SECTION 5
SPECIFICATIONS

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION OF THE PROJECT

A. The project is located in Perry Village and Perry Township, Lake County, Ohio. The project is bounded by Shepard Road to the west, Maple Street to the east and the Norfolk Southern tracks to the north and south.

1.2 PROJECT DESCRIPTION

A. Midwest Materials sanitary facilities currently include two on-site treatment systems. The system servicing the westerly end of the property is an on-site extended aeration treatment plant and the system servicing a building on the east end is an on-site septic system with a mounded drain field. The on-site extended aeration treatment plant and on-site septic system are to be abandoned/removed.

B. The extended aeration treatment system is being removed and replaced with 6" gravity sewers and service connections, a new pump station and about 3600 lineal feet of 2" HPDE force main. The on-site septic system is being removed and replaced with 6" gravity sewer service connection, a new pump station and about 340 lineal feet of 2" HPDE force main.

C. It is the design intent that all the force main within the limits of the Norfolk Southern (NS) railroad property, from Sta. 20+00 to Sta. 34+92.66 be installed by horizontal directional drilling methods (HDD). This method of installation has been approved by NS and is part of the system approved by the railroad under the Occupancy Agreement. Open-cut excavation for the installation of the flushing manholes will be permitted.

D. The base bid includes all work excepting the installation of the flushing manholes.

E. Alternate A is for the installation of flushing manholes and associated appurtenances as described in the Prices to Include and/or as shown on the drawings. The Owner reserves the right to award all or any portion of these alternate items to fit within the budget.

1.3 SPECIFICATIONS

A. In general, these Specifications describe the work to be performed by the various trades, other than work specifically excluded. It shall be the responsibility of the Contractor and Subcontractors to perform all work incidental to their trade, whether or not specific mention is made of each item, unless such incidentals are included under another Item.

B. It is advised that the Contractor and all Subcontractors familiarize themselves with the contents of the complete Specifications, particularly for the trades preceding, following, related or adjacent to their work.

1.4 DRAWING SCHEDULE

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

Sheet No.	Title
01	Cover Sheet
02	General Notes
03	Maintenance of Traffic
04	Gravity Sewer to P.S. & F.M. Plan Sta. 0+00 to Sta. 4+00
05	F.M. Plan Sta. 4+00 to Sta./ 11+00
06	F.M. Plan Sta. 11+00 to Sta. 16+54
07	Profile Gravity Sewer to P.S. & F.M. Sta. 0+00 to Sta. 3+00
08	Profile Sta. 3+00 to Sta. 13+00
09	Profile Sta. 13+00 to Sta. 16+54
10	Location Plan for NS and GOSOL
11	Plan & Profile Sta. 20+00 to Sta. 25+00
12	Plan & Profile Sta. 25+00 to Sta.30+00
13	Plan & Profile Sta. 30+00 to Sta. 34+80
14	Plan & Profile Sta. 34+80 to Sta. 38+50
15	Cross Sections at 20+70, 25+70 & 30+70
16	Cross Sections 32+30 & 34+80
17	Standard Details
18	Standard Details
19	Standard Details
20	Pump Station and Miscellaneous Details
21	Flushing Manhole and Miscellaneous Details

END OF SECTION 011100

SECTION 011419 – USE OF SITE

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor will be allowed the use of as much of the Midwest Materials site designated for the improvements as is necessary for his operation.

B. Work within the Norfolk Southern Railway right-of-way will be governed by the requirements and restrictions contained in the Occupancy Permit document and/or railroad specifications, whichever be the more stringent. A copy of the Occupancy Permit is included in the Appendix of these specifications.

C. Work within the Gosel properties shall be limited to the easement limits shown on the drawings. A copy of the easement is included in the Appendix of these specifications.

1.2 USE OF STREETS

A. During the progress of the work, the Contractor shall make ample provisions for both vehicle and pedestrian traffic on any public street and shall indemnify and save harmless the Owner from any expense whatsoever due to his operations over said streets. The Contractor shall also provide free access to all the fire hydrants, water, and gas valves located along the line of his work. Gutters and waterways must be kept open or other provisions made for the removal of storm water. Street intersections may be blocked only one-half at a time, and the Contractor shall lay and maintain temporary driveways, bridges and crossings, such as in the opinion of the Engineer are necessary to reasonably accommodate the public.

