SECTION 5
SPECIFICATIONS

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION OF THE PROJECT

A. The project is located within City of Barberton easements and in the public right-of-way, primarily paralleling along Van Hyning Run starting near I-76 and ending at the existing Brentwood Estates Package Plant.

B. The work to be performed is in the Corporation Limits of the City of Norton. However, the sanitary sewer and associated facilities are owned and operated by the City of Barberton.

1.2 PROJECT DESCRIPTION

A. The project consists of the installation of 18" gravity sanitary sewer, and associated manholes, as a sewer extension to serve the area currently served by the Brentwood Estates Package Plant. The project scope also includes the demolition of the existing Brentwood Estates Package Plant.

B. Special Project Requirements:
   1. Contractor shall confirm the location and elevation of the existing steel encasement pipe, to be utilized in crossing Cleveland-Massillon Road, prior to the commencement of any work. Refer to Sheet 9 of the Drawing Set.

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 as shown on Drawings 1 to 17 in the Project Drawing Set "CITY OF BARBERTON, PACKAGE PLANT ELIMINATION, PHASE 3 – BRENTWOOD."

END OF SECTION 011100

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 013223 – SURVEY AND LAYOUT DATA

PART 1 - GENERAL

1.1 STAKING

A. The Contractor shall hire a surveyor licensed in the state the work is to be installed to provide all reference points not already established and staking. The Contractor shall protect and preserve the established staking and reference points as long as required for installation of the work and field verifications by any party. The Contractor's surveyor shall replace and accurately relocate all staking and reference points so lost, destroyed or moved.

1.2 LAYOUT OF WORK

A. The Contractor shall lay out his work and be responsible for correct locations, elevations and dimensions of all work executed by him under this Contract. The Contractor must exercise proper precautions to verify the figures shown on the Drawings before laying out the work and will be held responsible for any error resulting from his failure to exercise such precaution. The Contractor shall insure the new construction aligns with any existing work.

END OF SECTION 013223

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 record of the surface features within the proposed construction zone of influence. This record shall include, but not be limited to, all audio-video files, storage devices, video logs, and indexes. The purpose of this coverage shall be to accurately document the pre-construction condition of these surface features.

1.2 PRODUCTS

A. The color audio-video recording delivered to the Owner shall be on a high quality 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 at the discretion of the Owner.

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. 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 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. 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. 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 deflectometer 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:

		Volume of Leakage	
Water Level Change in Test Manhole		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. 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 curred 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.

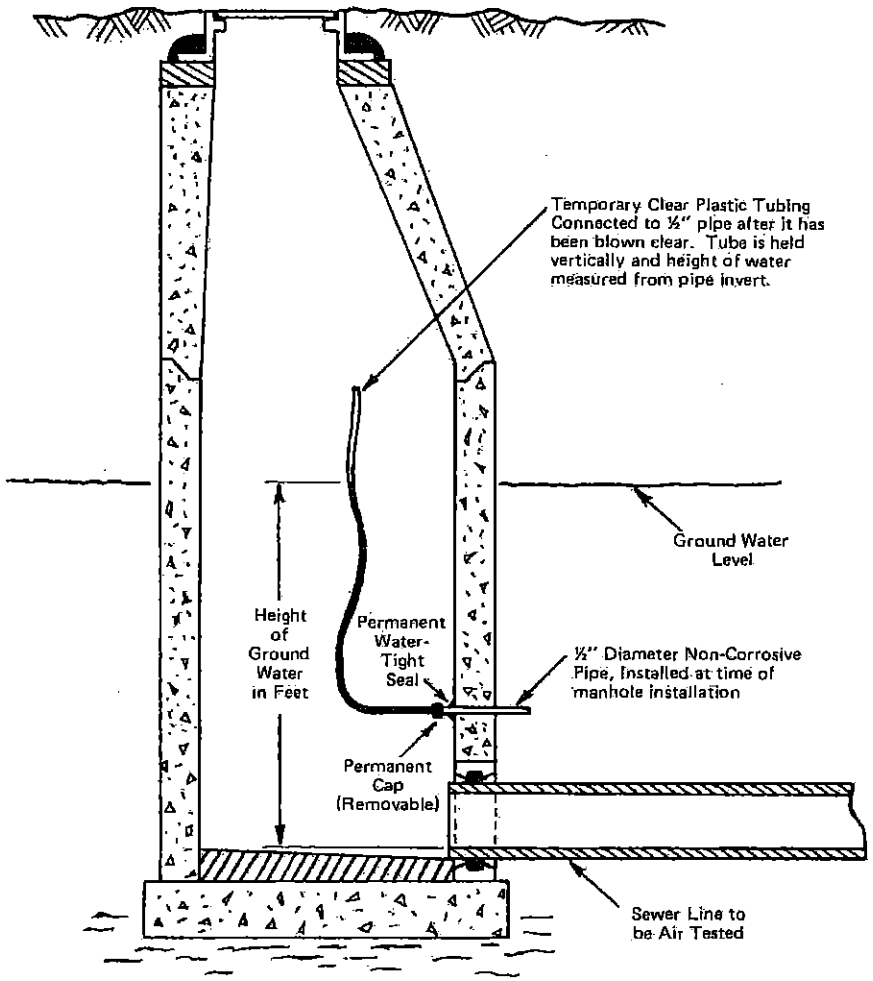
B. Written reports of each inspection, test, or similar service shall include, but not be limited to, the following:

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 013319

FIGURE NO. 1

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



AIR TEST DATA SHEET
PIPE TESTING FORM

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: **SANITARY ☐** **STORM ☐** **DATE:**
JOB LOCATION: **TEST COMPANY:**
JOB NO. **PROJECT REP:**
SPECIFIED PRESSURE DROP ( ) P.S.I.G. **BASE PRESSURE: 4.0 P.S.I.G.** **PIPE MATERIAL:**
(See Table 1 or Table II for Reference) **(Note: No test shall exceed 9.0 P.S.I.G.)**

PIPE SECTION UNDER TEST										
UPSTREAM MH/STATION	DN-STREAM MH/STATION	PIPE DIAMETER	PIPE LENGTH	GROUND WATER DEPTH	BASE P.S.I.G. PLUS GROUND WATER ADJ. (÷ 2.31=P.S.I.G.)	TEST TIME DURATION	TEST START TIME	TEST STOP TIME	TEST TIME ELAPSED	PASS FAIL P or F

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

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

REMARKS:

TABLE I

Minimum specified time required for a 1.0 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.	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

1 Pipe	2 Minim	3 Length	4 Time	Specification Time for Length (L) Shown (Min:Sec)

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

Diameter (Inches)	um Time (Min:Sec)	for Minimum Time (Ft.)	for Longer Length (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
engineers | architects | planners

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
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
	39	42	49	59	69	81	91	101	113
	42	45	53	63	74	87	98	108	121

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.

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 013326 – PRODUCT TESTING AND CERTIFYING

PART 1 - GENERAL

1.1 QUALITY OF MATERIALS

A. Where the specifications call for mill or shop tests, the Contractor shall furnish duplicate copies of attested manufacturer's certificates showing details of quality or performance sufficient to demonstrate conformity to contract requirements. Mill, shop or witness tests shall be subject to view by the Engineer's representative, but the Engineer's representation shall not relieve the Contractor from the necessity of furnishing certificates specified. The Engineer shall be notified by the Contractor in writing, sufficiently in advance of the time of making tests, so that proper arrangements may be made. Waiving of witness of tests by the Engineer may be in writing only by the Engineer. All costs for travel, lodging, food and transportation that are necessary for the Engineer's representative and the Owner's representative to attend witness tests shall be included in the Contractor's bid for those item(s) specifically designated as being subject to witness testing.

B. Unless otherwise specified, all materials, equipment and articles shall be erected, installed, applied, or connected, used, cleaned and conditioned in accordance with the printed instructions and directions of the manufacturer.

C. The installation shall be so made that its several component parts will function together as a workable system. It shall be complete with all accessories necessary for its operation and shall be left with all equipment properly adjusted and in working order.

D. The work shall be executed in conformity with the best practice and so as to contribute to efficiency of operation, minimum maintenance, accessibility and sightliness. It shall also be executed so that the installation will conform and accommodate itself to the building structure, its equipment and usage.

E. Whenever in the contract documents a particular brand, make of material, device or equipment is shown or specified, such brand, make of material, device or equipment is to be regarded merely as a standard and such trade name shall be followed by "or equal".

1.2 QUALITY ASSURANCE

A. The equipment and materials to be furnished under this Contract shall be the products of well established and reliable firms which have had ample experience for at least five (5) years in the manufacture of equipment or materials similar in design and of equal quality to that specified. If required, the manufacturer shall submit a list of installations of similar equipment which have been in successful operation for at least five (5) years.

1.3 EXPERIENCE CLAUSE REQUIREMENT AND PERFORMANCE BONDS FOR MANUFACTURER

A. For every piece of equipment furnished under this Contract, the manufacturer will be required to have a minimum of five (5) years of experience in providing this specific type of equipment. In lieu of this experience requirement, the manufacturer will be required to provide performance bond(s) for the faithful performance of the equipment and guarantee payment in a sum of not less than one hundred and fifty percent (150%) of the total equipment price for the completed work for that item. In the absence of verifiable experience, the manufacturer will be required to provide the performance bond(s) for the same number of years that the manufacturer was found lacking in experience from the specified five (5) year period. The performance bond(s) shall be from an approved surety company, to the satisfaction of the Owner's Law Director.

