineer. Quick-setting mortar shall be used to seal around all pipes.
4. The annular void between the manhole liner and existing brick or concrete manhole shall be filled with a Portland cement and sand grout. The grout shall be made with four bags of cement per cubic yard of sand.
5. Excavation, backfilling, and restoration shall be as required to match existing surfaces.
6. The existing ring and cover shall be reused and finished to grade by constructing a chimney on the flat shoulder of the manhole liner using brick and mortar or precast concrete rings. In no case shall the cast iron ring be placed directly on the manhole liner.

3.2 MEASUREMENTS FOR PAYMENT

- A. All measurements shall be as specified or made by conventional means with accuracies consistent with field conditions and common practice. Should a discrepancy in measurement exist which is greater than 10%, the item in question shall be remeasured by both the Contractor and the Engineer for verification.
- B. Measurements for payments shall be based on the following schedule:
 1. SEWER MANHOLE LINING, including all materials, shall be paid for at the unit price bid per manhole. Measurement shall be based on the actual number of manholes lined in the various categories.

END OF SECTION 330130.74

SECTION 331213 - WATER SERVICE CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section shall consist of laying new copper service branches from the water main to the curb box. This work shall include, but is not necessarily limited to, furnishing all materials, excavating and backfilling, restoration of areas disturbed by construction, bedding, constructing all necessary joints and connections, hydrostatic testing, disinfection and disposal of all surplus excavation.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and application instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All service pipe shall be Type K soft temper for underground piping installed. Fittings and unions shall be cast bronze solder joint fittings manufactured in accordance with ASTM Designation B62 and with ends complying to ANSI B16.18.

PART 3 - EXECUTION

3.1 TESTING

- A. The Contractor shall test and disinfect all service connections.

3.2 MEASUREMENT

- A. The number of service connections to be paid for shall be the actual number installed in accordance with these specifications.

3.3 PAYMENT

- A. See "Basis of Payment."

END OF SECTION 331213