B. In the event of the Contractor's failure to comply with these provisions, the Owner may cause the same to be done, and may deduct the cost of such work from any monies due the Contractor under this Agreement, but the performance of such work by the Owner at its instance shall serve in no way to release the Contractor from his general or particular liability for the safety of the public or the work.

C. The Contractor shall repair at no cost to the Owner, all existing roads, parking areas, grassed areas that are damaged due to the execution of his work. The Contractor shall remove daily all mud, soil and debris that may be tracked onto existing streets, drives, or walks by his equipment or that of subcontractors or suppliers.

1.3 CLOSING STREETS TO TRAFFIC

The Contractor may with the approval governing authority and of the Engineer, close streets, or parts of streets, to vehicular traffic. The streets are to remain closed as long as the construction work or the condition of the finished work requires or as determined by the Engineer. The Engineer shall be the judge of how many streets or parts of streets it is necessary for the Contractor to close at any time, and may refuse to permit the

closing of additional streets to traffic until the majority of the work on the closed streets is completed and they are opened to traffic.

1.4 RIGHTS-OF-WAY

A. Whenever it is required to perform work within the limits of public or private property or in rights-of-way, such work shall be done in conformity with all agreements between the Owner and the owners of such. Care shall be taken to avoid injury to the premises entered, which premises shall be left in a neat and orderly condition by the removal of rubbish and the grading of surplus materials, and the restoration of said public or private property to the same general conditions as pertained at the time of entry for work to be performed under this contract.

B. The Contractor shall not (except after consent from the proper parties) enter or occupy with men, tools or equipment, any land outside the rights-of-way or property of the Owner.

C. When the Contractor performs construction within 10 ft. of a right-of-way or easement line, he shall place tall stakes properly identified at points of change in width or direction of the right-of-way or easement line and at points along the line so that at least two stakes can be seen distinctly from any point on the line.

1.5 EASEMENTS

A. Where the work is to be constructed upon easements, such easements will be secured by the Owner without cost to the Contractor. The Contractor shall not enter upon or occupy any private property outside of the limits of the easements furnished.

B. Care shall be taken to avoid injury to the premises entered, which premises shall be left in a neat and orderly condition by the removal of rubbish and the grading of surplus materials, and the restoration of said public or private property to the same general conditions as pertained at the time of entry for work to be performed under this contract.

1.6 PROTECTING EXISTING BUILDINGS, STRUCTURES AND ROADWAYS

A. The Contractor shall, at his own expense, shore up and protect any buildings, roadways, utilities or other public or private structures which may be encountered or endangered in the prosecution of the work, and that may not be otherwise provided for, and he shall repair and make good any damages caused to any such property by reason of his operations. All existing fences removed due to the prosecution of the work shall be replaced by the Contractor. No extra payment will be made for said work or material, but the cost of this work must be included in the price stipulated for the work to be done under this contract.

1.7 SITE FACILITIES

A. The Contractor shall furnish and place sufficient quantities of portable toilet facilities at locations convenient for use by the Contractor's personnel, Subcontractors, the Engineer, and the Owner.

1.8 RESTORATION

A. The Contractor shall restore all areas per the plans and specifications and if not specified, at least to the condition existing prior to the start of work.

END OF SECTION

SECTION 011423 - ADDITIONAL WORK, OVERTIME

PART 1 - GENERAL

1.1 NIGHT, SUNDAY AND HOLIDAY WORK

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

END OF SECTION 011423

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.

1. Selected materials, equipment and/or services are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Utility allowance.
2. Inspection/Flagmen allowance.
3. Contingency/Discretionary Allowance

1.3 SUBMITTALS

A. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance, costs and manhours associated with each allowance.

B. Submit proposal for any proposed change or increase in allowances, in the form specified for Change Orders.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.4 UTILITY ALLOWANCES

A. Use the utility allowance only as directed by Owner and only by Change Orders that indicate amounts to be charged to the allowance.

B. The amount to be paid from the Owner to the Contractor and amount utilized in the allowance shall be the invoice amount the utility company without any markup by the Contractor and contract provisions regarding the retainer.