B. Agents of bonding companies which write bonds for the performance and payment of the contract shall furnish power of attorney bearing the seal of the company, evidencing such agent's authority to execute the particular type of bond to be furnished, and evidencing also the right of the surety company to do business in the State of Ohio. Copy of this proof shall be attached to each copy of the contract.

C. The bond shall be purchased through a surety company with a local agent upon whom service of process can be made.

D. In event of failure of surety or co-surety, the manufacturer shall immediately furnish a new bond, as required herein. The manufacturer's bond will not be released until all provisions of the contract have been fulfilled.

E. The surety used for the bid bond and performance bond shall be listed in the latest U.S. Treasury Circular 570 and the Penal Sums shall be within the maximum specified for such company in said Circular 570.

END OF SECTION 013326

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 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 014323 – QUALIFICATIONS OF TRADESMEN

PART 1 - GENERAL

1.1 CHARACTER OF WORKMEN AND EQUIPMENT

A. The Contractor shall employ competent and efficient workmen for every kind of work. Any person employed on the work who shall refuse or neglect to obey directions of the Engineer or his representative, or who shall be deemed incompetent or disorderly, or who shall commit trespass upon public or private property in the vicinity of the work, shall be dismissed when the Engineer so orders, and shall not be re-employed unless express permission be given by the Engineer. The methods, equipment and appliances used on the work and the labor employed shall be such as will produce a satisfactory quality of work, and shall be adequate to complete the contract within the specified time limit.

B. In hiring of employees for the performance of work under this Contract, or any Subcontract hereunder, no Contractor or Subcontractor, nor any person acting on behalf of such Contractor or Subcontractor, shall, by reason of race, sex, creed or color, discriminate against any citizen of the State of Ohio in the work to which the employment relates. No Contractor, Subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, creed, sex or color.

END OF SECTION 014323

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. Traping 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. Controling 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.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping
   1. Deliver grass seed, fertilizer and limestone in original containers labeled with content analysis.

1.3 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.

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.
Perenial 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.
Perenial 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		
Mulch	Per Acre	Per 1000 ft^2	Notes
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 20% (max.) Elongation *	Extra Strength - 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 (¼) 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 submittted 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 017839 - PROJECT RECORDS, DRAWINGS

PART 1 - GENERAL

1.1 RECORD DRAWINGS

A. The Contractor shall furnish an authentic set of marked-up drawings showing the installation insofar as the installation shall have differed from the Engineer's drawings. The drawings shall be delivered to the Engineer for making revisions to the original drawings immediately after final acceptance by the Owner.

B. The Contractor shall furnish dimensioned drawings indicating locations of all underground mechanical and electrical facilities.

1.2 SERVICE CONNECTION RECORDS

A. The Contractor shall record the location of all service and property connections, new or existing, made to utilities constructed under this contract. Such records shall be turned over to the Owner upon completion of the work. The cost of making such records shall be included in the various unit or lump sum prices stipulated for the various items of the work.

B. The location of each sewer connection as measured along the sewer from the nearest downstream manhole and its description with respect to the sewer shall be recorded. The record shall include the depth of new stubs for future connections and the depth of existing connections as measured from the surface grade. Also, the use of any vertical riser pipe shall be noted.

END OF SECTION 017839

SECTION 024116 – STRUCTURE DEMOLITION

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 section includes all demolition of existing structures and removal of pavement, piping, and equipment necessary to clear space for new construction and/or to rehabilitate existing construction.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. State and local code requirements shall control the disposal of debris resulting from the removal operation.

1.4 PROTECTION

A. Structures shall be removed in such a manner as not to damage portions of the existing structure which are to remain in place.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PAVEMENTS, SIDEWALKS, CURBING, SIMILAR STRUCTURES

A. 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.

B. For removal of reinforced or non-reinforced concrete, the minimum depth of saw cut shall be 3 in.

C. For removal of reinforced concrete, the depth of saw cut shall be sufficient to cut the steel.

D. If the concrete is coated with a bituminous surface or other material, the depth shall be sufficient to cut into the concrete, not including the coating depth, as specified above.

3.2 EXCAVATION OF RIGID PAVEMENT

A. The Contractor shall excavate rigid pavement, consisting of concrete or concrete base with a wearing surface of brick or bituminous concrete, wherever such excavation is required for the purpose of this Contract.

B. Pavement shall be excavated to neat lines and, only to widths required for trenches, for pipe laying and for construction of structures. Adequate provision shall be made to prevent settlement and breakage of pavement beyond the approved limits of excavation.

C. All pavement broken or damaged beyond the limits above stated, or the approved extension thereof, shall be replaced by the Contractor at his expense.

3.3 MANHOLES, CATCH BASINS, INLETS AND SIMILAR STRUCTURES

A. Existing drainage structure designated by the Engineer to be removed shall be completely removed.

B. Catch basins, inlets, and similar structures 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 selected backfill material compacted to 100% optimum density per ASTM D 698.

C. Manholes designated by the Engineer to be abandoned shall be adjusted to 1' below proposed ground grade and the casting welded closed or an 8" reinforced concrete slab placed over the manhole.

D. Live sewers connected to structures removed or abandoned shall be rebuilt through the area with new pipe. 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.

E. All castings salvaged from abandoned or removed drainage structures shall remain the property of the Owner and shall be cleaned and transported by the Contractor to a site designated by the Engineer or incorporated in the work where called for on the Drawings, scheduled, or so directed.

3.4 GUARDRAIL AND FENCE

A. Where so required by the Drawings, existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner.

B. Wood posts and other materials not considered salvageable by the Engineer shall be disposed of by the Contractor.

C. 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.

3.5 SUPERSTRUCTURES, TANKS, CHAMBERS AND SIMILAR STRUCTURES

A. Care shall be used in demolishing structural elements which are continuous with structural elements remaining in service. Concrete and masonry shall be cut with a masonry or concrete saw before removing unwanted portions.

B. Methods and equipment used in demolition work shall be chosen so the structural integrity and watertightness of both newly constructed and existing plant structures remain unimpaired by the performance of the demolition work.

C. Existing structures and equipment which are damaged in appearance and/or function by performance of demolition work shall be replaced or repaired to approved first-class condition by the Contractor at not increase in Contract Price.

D. Abandoned pipes shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.

3.6 EQUIPMENT REMOVAL

A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall remain the property of the Owner and shall be stored at site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.

3.7 DISPOSAL OF DEBRIS

A. All debris resulting from demolition operations; i.e., broken concrete, masonry, pipe, miscellaneous metal, trees and brush, equipment, etc., shall be disposed of off-site.

B. The Contractor shall police the hauling of debris to insure that all spillage from haul trucks is promptly and completely removed.

3.8 BACKFILLING

A. All trenches, holes, and pits resulting from the removal and abandonment of any structure or obstruction shall be backfilled and compacted in accordance with the requirements of Section 310000.

END OF SECTION 024116

SECTION 024116.13 - BUILDING DEMOLITION

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 this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of buildings.
2. Demolition and removal of structures.
3. Demolition and removal of site improvements.
4. Disconnecting, capping or sealing, and abandoning site utilities in place.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Contract Closeout" for record document requirements.

1.3 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.

B. Proposed dust-control measures.

C. Proposed noise-control measures.

D. Schedule of demolition activities indicating the following:

1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
2. Dates for shutoff, capping, and continuation of utility services.

E. Inventory of items to be removed and salvaged.

F. Photographs or video, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.

G. Record drawings at Project closeout according to Division 1 Section "Contract Closeout."

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of Work.

B. Owner assumes no responsibility for actual condition of buildings to be demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Storage or sale of removed items or materials on-site will not be permitted.

1.8 SCHEDULING

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.

C. Inventory and record the condition of items to be removed and salvaged.

D. Survey the condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.

E. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

3.2 UTILITY SERVICES

A. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving structures to be demolished.

1. Arrange to shut off indicated utilities with utility companies.

3.3 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

B. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during demolition operations.

C. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

D. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.

3.4 EXPLOSIVES

A. Explosives: Use of explosives will not be permitted.

3.5 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

3.6 DEMOLITION

A. Building Demolition: Demolish buildings completely and remove from the site. Use methods required to complete Work within limitations of governing regulations and as follows:

1. Locate demolition equipment throughout the building and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
2. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
3. Break up and remove concrete slabs on grade, unless otherwise shown to remain. Break up and remove asphalt paving in areas shown on Drawing D001.

B. Below-Grade Construction: Demolish foundation walls and other below-grade construction, as follows:

1. Completely remove below-grade construction, including foundation walls and footings to 3'-0" below grade.
2. Properly perforate below grade floor slabs to remain, to allow for adequate drainage after backfilling and surface restoration is complete.

C. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings.

D. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 024116.13

SECTION 310000 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Work covered by this Section shall include all excavation, trenching and related work for the construction of the designated structures and pipelines, backfill and other incidental work.

B. The Work includes transporting surplus excavated materials not needed for backfill at the location where the excavation is made, to other parts of the Work where filling is required, and disposal of all types of surplus material off the site.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013319 – Field Testing Requirements

B. Section 015713 - Temporary Erosion Control

C. Specific Project Requirements

1.3 DEFINITIONS

A. Backfill: Soil or granular materials used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, not including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported for use as fill or backfill.

D. Excavation: Removal and disposal of material encountered above subgrade or foundation elevations.
   1. Additional Excavation: Excavation below subgrade or foundation elevations as directed by Engineer.
   2. Trench: Narrow linear excavation
   3. Unauthorized Excavation: Excavation below subgrade or foundation elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
   4. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface or subsurface conditions encountered, including rock, soil materials and obstructions.

E. Granular materials: Natural aggregate, such as broken or crushed rock, gravel, or sand that can be readily incorporated into an 8-inch layer, and in which at least 65% by weight of the grains or particles are retained in a No. 200 sieve.

F. Laboratory Dry Weight: The maximum laboratory dry weight shall be the weight provided by the laboratory when the sample is tested in accordance with ASTM D-698 Method A, C, or D.

G. Optimum Moisture: The water content at which the maximum density is produced in a soil by a given compaction effort (ASTM D-698).

H. Pavement Prism: Also referred to as the zone of influence. The area below a line drawn 45 degrees to the horizontal from the surface at the edge of pavement, sidewalk or curb.

J. Pipe Embedment: The material placed in a trench surrounding a pipe or conduit consisting of the foundation, bedding, haunching, and initial backfill.

K. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material one (1) cu. yd. or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches.

L. Shale: Laminated material, formed by the consolidation in nature of soil, having a finely stratified structure. For the purpose of these specifications, the following bedrock types shall also be considered shale: mudstone, claystone, siltstone and hard clay.

M. Soil: All earth materials, organic or inorganic, which have resulted from natural processes such as weathering, decay, and chemical reaction.

N. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, pavement, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

O. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage course, or topsoil materials.

P. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Comply with all provisions of Section 013323, Shop Drawings and Submittals.

1.5 REFERENCES

A. AASHTO M 43 Standard Specification for Size of Aggregate for Road and Bridge Construction

B. ASTM C-150 Standard Specification for Portland Cement

C. ASTM C-618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

D. 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-in. (305-mm) Drop

E. ASTM D-1586 Standard Method for Penetration Test and Split-Barrel Sampling of Soils

F. ASTM D-2487 Standard Test Method for Classification of Soils for Engineering Purposes

G. ASTM D-2940 Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports

H. ASTM D-4253 Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

I. ASTM D-4254 Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

1.6 PROJECT CONDITIONS

A. Existing Conditions
   1. Existing ground elevations of the site are shown by figures and/or by contours on the Drawings. The contours and elevations of the present ground are believed to be reasonably correct, but do not purport to be absolutely so, and, together with any schedule of quantities, are presented only as an approximation. The Contractor shall satisfy himself, however, by actual examination on the site of the Work, as to the existing elevations and contours, and the amount of work required.

B. Existing Utilities
   1. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
   2. Notify Engineer not less than two days in advance of proposed utility interruptions.
   3. Do not proceed with utility interruptions without Engineer's written permission.

4. Contact utility-locator service for area where Project is located before excavating.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the site, store and protect under provisions of Section 016600, Product Handling and Protection.

B. Comply with all provisions of Section 013543, Environmental Protection.

1.8 SEQUENCING AND SCHEDULING

A. Refer to 013319 for testing laboratory service scheduling.

1.9 PROHIBITION OF EXPLOSIVES

A. The use of explosives is not permitted.

1.10 FIELD MEASUREMENTS

A. The Contract Drawings may indicate locations where certain utilities, structures or facilities might possibly interfere with the installation of new improvements. The Contractor shall dig such exploratory test pits as may be necessary to determine the exact location and elevation of the indicated subsurface structure and shall make acceptable provision for their protection, support and maintenance in operation. The Engineer shall be provided advance notification when and where excavation for test pits will take place. The Contractor shall provide the Engineer a record of field locations of all listed utilities, structures or facilities a minimum of five (5) days prior to initiating construction of the project. Locations and elevations are to be provided by a Surveyor registered in the State of Ohio.

PART 2 - PRODUCTS

2.1 GRANULAR PIPE EMBEDMENT

A. Crushed gravel or crushed limestone meeting AASHTO M 43 gradation shall be used for bedding, haunching, and initial backfill as shown on the Drawings.

2.2 ONSITE BACKFILL

A. Excavated soil material, capable of meeting specified compaction, and approved by the Engineer for use as backfill in designated locations.

B. Based upon subsurface investigation, the Owner does not guarantee the onsite soils in its present state consists of the proper moisture content to achieve the specified compaction without drying or adding water.

C. Unsuitable Backfill Material

1. Onsite materials that are unsuitable for backfill, unless otherwise specifically shown in the Drawings, include rock or other materials greater than six (6) inches in their largest dimension, pavement, rubbish, debris, wood, metal, plastic, frozen earth, and the following soils classified per ASTM D-2487:

Symbol	Description
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity
PT	Peat, muck, and other highly organic soils

2.3 SPECIAL BACKFILL MATERIAL (ODOT Item 304)

A. Special backfill material shall meet the gradation requirements of ODOT Item 304 and shall consist of crushed gravel or crushed limestone in combination with natural sand or stone. The aggregate shall meet the following gradation requirements:

Sieve	Total Percent Passing
2 inch	100
1 inch	70-100
¾ inch	50-90
No. 4	30-60
No. 30	9-33
No. 200	0-15

2.4 ACCESSORIES

A. Detectable Warning Tape

1. Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   a. Red: Electric.
   b. Yellow: Gas, oil, steam, and dangerous materials.
   c. Orange: Telephone and other communications.
   d. Blue: Water systems.
   e. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PROTECTION

A. Excavation; Temporary Sheeting, Shoring, and Bracing
   1. All excavation shall be in accordance with the Occupation Safety and Health Administration (OSHA) regulations.
   2. The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all adjacent neighboring structures from damage by settlement.
   3. Bracing shall be arranged so as not to place a strain on portions of completed work until construction has proceeded enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built work and adjacent and neighboring structures.
   4. All sheeting shall be removed unless specifically authorized in writing by the Engineer to be left in place.

3.2 REPLACING, MOVING AND REPAIRING OF EXISTING UTILITIES

A. The Contractor shall:
   1. replace, move, repair and maintain all utilities and all other structures encountered in the work
   2. coordinate and communicate with applicable utility companies
   3. repair all damage done to any of the said structures and appurtenances through his acts or neglect and shall keep them in repair during the life of this contract. The Contractor shall in all cases leave them in as good condition as they were previous to the commencement of the work and to the satisfaction of the Engineer.

3.3 DEWATERING

A. Drainage and Removal of Water
   1. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property or structures.
   2. The Contractor shall, when ordered by the Engineer, construct tight bulkheads across trench and provide pumps suitable for the removal of any water which may be encountered or which may accumulate in the trenches. Unless otherwise provided for in the Contract Documents, drainage water will not be permitted to flow through the conduit.
   3. The trench shall be kept free from sewage and storm, surface, and subsurface water to at least 2 feet below the bottom of the excavation.
   4. Where open water courses, ditches, or drain pipes are encountered during the progress of the Work, the Contractor shall provide protection and securing of the continuous flow in such courses or drains and shall repair any damage that may be done to them.

3.4 EXCAVATION CLASSIFICATION

A. All excavated materials are unclassified as defined in Article 1.3.

3.5 GENERAL EXCAVATION

A. All necessary excavation for buildings, structures, pavements, and site improvements shall be performed to accommodate the completion of all related Contract Work.

B. The Drawings show the horizontal and the lower limits of structures. The methods and equipment used by the Contractor when approaching the bottom limits of excavation shall be selected to provide a smooth surface and to prevent disturbing the soil below the bottom limits of excavation. All soil loosened during excavation shall be removed from the bottom of the excavation.

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

D. Excavation which is carried below the bottom limits of structures shall be classified as Unauthorized Excavation, unless said excavation below bottom limits of structures has been authorized by the Engineer prior to each occurrence.

3.6 TRENCH EXCAVATION

A. Excavation for trenches in which pipelines, sewers, and conduits are to be installed shall provide adequate space for workmen to space and joint pipe properly, but in every case the trench shall be kept to a minimum width. The width of trench shall not exceed the limits shown on the Drawings.

B. Excavation shall be to the depth necessary for placing of granular bedding material under the pipe as shown on the Drawings. If over-excavation occurs, the trench bottom shall be filled to grade with compacted granular bedding material.

C. Trenching operations shall not be performed beyond the distance that will be backfilled and compacted the same day.

D. In general, backfilling shall begin as soon as the conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.

3.7 EXCAVATION OF UNSUITABLE MATERIALS

A. Unsuitable materials existing below the Contract bottom limits for excavation shall be removed as directed by the Engineer. Such excavation shall not exceed the vertical and lateral limits as prescribed by the Engineer.

B. In utility trenches, the voids left by removal of unsuitable excavated material shall be filled with AASHTO M 43 No. 1 and No. 2 aggregate conforming to the material requirements of Article 2.1 of this Section.

C. In excavations other than utility trenches, the voids left by removal of unsuitable excavated material shall be filled with material consisting or either: (1) Special Backfill Material; (2) Class B concrete; or (3) Low Strength Mortar Backfill, whichever is ordered by the Engineer.

D. Removal of unsuitable excavated material and its replacement as directed will be paid on basis of Contract Conditions relative to Changes in Work unless specific unit prices have been established for excavation of unsuitable material.

3.8 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. It shall be the responsibility of the Contractor to dispose of all surplus material that cannot be used in backfill or embankments at his expense outside the limits of the project. Unsuitable excavated material, including rock or large boulders, shall be disposed of outside the limits of the project.

B. Surplus material may be wasted adjacent to or incorporated in the regular construction only when ordered in writing by the Engineer.