C. Invoices for all work completed by the utility company shall be submitted as evidence of the work completed on the project.

D. No payment for this item will be made to the Contractor for utility work required when resulting from the Contractor's construction methods or rework due to negligence ~~or~~ construction methods.

E. At Project closeout, credit unused amounts remaining in the utility allowance to Owner by Change Order.

1.5 INSPECTION ALLOWANCE

A. Use the inspection allowance only as directed by Owner and only by Change Orders that indicate amounts to be charged to the allowance.

B. Inspection allowance includes the cost of actual on-site inspections or use of flagmen by Norfolk Southern Railway Company for work on this project.

C. The allowance does not include incidental labor or scheduling required to assist Norfolk Southern in the performance of their inspections. The cost for incidental labor shall be included in the Contract Sum.

D. Costs of services not required by the Contract Documents are not included in the allowance.

E. Project closeout, credit unused amounts remaining in the inspection/flagmen allowance to Owner by Change Order.

1.6 CONTINGENCY/DISCRETIONARY ALLOWANCE

A. Use the contingency/discretionary allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency/discretionary allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency/discretionary allowance to Owner by Change Order. Use the contingency/discretionary allowance only as directed by Owner and only by Change Orders that indicate amounts to be charged to the allowance.

1.7 USED MATERIALS

A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Engineer, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Engineer, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

A. Utility Allowance: Includes the lump sum allowance of $10,000 for utility company charges to support, repair, and/or relocate existing utilities that are not shown on the Contract Drawings.

B. Inspection/Flagmen Allowance: Include the sum lump sum allowance of $20,000 for inspection services and/or flagmen services by Norfolk Southern Railway Company.

C. Contingency/Discretionary Allowance: Include the sum lump sum allowance of $10,000 for items of work that cannot be defined until after the contract has been

END OF SECTION 012100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing Alternates.

1.3 DEFINITIONS

A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
2. Bidders must provide pricing for all alternates.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate that Work into the Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

B. Notification: Immediately following the award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other Work of this Contract.

D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. A1: Add a minimum of one (1) up to a maximum of ten (10) new Flushing Manholes at locations shown on the drawings as selected by JEDD and/or the Engineer. Each Flushing Manhole shall be installed in accordance with the details shown on the plans and include pressure relief valves; concrete anchor blocks for force mains entering and exiting the manholes; earthwork; piping and fittings; precast concrete manholes and appurtenances as detailed for each location.

END OF SECTION 012300

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

SECTION 013216 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 PROGRESS SCHEDULE

A. Immediately after signing the Contract, the General Construction Contractor shall prepare a graphic progress schedule, indicating the work to be executed during each month and the rate of expected progress to secure completion on the agreed-upon completion date. The progress schedule shall be approved by the Engineer and Owner prior to starting work on the site. Copies of such graphic progress charts, upon which has been indicated the actual progress, shall be furnished to the Engineer with each requisition for payment.

B. Should the rate of progress fall materially behind the scheduled rate of progress, and unless the delay is authorized by the Engineer, each offending Contractor shall furnish additional labor, work overtime, or take other necessary means required for completion of the work on the scheduled date. No additional compensation beyond the set Contract price shall be paid for action taken or overtime expense incurred in maintaining scheduled progress.

END OF SECTION 013216

SECTION 013223 - SURVEYS, LAYOUTS AND LEVELS

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

SECTION 013233 – PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 PROGRESS PHOTOGRAPHS

A. The General Construction Contractor shall have two (2) color photographs made of the project every three (3) weeks it is in progress. The photographs shall be of such views and taken at such times as the Engineer directs.

B. All photographed work shall be done by a qualified, established, commercial photographer. Two (2) glossy prints of each photograph shall be furnished the Engineer and two (2) to the Owner. Prints shall be approximately 7-1/2 in. X 10 in. in size. Prints shall be inserted in transparent sheet protectors provided with punching for a 3-ring binder. Suitable binders shall be provided by the Contractor.

C. Each photograph shall have a permanent negative title block in the lower right hand corner or on the back, approximately 2-1/4 in. wide x 1-3/4 in. high, and stating therein in neat lettering:

1. Owner's Name
2. Contract Description
3. Contractor's Name
4. Description of View
5. Photo No._____, Date_____
6. Consulting Engineer

D. The arrangement of and the information in the title block, shall be subject to the Engineer's approval. The cost for all photographs shall be paid for by the General Construction Contractor.