3.9 BACKFILL

A. Pipelines, Sewers and Conduits

1. All pipe shall have bedding extending the width of the trench with depth in conformance with the Drawings. The bedding material shall be thoroughly compacted by tamping until no further densification is possible.
2. Pipe cover material shall be used for filling above the pipe bedding along the sides of the pipe and to a height of twelve (12) inches over the top of the pipe. The pipe cover material shall be brought up evenly on both sides of the pipe to eliminate the possibility of lateral displacement of the pipe and shall be thoroughly compacted by tamping until no further densification is possible. Care shall be taken to spade the aggregate under the pipe haunch below the spring line.
3. All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless otherwise directed by the Engineer.
4. After the pipe cover has been placed and compacted around the pipe as specified above, the remainder of the trench may be backfilled by machine. The backfill material shall be deposited in eight (8) inch horizontal layers, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will

backfilling material from a bucket be allowed to fall directly on a pipe and in all cases the bucket must be lowered so that the shock of the falling earth will not cause damage.

B. Structures

1. Backfilling shall not commence before concrete has attained specified strength. Do not use equipment for backfilling and compaction operations against structures that will overload the structure.
2. Backfilling around and over structures shall be carefully placed and tamped with tools of suitable weight to a point one (1) foot above the top of same. Additional backfill may be required to protect the structure from damage from heavy equipment. Backfill shall be placed in uniform layers not exceeding eight (8) inches in depth. Each layer shall be placed, then carefully and uniformly compacted to the specified density so as to eliminate the possibility of displacement of the structure.
3. After the backfill has been placed and compacted around the structure to the height specified above, the remainder may be backfilled by machine. The backfill material shall be deposited in eight (8) inch horizontal layers, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfilling material from a bucket be allowed to fall directly on a structure, and in all cases the bucket must be lowered so that the shock of the falling earth will not cause damage.

C. Where any new, proposed, or future pavement, driveway, parking lot, curb, curb and gutter, or walk is to be placed over a backfilled area, Special Backfill material shall be used for any portion of the trench falling within the pavement prism.

D. Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with approved Granular Pipe Embedment Material compacted in place in eight (8) inch layers to the required density. The approved Granular Pipe Embedment Material shall extend outward from the spring line of the conduit a distance of two (2) feet on either side and thence downward at its natural slope.

3.10 LOW STRENGTH MORTAR BACKFILL

A. Low strength mortar backfill shall be discharged from the mixer as recommended by the supplier and approved by the Engineer.

B. Low strength mortar backfill may be placed in the trench in as few lifts as may be practical.

C. Secure conduit or pipelines before placing low strength mortar backfill to prevent conduits and pipelines from floating during backfilling.

D. For low strength mortar backfill placed against existing structures of unknown strength, backfill material shall be brought up uniformly in maximum 12 inch lifts

and allowed to cure for a minimum of 24 hours or until it can carry a person's weight without leaving imprints before the next lift is placed.

E. Low strength mortar backfill shall be brought up to subgrade elevation or the pavement prism, whichever may be applicable.

3.11 COMPACTION REQUIREMENTS

A. Compaction of non-paved areas shall be 90% of maximum dry density per ASTM D-698.

B. Aggregate pipe embedment and aggregate backfill around structures shall be compacted to not less than 100% of maximum dry density per ASTM D-4253 and ASTM D-4254.

C. Final backfill shall be compacted to not less than 100% of maximum dry density per ASTM D-698.

D. Test Sections

1. If it is determined by the Engineer that the composition of the material is such that it cannot be tested for density using a nuclear densometer or other methods; or where, in the opinion of the Engineer, in-place compaction testing is not feasible; and if approved by the Engineer, the Contractor may construct a test section to demonstrate acceptable compactive effort in lieu of in-place compaction testing. Test sections shall be constructed at no additional cost to the Owner.
2. The test section shall be completed by repeatedly compacting the material until no further density is achieved. This value shall be the Minimum Test Section Density (MTSD). The compaction equipment used to complete the test section shall be of suitable size to compact the material and shall be the same equipment used to compact the in-place material.
3. The test section shall be constructed with moisture density control as specified in this Section.
4. The material shall be compacted to at least 98% of the MTSD.
5. Each lift of in-place fill or backfill shall be densified using a compactive effort equal to or greater than the effort applied to achieve the MTSD; i.e., if six passes were required to achieve MTSD, then each lift of material shall be compacted using six or more passes.
6. Construct a new test section when, in the opinion of the Engineer, the fill or backfill material has changed character or when the supporting material has changed character.

3.12 GRADING

A. Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading
1. Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   a. Lawn or unpaved areas shall be graded to plus or minus 1 inch.

END OF SECTION 310000

SECTION 329219 - SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. All existing lawn or grassed areas disturbed by construction shall be seeded and mulched in accordance with this specification. Restoration shall include supplying all seed, topsoil, soil conditioning materials, and watering, and the incorporation of these materials into the work as specified.

B. The Contractor shall place topsoil at the depths specified in those areas requiring seeding. Topsoil shall be furnished by the Contractor.

1.2 QUALITY ASSURANCE

A. Any subcontracted restoration work shall be performed by a qualified firm specializing in landscape work.

B. Topsoil: Before delivery of topsoil, furnish the Owner's Representative with a written statement giving the location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years.

C. Seed: All seed specified shall meet O.D.O.T. specifications as to the percentage purity, weed seed, and germination. All seed shall be approved by the State of Ohio, Department of Agriculture, Division of Plant Industry, and shall meet the requirements of these specifications.

D. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

1.4 PROJECT CONDITIONS

A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, such conditions shall be rectified by the Contractor before planting, with approval from the Owner's Representative.

C. Soil Stabilization: The Contractor shall provide permanent or temporary soil stabilization to denuded areas within fifteen (15) days after final grade is reached on any portion of the site. Any such area which will not be regraded for longer than fifteen (15) days shall also be stabilized. Soil stabilization includes any measures which protect the soil from the erosive forces of raindrop impact and flowing water. Applications include seeding and/or mulching, or the use of other erosion control measures as directed by the Owner's Representative. If necessary, the Contractor shall coordinate soil stabilization practices with the local Soil and Water Conservation District.

D. Spring-sown work shall be installed between April 1st and May 30th and Fall-sown work shall be installed between September 1st and October 15th. No permanent seeding shall take place between May 30th and September 1st and between October 15th and April 1st. The dates for seeding may be changed at the discretion of the Owner's Representative.

E. All work shall be guaranteed for one full growing season to commence upon final acceptance of lawn work, as described in these specifications.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil shall be furnished by the Contractor. Stockpiled material, if any, shall be utilized prior to obtaining additional topsoil.

B. All topsoil shall conform to the U.S. Department of Agriculture soil texturing triangle and shall contain between 3% to 8% organic matter. Topsoil shall be loamy and not consist of more than 38% clay. New topsoil shall be screened to remove clay lumps, brush, weeds, litter, roots, stumps, stones larger than ½" in any dimension and any other extraneous or toxic matter harmful to plant growth.

New topsoil shall be obtained only from naturally well drained sites where topsoil occurs in a depth of not less than 4". Do not obtain from bogs or marshes.

C. Soil amendments shall be added according to the soils test requirements. Amendments can include, but are not limited to fertilizer, lime, compost, sand, and organic matter. Organic matter shall consist of composted leaves or other approved material.

2.2 SEED

A. Seed shall be vendor mixed, delivered in original bags and shall be proportioned as follows:

Common Name	Proportion by Weight
Kentucky Blue Grass	50%
Perennial Rye	50%

2.3 MULCH

A. Mulch shall be clean straw free of seed and weed seed.

1. Anchoring for mulch shall be an ODOT specified SS-1 at 60 gal./ton non-toxic tackifier such as Hydro-stik, or equal, or by securing with a photo degradable netting.

PART 3 - EXECUTION

3.1 PREPARATION - GENERAL

A. Rough grading to a depth necessary to accept the specified thickness of topsoil must be approved prior to placing topsoil.

B. Loosen subgrade, remove any stones greater than ½" in any dimension. Remove sticks, roots, rubbish, and other extraneous matter.

B. Spread topsoil to a minimum depth of 4 inches, to meet lines, grades, and elevations shown on plan, after light rolling and natural settlement. Remove sticks, roots, rubbish, stones greater than 1/2" in any dimension, and other extraneous matter. Topsoil shall be tilled thoroughly by plowing, disking, harrowing, or other approved methods. Add specified soil amendments and mix thoroughly into the topsoil.

C. Preparation of Unchanged Grades: Where seed is to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for planting as follows: Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter. Soils test requirements apply here as well.

1. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of project limits. Do not turn existing vegetation over into soil being prepared for seed.

   If necessary, supply and install topsoil in areas where there is no topsoil left after vegetation has been removed.

2. Apply specified soil amendments at rates specified in the soils test and thoroughly mix into upper 2 inches of topsoil. Add topsoil if existing grade has less than 4" of topsoil. Delay application of amendments if planting will not follow within two (2) days.

D. Fine grade areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Remove sticks, roots, rubbish, stones greater than 1/2" in any dimension, and other extraneous matter. Limit fine grading to areas which can be planted immediately after grading.

E. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

F. Restore areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.2 SEEDING

A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. Seed shall not be sown when the ground is frozen, muddy, or when weather conditions prevent proper soil preparation, interference with sowing and/or proper incorporation of seed into the soil.

B. Sow seed using a spreader. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing 3 lbs. per 1000 S.F. at right angles to each other. Total amount to equal a minimum of 6 lbs. per 1000 S.F.

C. Mulch shall be spread uniformly to form a continuous blanket at a rate of 100 lbs. per 1,000 S.F. Mulch shall be 1 1/2" loose measurement over seeded areas and shall be anchored.

D. The seeded area shall be watered, as soon as the seed is applied, at the rate of 120 gallons per 1000 square feet. The water shall be applied by means of a water tank under pressure with a nozzle that will produce a spray that will not dislodge the mulching material. Cost of this watering shall be included in the cost of seeding and mulching.

3.3 DORMANT SEEDING METHOD

A. Seeding shall not take place from October 15 through November 20. During this period prepare the seed bed, add the required amounts of lime and fertilizer, and other amendments, then mulch and anchor.

B. From November 20 through April 1, when soil conditions permit, prepare the seed bed, lime and fertilize, apply the selected seed mixture, mulch, and anchor. Increase the seeding rate by 50 percent.

3.4 RECONDITIONING EXISTING LAWNS

A. Recondition all existing lawn areas damaged by Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing lawn areas where minor regrading is required.

B. Provide new topsoil, as required, to fill low spots and meet new finish grades.

C. Cultivate bare and compacted areas according to the topsoil specifications.

D. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from the Contractor's operations, including oil drippings, stone, gravel, and other loose building materials.

E. All work shall be the same as for new seeding.

F. Water newly planted seed areas. Maintenance of reconditioned lawns shall be the same as maintenance of new lawns.

3.5 ESTABLISHMENT

A. Maintain work areas as long as necessary to establish a uniformly close stand of grass over the entire lawn area. A uniformly close stand of grass is defined as the seeded areas having 90%+ coverage of grass at 60 days after seeding. 90%+ coverage is defined as very little or no dirt showing when seeded area is viewed from directly overhead.

B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish a smooth acceptable lawn.

1. Mowing
   a. Mow lawn areas during the period of maintenance to a height of 2 inches whenever the height of the grass becomes 3 inches. A minimum of 3 mowings is required during the period of maintenance.
2. Refertilizing
   a. Distribute fertilizer on the seeded area between August 15 and October 15, during the period when grass is dry, and in accordance with the manufacturer's recommendations. The fertilizer shall be as specified in the soils test.
3. Reseeding
   a. Reseed with the seed specified for the original seeding, at the rate of 4 lbs. per 1,000 S.F. in a manner which will cause minimum disturbance to the existing stand of grass and at an angle of not less than 15 degrees from the direction of rows of prior seeding.
4. Watering
   a. The Contractor shall keep all work areas watered daily to achieve satisfactory growth. Water shall be applied at a rate of 120 gallons per 1,000 square feet. If water is listed as a pay item, it shall be separately paid for based on the actual amount of water used, measured in thousands of gallons.
5. Any mulching which has been displaced shall be repaired immediately. Any seed work which has been disturbed or damaged from the displacement of mulch shall be repaired prior to remulching.

3.6 INSPECTION AND ACCEPTANCE

A. When seeding work is complete and an acceptable stand of growth is attained, the Contractor shall request the Owner's Representative to make an inspection to determine final acceptance.

B. Acceptance shall be based upon achieving a vigorous uniformly stand of the specified grasses. If some areas are satisfactory and some are not, acceptance may be made in blocks, provided they are definable or bounded by readily identified permanent surfaces, structures, or other reference means. Partial acceptance decisions may be made by the Owner's Representative. Excessive fragmentation into accepted and unaccepted areas shall not be allowed. Unaccepted areas shall be maintained by the Contractor until acceptable.

C. No payment shall be made until areas are accepted.

D. All seeded areas shall be guaranteed for one full growing season to commence upon final acceptance of the areas.

END OF SECTION 329219

SECTION 330507.23 - HORIZONTAL BORING AND PIPE JACKING

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 work under this section shall include all underground utility crossings where indicated on the contract drawings by boring a casing and placing the carrier pipe within the casing. It is intended that this section apply to all State highways, railroads, and other facilities or structures designated by the Engineer. This section shall also include all necessary excavation, water removal, casing and carrier pipe, and the furnishing of all labor, material, tools, equipment and accessories to complete the work as specified, shown on the contract drawings, or as directed by the Engineer.

B. The Contractor shall provide all shoring, blocking or other special supports required to maintain uninterrupted traffic flow, together with all watchmen, flagmen and other services necessary to complete the work.

1.3 QUALITY ASSURANCE

A. Boring shall follow the guidelines of "The Horizontal Earth Boring and Pipe Jacking Manual" published by the National Utility Contractor's Association.

1.4 JOB CONDITIONS

A. The Contractor shall provide a safe working condition for his personnel and the public with sheeting, if required, for the receiving and boring pits and include barricades around the pits.

1.5 SUBMITTALS

A. Certificates of compliance shall be submitted for casing pipe.

B. Plans and description of the boring arrangement to be used shall be submitted to the Engineer for approval and no work shall proceed until such approval is obtained.

1.6 ALTERNATIVES

A. The Contractor is not limited to any one method for boring. The following methods can be used:

1. Auger Boring.
2. Slurry Boring.
3. Hand Tunneling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing pipe shall conform to ASTM A139, or API 5L, Grade B, and shall be the size and have wall thickness indicated on the drawings.

B. Carrier pipe shall conform to drawings.

C. Drilling fluid shall consist of a mixture of water and a gel-forming colloidal material such as bentonite or approved equal.

D. Materials used for sheeting, sheet piling, cribbing, bracking, shoring and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots and of proper dimensions, as required by the Occupational Safety and Health Administration regulations.

2.2 EQUIPMENT

A. All equipment used in the execution of work covered under the utility permit shall have the built-in capacity, stability and necessary safety features required to fully comply with the specifications and requirements without showing evidence of undue stress or failure.

B. It shall be the responsibility of the Contractor to assure that the equipment to be used in the crossing operation is in sound operating condition. Backup equipment may be required where job site conditions indicate that severe damage to the roadway or a hazardous condition may result in the event of an equipment breakdown and where the condition of the equipment to be used indicated that routine component replacement or repair will likely be necessary during the crossing.

C. Jacks shall be hydraulic, mechanical or manual power units providing horizontal thrust for pushing casing and carrier pipe. Jacks shall have sufficient power to satisfactorily complete the proposed crossing according to manufacturer's recommendations.

D. Dewatering equipment shall be used to evacuate ground and surface water from the boring and receiving pit areas.

1. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site and they shall be in constantly attended operation on a 24-hour basis until their operation can be safely halted. When dewatering, close observation shall be maintained to detect any settlement or displacement of the roadway.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavation of the receiving and boring pits shall adequately and safely accommodate the boring equipment, materials and workmen.

B. The face and sides of each pit shall be properly sloped or sheeted and care shall be taken to ensure the safety of the workmen, the integrity of the surface being bored and the traveling public.

C. When augers, or similar devices, are used for pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe.

D. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered.

E. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than one-half (1/2) inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material.

F. Preparation of the pit floors, whether of dirt, stone or concrete slab, shall be determined by the job conditions. Dewatering provisions shall be considered and implemented as required.

G. If an obstruction is encountered during installation to stop the forward action of the pipe, and it becomes evident that it is impossible to advance the pipe, operations will cease and the pipe shall be abandoned in place and filled completely with grout at the Contractor's expense. The new boring location, direction and depth shall be chosen by the Owner.

H. The casing shall be bored in a straight line and on a uniform and level grade.

I. After the casing is installed, the carrier pipe shall be pushed through on skids to prevent injury to pipe or joints. Every precaution shall be taken to insure that the joints are and will remain in perfect condition.

J. Bored or jacked installations shall have a bore hole essentially the same as the outside diameter of the pipe. If voids should develop or if the bored hole diameter is greater than the outside of the pipe by more than approximately one (l) inch, grouting or other methods approved by the Engineer shall be employed to fill such voids. Cost of such grouting shall be at the Contractor's expense.

3.2 GROUTING

A. Where grouting is required in accordance with specifications of the Owner it shall be as follows:

1. A uniform mixture of grout shall be placed under pressure between the casing and carrier pipe. Grouting shall start at the lowest point and proceed upwards simultaneously on both sides of the carrier pipe. A plug shall be installed in each grout hole as the grouting is completed.
2. Grouting shall be kept as close to the heading as possible. Grouting shall proceed as directed by the Engineer.

3.3 BLASTING

A. Blasting will not be permitted.

3.4 PERMITS AND INSURANCE

A. Permits

1. The Owner will obtain all permits necessary for working within the right-of-way. The Contractor shall make, with the proper authority, satisfactory arrangements for the actual work of this Item.

B. Insurance

1. The Contractor shall be responsible for obtaining any and all insurance required by the proper authorities to perform this work at his own expense. The Contractor shall save harmless the Owner, and any all public agencies affected by this Contract for work performed under this Item from any claims, damages or injury and shall immediately make whatever repairs are necessary to correct any damage to any highway facility and/or right-of-way.

END OF SECTION 330507.23

SECTION 330533.33 – RESTRAINED JOINT PVC PIPE AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work covered by this Section includes but is not limited to Cast Iron Outside Diameter (CIOD) restrained joint polyvinyl chloride (RJPVC) pipe intended for the transportation of sanitary wastewater and contains guidelines and specifications applicable to the installation of RJPVC using Horizontal Directional Drilling (HDD).

B. It is the intent of this Contract that the final installation be complete in all respects and the Contractor shall be responsible for minor or specific details; coordination with trades, equipment manufacturing, installation and manufacturers start-up representatives; and any necessary special construction not specifically included in the Drawings or Specifications.

1.2 RELATED DOCUMENTS

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

1.3 QUALITY ASSURANCE

A. The named equipment in addition to the detailed specifications, establishes the minimum acceptable standards of material and workmanship. In addition to requirements of these Specifications, all work performed shall be in accordance with approved trade practices and manufacturers recommendations. All equipment shall perform as specified and accessories shall be provided as required for satisfactory operation.

B. The Contractor shall coordinate and verify that the material furnished meets the Specification, intentions and design criteria prior to equipment submittals and shipment from the manufacturer to the project site.