END OF SECTION 013233

SECTION 013236 – VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

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

1.2 QUALIFICATIONS

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

1.3 PRODUCTS

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

END OF SECTION 013236

SECTION 013319 – FIELD TEST REPORTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes, but is not limited to, services performed by an independent testing laboratory. Laboratory services covered under this section are for testing materials used for field constructed elements of the work. Performance testing of manufactured items and shop fabricated materials shall be covered under their respective specification section.

B. All testing performed under this item shall be for the protection and benefit of the Owner and shall not be construed by the Contractor as a comprehensive quality control program intended to protect the Contractor, his subcontractors, or his suppliers. Unless otherwise directed by the Owner, testing frequency and types of testing shall be as scheduled herein.

C. Inspections, tests, and related actions specified in this section and elsewhere in the contract documents are not intended to limit the Contractor's own quality control procedures and testing, which facilitate overall compliance with requirements of the contract documents. Requirements for the Contractor to provide quality control services as required by the Engineer, the Owner, governing authorities, or other authorized entities are not limited by the provisions of this Section.

D. The Contractor is required to cooperate with the independent testing laboratories performing required inspections, test, and similar services and the Engineer or his representative.

E. Materials and installed work may require testing or retesting at any time during progress of work. Retesting of rejected materials or installed work shall be done at Contractor's expense.

1.2 RELATED DOCUMENTS

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

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.

1.5 SUBMITTALS

A. Prior to the start of work, submit testing laboratory name, address, and telephone number, and names of full-time registered Engineer and responsible officer.

B. Submit copy of the testing laboratory's evaluation report issued by one of the evaluation authorities identified in Article 1.6 of this Section with memorandum of remedies of any deficiencies reported by the inspection.

C. Submit the chain of custody and other QA/QC procedures for each test to be utilized by the laboratory.

D. Submit a sample test report for review by the Engineer to demonstrate conformance with Article 3.2 herein.

1.6 QUALITY ASSURANCE

A. Except as otherwise indicated, the testing laboratory engaged shall be prequalified by the Ohio Department of Transportation for the types of services specified herein.

B. The field personnel utilized to perform all field-testing and preparation shall be certified for those tests being performed.

1.7 RESPONSIBILITIES

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

B. Contractor Responsibilities:
   1. Provide access to materials proposed to be used which require testing.
   2. Cooperate with laboratory personnel and provide access to the work and to manufacturers' facilities, if so required.
   3. Provide incidental labor and facilities:
      a. To provide access to work to be tested.

b. To obtain and handle samples at the site or at the source of products to be tested.
c. To facilitate tests.
d. To provide storage and curing of test samples as required by the testing laboratory.

4. Notify the Engineer and laboratory 24 hours prior to expected time for operations requiring testing services for scheduling purposes. Materials will not be permitted to be placed without the proper testing being performed in conformance with this Section.

1.8 LIMITS OF LABORATORY AUTHORITY

A. The laboratory may not release, revoke, alter, or enlarge the requirements of the contract documents.

B. The laboratory may not approve or accept any portion of the work.

C. The laboratory may not assume any duties of the Contractor.

D. The laboratory has no authority to stop the work.

1.9 SCHEDULE OF TESTS

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

A. Earthwork
1. Special backfill material sieve analysis per ASTM C-136, one test per source.
2. On-site trench backfill analysis per ASTM D-2487, as directed by Engineer.
3. Pipe bedding and cover sieve analysis per ASTM C-136, one test per source.
4. Drainage fill sieve analysis per ASTM C-136, one test per source.
5. Soil compaction per ASTM D-698.
   a. Embankment testing shall be at least one (1) test/5,000 S.F. of each lift;
   b. Trench backfill testing shall be at least one (1) test/50 L.F. of each lift;
   c. Subgrade and/or subbase testing shall be at least one (1) test/200 L.F. of pavement or 5,000 S.F. of slabs subject to greater frequency due to soil conditions or Engineer's direction.
6. Backfill compaction per ASTM D-4253 and D-4254, one test per 50 L.F. of each lift.
7. Low Strength Mortar testing per ASTM D-4832.