C. Material References:

Reference		Title
1.	AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe for water distribution.
2.	ASTM D1784	Standard Specification for Rigid PVC Compounds and CPVC Compounds
3.	ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
4.	ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. All horizontal directional drilling operations shall be performed by a qualified Contractor having a minimum of five (5) years' experience of installing pipe using directional drilling methods.

E. The Contractor shall have demonstrated experience and expertise installing pipe using directional drilling methods involving work of a similar nature to the work required by this project.

F. All field supervisory personnel employed by the Contractor shall be adequately trained in directional boring methods and have at least three (3) years' experience in the performance of the work and tasks required.

G. The Contractor shall show demonstrated experience and expertise in directional drilling methods by providing a job list with pipe sizes and depths similar to the specifications required by this project. This list shall also include a name and telephone number for contact.

1.4 SUBMITTALS

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

B. Shop Drawings: The Contractor shall submit complete shop drawings of all materials furnished for this project.

PART 2 - PRODUCT

2.1 GENERAL

A. Manufacturer
1. All RJPVC pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the RJPVC Pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

B. Quality Control
1. Production staff shall check each length of pipe produced for the items listed below. The results of all measurements shall be recorded on production sheets, which become part of the manufacturer's permanent records.

    a. Pipe in process shall be checked visually, inside and out for cosmetic defects (grooves, pits, hollows, etc.)
    b. Pipe outside diameter shall be measured using a suitable periphery tape to ensure product conformance and consistency.
    c. Pipe wall thickness shall be measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance.
    d. Pipe length shall be measured.
    e. Pipe marking shall be examined and checked for accuracy.

C. Compatibility
   1. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

D. HDD:
   1. The bore path alignment and design for HDD shall be based on the Engineer's plans and other factors. Some of these factors are the pipe bell and barrel diameters, the optimum individual pipe length (20' nominal), bore path inside diameter, and maximum deflection capabilities of the joint.
   2. Prior to the start of drilling, reaming, and pipe placement operations, the Contractor shall properly locate and identify all existing utilities and structures in proximity to the pipeline alignment. The Contractor shall confirm the alignment of all critical utilities using vacuum excavation or other suitable excavation method for further detailed confirmations as necessary.

2.2 PIPE AND FITTINGS

A. Materials used for the manufacture of pipe and fittings shall be made from a compound meeting cell classification 12454 per ASTM D1784.

B. RJPVC pipe shall comply with AWWA Specifications C900.

C. Pipe couplings shall be manufactured from a Fiberglass Composite with two gaskets, and two nylon splines, per coupling. Gaskets shall be styrene-butadiene rubber.

D. If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

E. Pipe and accessories shall be 200 psi at 73°F and includes 2:1 safety factor; meeting the requirements of Dimension Ratio (DR) 21 as MINIMUM STRENGTH.

F. The pipe Manufacturer must certify compliance with the above requirements.

2.3 EQUIPMENT

A. The Contractor shall have equipment appropriate for horizontal directional drilling installations. This includes the preparation and maintenance of the bore path using drilling fluids appropriate for the geology of the soils.

B. The directional drilling machine shall consist of a hydraulically powered system to rotate, push, and pull hollow drill pipe into the ground at variable angles down to 8 degrees above horizontal, while delivering a pressurized fluid mixture to a guidable drilling and piping installation. The machine shall be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. The rig shall have a system to

monitor the maximum pull-back pressure during the pull-back operation. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

C. The drill head shall be a steerable type and shall provide the necessary cutting surfaces and drilling fluid jets.

D. Mud motors shall be of adequate power to turn the required drilling tools.

2.4 GUIDANCE SYSTEM

A. A conventional electromagnetic sound walkover system, Magnetic Guidance System (MGS) probe, or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at the maximum depth required and in any soil condition including hard rock. It shall enable the driller to guide the drill head by providing immediate information to the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 1.5 meters horizontally.

B. The Guidance System shall be of a proven type and shall be set up and operated by personnel trained and experienced with this system. The operator shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.5 DRILLING FLUID SYSTEM

A. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. The mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be a minimum of 500 gallons. The mixing system shall continually agitate the drilling fluid during drilling operations.

B. Additives to drilling fluid such as drill soap, polymers, etc., shall be "environmentally safe" and be approved for such usage. No diesel fuel shall be used.

C. Unless otherwise authorized, an environmentally safe drilling fluid that does not contain bentonite shall be used for all HDD operations where drilling will be done under any stream, river or other watercourse.

2.6 OTHER EQUIPMENT

A. Pipe rollers shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe. Rollers shall be used as necessary to assist in pull-back operations and in layout/jointing of piping.

B. Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.

C. Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work.

2.7 PROOF-OF-DESIGN TESTS

A. The pipe manufacturer shall have representative proof-of-design tests of flexible restrained pipe joints.

2.8 PIPE IDENTIFICATION

A. The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding 5 feet:
   1. Name and/or trademark of the pipe manufacturer.
   2. Nominal pipe size.
   3. Dimension ratio.
   4. A production code from which the date and place of manufacture can be determined.

B. Tracer Wire:
   1. All piping shall be installed with a continuous, insulated solid number 10 gauge UF (underground feeder per National Electrical Code Article 339) copper wire for location of non-metallic pipe with an electronic pipe tracer.
   2. Upon completion, the Contractor shall demonstrate to the Engineer or his representative that the wire is continuous and unbroken through the entire pipe run by providing full signal conductivity when energized. If the wire is broken, the Contractor shall repair it at no additional cost.

PART 3 - EXECUTION

3.1 JOINTING METHOD

A. The pipe shall be joined with couplings. All joints shall be made in strict compliance with the manufacturer's recommendations.

B. Lengths of pipe shall be assembled into suitable installation lengths by the coupling process. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

3.2 INSTALLATION

A. Pipe shall be installed in accordance with the manufacturer recommendations.

B. Care shall be taken in loading, transporting and unloading to prevent injury to pipe. Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the contractor, at his own expense.

C. Under no circumstances shall the pipe or accessories be dropped into the trench or forced through a directional bore upon "pull-back".

D. Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

E. Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

F. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

G. Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

H. Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings.

I. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means.

J. Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

K. All pipe must be at the temperature of the surrounding soil at the time of backfilling and compactions.

L. If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.

3.3 DRILLING PROCEDURE

A. The work site within right-of-way as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor shall confine all activities to designated work areas.

B. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If the Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

C. The Contractor shall adhere to all applicable state, federal, and local safety regulations, and all operations shall be conducted in a safe manner.

D. Pipe lengths shall be connected together in one length if space permits. Pipe shall be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.

E. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than 5%, the Contractor shall notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation.

F. Upon successful completion of pilot hole, the Contractor shall ream bore hole to a minimum of 25% greater than outside diameter of pipe bell for straight pulls and 50% greater for curved or radius pulls using the appropriate tools. Contractor shall have the option to pre-ream or ream and pull back pipe in one operation if conditions allow. The Contractor shall not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.

G. After successfully reaming bore hole to the required diameter, the Contractor shall pull the pipe through the bore hole. In front of the pipe shall be a swivel. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations the Contractor shall not apply more than the maximum safe pipe pull force at any time. In the event that pipe becomes stuck, the Contractor shall notify the Engineer. The Engineer and Contractor shall discuss options and then work shall proceed accordingly.

H. Excess pipe shall be removed and the bore hole associated with this excess pipe shall be filled with flowable fill or grout unless the area of the excess pipe is excavated and backfilled as part of the tie-in operations. In the event that a drilling fluid fracture, inadvertent returns, or returns loss occurs during pilot hole drilling operations, the Contractor shall cease operations and shall discuss corrective options with the Engineer; then work shall proceed accordingly.

3.4 BASIC ASSEMBLY/PULLING METHODS

A. Cartridge Assembly (Option 1). Cartridge Assembly option is defined as the assembling of individual sections of pipe in a secured entry and assembly pit. The pipe sections are assembled individually and then progressively pulled into the bore path a distance equivalent to a single pipe section. This assembly-pull process is repeated for each pipe length until the entire line is pulled through the bore path to the exit point.

B. Assembly-Line or Ramp Method (Option 2). Assembly-Line option is defined by the pre-assembly of multiple lengths of pipe with subsequent pulling installation into the bore path as a long pipe string. With this option, the Contractor shall provide an entry ramp to the entrance of the bore path. The ramp shall be of sufficient length and grade such that any one pipe joint does not exceed the allowable joint deflection at any point prior to the pipe string entering the bore path.

The Contractor shall be responsible for providing the necessary equipment or ground surface preparation to allow the pipe to be pulled back along the surface prior to the entry ramp and bore path.

The pulling head may also be used as one of the two (2) bulkheads required for a low pressure air test of the pipe string prior to pull back, if required by the engineer. After complete installation, the pulling head may also be helpful with or without further connection of piping in normal higher pressure hydrostatic testing of the installed piping.

3.5 JOINT CLEANING/ASSEMBLIES IN HDD

A. The Contractor shall be responsible for the proper assembly of all pipe and appurtenances in accordance with the Manufacturer's written installation procedure and as supplemented by these guidelines. Prior to joint assembly all joints and joint components shall be thoroughly cleaned and examined to ensure proper assembly and performance. In the event that the Contractor is not experienced with the assembly of the type of restrained joint being used, it shall be the responsibility of the Contractor to contact a factory-trained representative for recommendations on the proper and efficient installation of the joint.

3.6 RECORD KEEPING AND RECORD DRAWINGS

A. The Contractor shall maintain a daily record of the drilling operations and a guidance system log with a copy given to Engineer at completion of boring.

B. The MGS data shall be recorded during the actual crossing operation. The Contractor shall furnish as-built plan and profile drawing based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. The MGS data shall be certified accurate by the Contractor to the capability of the MGS System.

C. Record drawings shall be completed and reviewed by the Engineer and prepared at the Contractor's expense. The as-built drawings shall be certified by the Contractor for accuracy.

3.7 CLEANING

A. At the conclusion of the work, thoroughly clean all of the new pipe lines to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period by forcing a cleaning swab through all mains 6" or greater. Flushing velocities shall be a minimum of 2.5 feet per second. All flushing shall be coordinated with the inspector. Debris cleaned from the lines shall be removed from the job site.

3.8 PIPE TESTING

A. Following the successful pullback of the pipe, the Contractor shall hydro-test pipe from end to end.

3.9 SITE RESTORATION

A. Following drilling operations, the Contractor shall de-mobilize equipment and restore the work-site to original condition. Any noticeable surface defects, due to the drilling operation, shall be repaired by the Contractor.

3.10 CONTINGENCY AND RESOURCE PROTECTION PLAN

A. On-Site Monitoring:
   1. During drilling operations, visual inspection along the bore path of the alignment shall take place at all times.
   2. The Contractor shall supply the following information to the monitoring team throughout the duration of the HDD operation at specific time intervals (e.g. upon completion of each drill rod):
      a. Position of the drilling head relative to the drilling point of entry;
      b. Estimated total volume of drilling fluid that has been pumped during the drilling operation;
      c. Comparison of the current total volume of drilling fluid used and the estimated current total volume of returns;
      d. Equipment breakdowns and repairs;
      e. Any abnormal drilling fluid pressure at the time of occurrence; and
      f. Any change of drilling fluid contents (e.g. new bentonite mixture or introduction of LCMs.

B. Field Response Plan:
   1. During the drilling process, the operator shall adjust the thickness of the bentonite mixture to match the substrate conditions and ensure continuous flow. Subsequently, the operator shall closely monitor drilling pressures and penetration rates so use of fluid pressure shall be optimal to penetrate the formation.
   2. A complete and sudden loss of returns serves as a signal to both the operator and the monitor that something more significant may be occurring and to watch closely for a possible surface release. This plan uses the loss of returns or pressure, the use of a tracing dye and visual indications, to trigger response and mitigation actions.

3. In the event of a sudden loss of approximately 75 percent of expected returns, or in the event that a surface release of drilling fluid or dye are detected, the Contractor shall immediately cease operations to determine what actions need to be taken. In areas containing sensitive resources, agency notifications shall be made and the decision to resume operations shall be determined in consultation with the appropriate agencies' representatives.
4. All equipment required to contain and clean up a frac-out release shall either be available at the work site or readily available at an off-site location within 10 minutes of the bore site. Required equipment will be made available by manual transport; unless vehicle transportation is required due to magnitude of equipment and access is available. This equipment includes the following:
    a. Heavy weight plastic clean gravel filled sand bags (at least 20 bags);
    b. Geotek filter bags 10-by-12 foot size or equivalent (at least 3 bags per segment):
    c. Several hard plastic (5-gallon) buckets;
    d. One wide heavy-duty push broom;
    e. Three flat bladed shovels;
    f. Silt fence (appropriate coverage up to 40 foot perimeter);
    g. Certified weed-free hay bales (appropriate coverage up to 40 foot perimeter);
    h. Two bundles of absorbent pads to use with plastic sheeting for placement beneath motorized equipment while in operation in the vicinity of a riparian/stream zone;
    i. Straw logs (wattles or fiber rolls) (at least two 10-foot rolls);
    j. Portage pumps;
    k. A minimum of 100 feet of hose; and
    l. Vacuum truck (800 and 3,000 gallon).
5. General responses to frac-out releases related commitments are as follows:
    a. Directional boring would stop immediately;
    b. The bore stem would be pulled back to relieve pressure on frac-out;
    c. The Lake County Department of Utilities Inspector would be notified to ensure adequate response actions are taken and notifications are made;
    d. Terrestrial releases would be cleaned up using on-site equipment;
    e. A dike/berm may be constructed around the frac-out (terrestrial only) to entrap released drilling fluid;
    f. Response equipment stored off-site in readily accessible locations (e.g. portable pumps and full equipped 800 or 3,000 gallon vacuum trucks) would be mobilized to recover larger releases of drilling fluid;
    g. Access to the frac-out release area would be via existing roads and temporary work easements. Additional access needed to perform clean-up activities would be coordinated with and require approval of all regulating entities.

C. Proper Notification and Documentation
1. If frac-out occurs or any degree of dye were detected within the water column of a stream, the Contractor shall immediately notify the appropriate permitting agencies, and additional follow-up response actions would be developed in coordination with agency representatives.

2. Documentation of environmental compliance shall include written reports of observations, documentation of events and follow-up, and project tracking.

END OF SECTION 330533.23

SECTION 333100 - SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Furnishing all labor, materials, tools, equipment, and services for all sanitary sewers as shown on the Drawings.

B. Although such is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a functional and complete installation.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013319 – Field Testing Requirements

B. Section 310000 - Earthwork

C. Section 015713 - Temporary Erosion Control

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Granular pipe bedding and cover material specified in Section 310000 - Earthwork

B. Special backfill material specified in Section 310000 - Earthwork

1.4 SUBMITTALS

A. Product Data
   1. PVC pipe
   2. Polypropylene pipe
   3. Manhole castings
   4. Precast concrete manholes
   5. Manhole steps

B. Shop Drawings
   1. Precast concrete manholes showing:
      a. Orientation plan for each manhole or inlet indicating where all pipes connect.
      b. The size and elevation of connecting pipes.
      c. Details of drop connections.
      d. Invert concrete channeling details.
      e. Pipe to manhole connection details.
      f. Casting and step orientation.

C. Quality Control Submittals
   1. Design Data
   2. Test Reports
   3. Certificates
      a. Evidence of current membership in specified manufacturer's associations.
      b. Evidence of National Precast Concrete Association (NPCA) certification for the manufacture of precast concrete manholes.
   4. Manufacturers Instructions

D. Contract Closeout Submittals
   1. Project Record Documents
   2. Operation and Maintenance

1.6 REFERENCES

A. ASTM C-150 Standard Specification for Portland Cement

B. ASTM C-270 Standard Specification for Mortar for Unit Masonry

C. ASTM C-443 Standard Specifications for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

D. ASTM C-478 Standard Specifications for Precast Reinforced Concrete Manhole Sections

E. ASTM C-990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

F. ASTM C-1173 Standard Specification for Flexible Transition Couplings for Underground Piping Systems

G. ASTM D-2321 Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

H. ASTM D-3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

I. ASTM D-3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

J. ASTM F-477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

K. ASTM F-679 Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

1.7 PROJECT CONDITIONS

A. Environmental Requirements

B. Existing Conditions
1. Verify locations of underground utilities.
2. Protect existing structures and utilities from damage. Repair if damaged by this work.
3. Do not change pipe sizes without securing written approval of Engineer.

C. Field Measurements
1. If it becomes necessary to change location of sanitary sewer lines due to underground utility interference, secure approval of Engineer.
2. If Contractor initiated, make changes approved by the Engineer without added cost to Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site
1. All material and all equipment shall be subject to visual inspection and acceptance or rejection after delivery to the site of the work. All rejected material shall immediately be removed from the site.

PART 2 - PRODUCTS

2.1 PIPE

A. Polyvinyl Chloride Pipe (PVC) 18" - 36" Diameter
1. All large diameter polyvinyl chloride pipe shall conform to ASTM F-679, shall be integral bell and spigot type, with joints conforming to ASTM D-3212 and elastomeric seals conforming to ASTM F-477.
2. All pipe and fittings shall be marked or stenciled in conformance with ASTM F-679. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.
3. Acceptable manufacturers shall be current members of the Uni-Bell Plastic Pipe Association.

B. Polypropylene Pipe (PP) 12" – 60" Diameter
1. All polypropylene pipe shall conform to ASTM F2764, integral bell and spigot type, with joints conforming to ASTM D3212 and elastomeric seals conforming to ASTM F-477.
2. All pipe and fittings shall be marked or stenciled in conformance with ASTM F2764. All gaskets shall be marked or stenciled in conformance with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.

2.2 PRECAST CONCRETE MANHOLES

A. All precast manhole units shall be manufactured in accordance with the provisions of ASTM C-478.

B. Joints between manhole units shall be gasketed and shall comply with the requirements of ASTM C-443. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.

C. The standard length of riser units shall be 48 inches. Lengths of 32 inches or 16 inches shall be used to meet required dimensions.

D. Openings for connecting pipes in riser units, bottom riser units, integral base units, and for access in flat slabs shall be preformed or cored by the manufacturer. Cut-out openings shall be made immediately after the pipe is removed from the casting form.

E. Connectors between new precast concrete manholes and pipes shall be made by casting the connector integrally with the manhole wall. The connectors shall be composed of EPDM with stainless steel take down bands for compressing the connector against the outside diameter of the pipe. The connectors shall comply with the requirements of ASTM C-923, and shall be "Z-Lok" Type as manufactured by A-Lok Products; or an approved equivalent.

F. All openings in existing manholes shall be field cored and shall have mechanical connectors complying with the requirements of ASTM C-923 and shall be equal to Kor-N-Seal as manufactured by NPC, Inc., Milford, NH.

G. Annular spaces at pipe entrances shall be field sealed with a one component, hydraulic cement based, fast setting repair mortar equal to Thoro Products Waterplug as manufactured by ChemRex Inc., Shakopee, MN.

H. The top four (4) inches to twelve (12) inches of the manhole shall provide for adjustment of casting to grade. Adjustment shall be through the use of a maximum of two (2) precast concrete adjusting collars.

I. Where pressure tight manhole frames and covers are specified, threaded inserts shall be cast in eccentric cones or flat slab tops, and holes formed or cored in adjusting rings to match bolt size and spacing specified for manhole casting.

J. Precast concrete shall be manufactured by an NPCA certified plant.

2.3 MANHOLE STEPS

A. All steps shall be minimum of twelve (12) inches in width with safety side lugs to prevent slipping and shall conform to the latest OSHA requirements. Manhole steps shall be of polypropylene plastic reinforced with a 3/8", No. 60 grade epoxy coated reinforcing rod.

B. Manhole steps shall conform to the requirements of ASTM C-478.

C. Acceptable manufacturers are:
   1. American Step Company, Inc.
   2. Lane International, Inc.
   3. M. A. Industries, Inc.

2.4 CASTINGS

A. All castings shall be true to pattern and free from cracks, gas holes, flaws and excessive shrinkage. Surfaces shall be free from burnt-on sand and shall be reasonably smooth. Runners, fins, risers and other cast-on pieces shall be removed. Castings for manhole frames and covers and for any other purpose under these specifications shall conform to all the requirements for Class No. 35B for Gray Iron Castings of the ASTM A-48. All castings shall be commercially machineable and, in the case of manholes, the frame and cover shall be so machined that it will be impossible to rock the cover after it has been seated in the proper position in the frame.
   1. Manhole frames and covers shall be as detailed on the Drawings.
   2. Frame and cover shall be painted with one coat of the manufacturer's standard asphaltum paint.

2.5 MASONRY MORTAR

A. Mortar shall conform to ASTM C-270, Type M, but shall not contain masonry cement.

B. Mortar shall be UltraMortar Type M as manufactured by UltraKote Products, Inc. or Lafarge Mortar Cement, Type M as manufactured by Lafarge Corporation, or approved equal.

C. Only sufficient mortar shall be prepared for immediate use, and any mortar that has set shall not be retempered or used in the work.

D. Setting accelerators or anti-freeze compounds shall not be used.

2.6 COUPLINGS

A. Couplings for connecting dissimilar pipe materials or pipe sizes shall be a rubber type coupling with a sealing "O" ring under each of two sealing clamp bands and a Type 316 stainless steel shear ring. Coupling shall be manufactured with natural and synthetic rubbers conforming to ASTM C 425 and ASTM C 1173.

B. Coupling shall be Flex-Seal Adjustable Repair Coupling as manufactured by the Mission Rubber Company, Corona, CA, or approved equal.

PART 3 - INSTALLATION

3.1 ALIGNMENT AND GRADE

A. Horizontal and Vertical Control
   1. All horizontal and vertical control required for the complete layout and performance of the Work under this contract shall be done by a registered surveyor at the Contractor's expense, and any observations by the Engineer of the Contractor's methods will not relieve the Contractor of his responsibility.
   2. The Contractor shall be solely responsible for the accuracy of all horizontal and vertical control.

B. Alignment and grade shall be established by means of a laser beam.

C. The Contractor shall furnish all material and labor to establish line and grade of the generated laser beam from the benchmarks and control points indicated on the Drawings. The laser shall be securely anchored and checked periodically by the Contractor. The laser calibration shall be demonstrated when requested by the Engineer. Strict adherence to the manufacturer's operation procedure shall be observed. Only qualified and trained employees may be assigned to install, adjust, or operate laser equipment, and proof of qualifications of the equipment operator must be available at all times. Areas in which lasers are used must be posted with standard laser warning placards, and the laser beam shall be turned off when not needed. During rain, snow, dust, excessive heat, or fog the operation of laser systems shall be prohibited where practicable because of beam scatter.

3.2 PIPE INSTALLATION

A. All pipe installation shall conform to the trench and bedding details shown on the Drawings.

B. PVC and PP pipe shall be installed in full compliance with ASTM D-2321.

C. Only one type and strength of pipe shall be used between any two consecutive manholes, unless otherwise shown on the Drawings.

D. After the trench has been excavated and the pipe bedded , the pipe shall be laid to the line and grade as shown on the Drawings. All joints shall be made as hereinafter specified. In no case shall any material except bedding material be placed under the bell of the pipe to secure proper grade.

E. Prior to being lowered into the trench, each pipe shall be carefully inspected and those which are damaged or not meeting the specified requirements shall be rejected and clearly marked as rejected and removed from the Work. Satisfactory means shall be used to hold the pipe in line until embedment of pipe is complete. Precautions shall be taken to insure that the spigot end of the pipe being laid is pushed the proper depth into the bell of the preceding pipe.

F. All conduit shall be laid starting at the outlet end and laid with the bell end upstream.

G. In no case shall more than thirty (30) feet of trench be opened in advance of the pipe laying operations.

H. Conduit shall not be laid in water, mud, or any otherwise unsuitable trench No drainage shall run through the newly laid pipe. All sewers shall be temporarily capped with a watertight seal at the open ends at the completion of each day's work and no drainage water shall be permitted to flow through the sewer.

I. All trenches and excavations shall be backfilled as specified as soon as possible after the pipe is laid and jointed. Where concrete encasement or cradle is used, pipe shall not be backfilled for at least twenty four (24) hours after placing concrete except that pipe may be covered to a depth of not to exceed sixteen (16) inches over the top of the pipe.

3.3 JOINTING

A. PVC and PP Pipe
   1. Dust, dirt and foreign matter shall be removed from joint surfaces. When jointing pipe using the required compression type joint, a lubricant recommended by the gasket manufacturer shall be used. The gasket shall be lubricated by drawing it through lubricant held in the hand of the worker, thus coating the entire surface of the gasket.
   2. When laying the pipe in concrete bedding, care shall be exercised to prevent the joint materials from coming in contact with the fresh concrete until after the joint has been completed.

3.4 PERMISSIBLE DEFLECTION AT JOINTS

A. No pipe deflections or springing of joints, to effect a change in direction will be allowed, except by permission or direction of the Engineer, or as shown on the Drawings. Any permitted or directed deflection shall be a maximum of 80 percent of the allowable deflection value established by the pipe manufacturer.

3.5 MANHOLES

A. Build each manhole to dimensions shown on Drawings and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.

B. Set frames for manholes, within areas to be paved, to final grade. In asphalt pavement, surround frames set to grade with a ring of compacted asphalt concrete base material immediately after backfilling operations are complete. Place asphalt concrete mixture up to one (1) inch below top of frame, slope to grade, and compact with hand tamp.

C. Precast bases shall be placed on a bed of crushed gravel or crushed limestone, meeting AASHTO M 43 gradation, having a minimum thickness of three (3) inches. The bedding shall be compacted and provide uniform support for the entire area of the base.

D. Provision shall be made for a minimum of four (4) inches and a maximum of twelve (12) inches of precast concrete grade rings between the uppermost precast section and the bottom of the cast iron manhole frame in order to set manhole cover to grade.

E. No more than two lifting holes or other lifting devices shall be utilized for handling the precast sections. All lifting holes shall be acceptably sealed with a hydraulic cement based, fast setting repair mortar, meeting the requirements of Article 2.2 of this Section, prior to backfilling around the manhole.

F. Inverts shall be formed to the equivalent of half-pipes in concrete and as follows:
   1. Carry concrete out to the manhole wall with a slope of ½ in./ft. from the top of the half-pipe.
   2. 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 connecting pipe at the manhole wall.

3.6 DROP MANHOLES

A. Where shown on the plans, drop manholes shall be built in accordance with the Drawings.

3.7 BRANCH CONNECTIONS

A. In general, provision shall be made in the sewers for service connections by inserting a wye branch in the sewer at the location designated by the Engineer or Owner; for each service connection with a branch size required or ordered by the Engineer or Owner, but never less than six (6) inch, for sewers ten (10) feet or less

in depth. If directed, the Contractor shall construct a riser, 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%).

B. Openings at the outer ends of the connections shall be closed and sealed with approved stoppers when connection is not immediately placed into service.

3.8 MAINTAINING SEWAGE FLOW

A. The Contractor shall be required to maintain the flow in all existing live sewers during construction and the method employed shall be approved by the Engineer.

3.9 REPLACING, MOVING AND REPAIRING OF EXISTING UTILITIES

A. The Contractor shall replace, move, support, or repair and maintain all pipes for water, steam, air or gas, and all wire conduit(s), and all other structures encountered in the work and repair all damage done to any of the said structures and appurtenances through his acts or neglect and shall keep them in repair during the life of the Contract. The Contractor shall in all cases leave them in as good condition as they were previous to the commencement of the work and to the full satisfaction of the Owner.

3.10 CONNECTION TO EXISTING SEWER SYSTEM

A. The Contractor shall make connections to the existing sewer system as shown on the Drawings. The connections shall be made by the Contractor at such hours that will cause the least disturbance to the flow in the existing sewer system. The Contractor, however, shall notify the Engineer at least five working days in advance of the time he desires to make the connections and no such connections shall be made until the permission of the Engineer is obtained.

3.11 CLEAN-UP

A. Before final acceptance for the Work, the Contractor shall clear the sewers of any mortar, dirt or other refuse that may have been left or accumulated in the sewers. All manholes and other structures shall be cleared of all forms, scaffolding, bulkheads, centering, surplus mortar, rubbish or dirt and left in a clean and proper condition.

3.12 DEFECTS TO BE MADE GOOD

A. If, at any time before the completion of the contract, any broken pipes, or any defects, are found in the sanitary sewers or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without extra compensation for the labor and material required. All materials shall be carefully examined by the Contractor for defects before placing and any found defective shall not be placed in the line.

END OF SECTION 333100