B. Concrete

1. Concrete aggregate deleterious substances per ASTM C-40, ASTM C-117, and ASTM C-142, one test per source.
2. Concrete aggregate abrasion per ASTM C-535, one test per source.
3. Sodium sulfate soundness of coarse aggregate per ASTM C-88, one test per source.
4. Sampling Fresh Concrete: ASTM C-172, except modified for slump to comply with ASTM C 94.
   a. When cylinders and/or beam samples are made, the slumps and air test shall be made using concrete from the same batch.
   b. Slump: ASTM C-143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
   c. Air Content: ASTM C-173, volumetric method of lightweight concrete; ASTM C-231 pressure method for normal weight concrete; at least one for each pour of each type of air-entrained concrete, and each time a set of compression test specimens is made.
   d. Concrete Temperature: ASTM C-1064, test hourly when air temperature is 40° F. (4° C.) and below, and when 80° F. (27° C.) and above; and each time a set of compression test specimens is made.
   e. Compression Test Specimen: ASTM C-31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
   f. Compressive Strength Tests: ASTM C-39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days.
      i. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
      ii. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
   g. Two (2) tests beams shall be made for each 250 square yards of concrete pavement and/or slabs on grade placed.

i. For traffic to be allowed on pavement or slab, the modulus of rupture shall be a minimum of 600 psi for Class C concrete or 400 psi for ODOT Class MS or FS.

h. When cylinders and/or beam samples are made, the slumps and air test shall be made using concrete from the same batch.

5. Nondestructive Testing: Penetration resistance, sonoscope, or other nondestructive devices may be permitted but shall not be used as the sole basis for acceptance or rejection.

6. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

a. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

C. Pavement

1. Aggregate base sieve analysis per ASTM D-2940, one test per source.
2. Sodium sulfate soundness of aggregate base per ASTM C-88, one test per source.
3. Percent of fractured pieces for aggregate base per ODOT Supplement 1021, one test per source.

D. Asphalt

1. Provide testing for mixture acceptance in accordance with Ohio Department of Transportation Procedures. The person performing the testing must have a current Level 1 Bituminous Concrete approval from ODOT.

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

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 01061.

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 01061.

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 NDPES 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

SECTION 014126 - GENERAL REGULATIONS AND PERMITS

PART 1 - GENERAL

1.1 REGISTRATION

Only water/sewer Contractors and subcontractors licensed by the Lake County Board of Commissioners may install sanitary sewers.

1.2 PERMITS

The General Contractor shall apply for all building and right-of-way permits from the Owner or other authorities. All permits and inspection fees shall be obtained and paid for by the General Contractor.

1.3 NORFOLK SOUTHERN RAILWAY COMPANY OCCUPANCY PERMIT

All Contractors shall comply with the terms and conditions of the Norfolk Southern Railway Company Occupancy Permit included in the appendix of these specifications.

1.4 ARCHAEOLOGICAL DISCOVERIES

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

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

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

END OF SECTION

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, 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

SECTION 016600 - PRODUCT HANDLING AND PROTECTION

PART 1 - GENERAL

1.1 DELIVERY AND STORAGE OF MATERIALS

A. The Contractor shall be responsible for delivery and storage of all materials.

B. The Contractor shall coordinate with the Engineer on the arrangement for storing construction materials and equipment. Deliveries of all construction materials and equipment should be made at suitable times.

C. The Contractor shall store all materials required for the performance of this contract at sites designated by the Engineer.

D. All stockpiles shall be neat, compact, completely safe, and barricaded with warning lights if necessary.

E. Precautions shall be taken so that no shade trees, shrubs, flowers, sidewalks, driveways or other facilities will be damaged by the storage of materials. The Contractor shall be responsible for the restoration of all stockpile sites to their original condition.

F. Materials, tools and machinery shall not be piled or placed against shade trees, unless they shall be amply protected against injury therefrom. All materials, tools, machinery, etc. stored upon public thoroughfares must be provided with red lights at night time so as to warn the traffic of such obstruction.

G. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, shall again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the construction site may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefore must be provided by the Contractor at his expense. Private property shall not be used for storage purposes without written permission of the property owner or lessee, and copies of such written permission shall be furnished the Engineer. All storage sites shall be restored to their original condition by the Contractor at his expense.

END OF SECTION 016600

SECTION 017800 - FINAL COMPLIANCE AND SUBMITTALS

PART 1 - GENERAL

1.1 The following forms and related sign-offs shall be documented in accordance with provisions of the contract. These forms shall be completed by the Contractor and approved by the Owner before final retainer is approved for release. Forms for Items A to E will be attached to the Contractor's executed copy of the contract.

A. Certificate of Substantial Completion (To be submitted at time of Substantial Completion).

B. Contractor's Certification of Completion.

C. Contractor's Affidavit of Prevailing Wage.

D. Consent of Surety Company for Final Payment.

E. Affidavit of Final Acceptance Date and Correction Period.

F. DBE Subcontractor Participation Forms SR-EPA.7-8 (Applicable for WPCLF & WSRLA funded projects only).

G. CDBG Subcontractor List 01099CT (Applicable for CDBG funded projects only).

END OF SECTION

SECTION 017821 - CLEANING AND PROTECTION

PART 1 - GENERAL

1.1 GENERAL

A. On or before the completion date for the work, the Contractor shall tear down and remove all temporary structures built by him, all construction plant used by him, and shall repair and replace all parts of existing embankments, fences or other structures which were removed or injured by his operations or by the employees of the Contractor. The Contractor shall thoroughly clean out all buildings, sewers, drains, pipes, manholes, inlets and miscellaneous and appurtenant structures, and shall remove all rubbish leaving the grounds in a neat and satisfactory condition.

B. As circumstances require and when ordered by the Engineer, the Contractor shall clean the road, driveway, and/or sidewalk on which construction activity under this contract has resulted in dirt or any other foreign material being deposited with an automatic self-contained mechanical sweeper with integral water spray, vacuum and on-board or supplementary containment.

C. Failure to comply with this requirement when ordered by the Engineer or his representative, may serve as cause for the Engineer to stop the work and to withhold any monies due the Contractor until such order has been complied with to the satisfaction of the Engineer.

D. As the work progresses, and as may be directed, the Contractor shall remove from the site and dispose of debris and waste material resulting from his work. Particular attention shall be given to minimizing any fire and safety hazard from form materials or from other combustibles as may be used in connection with the work, which should be removed daily.

E. The Contractor shall wash all windows and other glass surfaces, leaving all areas free from putty marks, paint, etc.

F. During and after installation, the Contractor shall furnish and maintain satisfactory protection to all equipment against injury by weather, flooding or breakage thereby permitting all work to be left in a new condition at the completion of the contract.

END OF SECTION

SECTION 017823 –MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance information shall be submitted for all manufactured items, i.e. equipment, hardware, pumps, valves, motors, etc.

B. This manual will either contain or make reference to all information that has been issued during the construction and start-up periods, as well as information necessary for the proper operation and maintenance of equipment.

C. It shall be the responsibility of the Contractor who supplies such equipment to obtain from his vendors the required information and submit to the Engineer. This information will be accepted only if properly identified and only after it has been revised, where necessary, to conform to previous transmittals of the same material that have been "approved as noted" by the Engineer. All submittals shall be on 8-1/2" X 11" size paper or folded to that size.

D. In general and where applicable, the information shall consist of, but not be limited to, six (6) sets of the following:

1. Descriptive literature, bulletins or other data covering equipment or system.
2. Complete list of equipment and appurtenances included with system, complete with manufacturer and model number.
3. Utility requirements.
4. General arrangement drawing.
5. Sectional assembly.
6. Dimension print.
7. Materials of construction.
8. Certified performance curve.
9. Performance guarantee.
10. Parts list.
11. Recommended spare parts list with part and catalog number.
12. Lubrication recommendations and instructions.
13. Schematic wiring diagrams.
14. Schematic piping diagrams.
15. Instrumentation data.
16. Drive dimensions and data.
17. Control data.
18. Operating instructions.
19. Maintenance instructions including troubleshooting guidelines and preventative maintenance instructions with task schedule.
20. Required tools and equipment for operation and maintenance.
21. Safety considerations for O & M procedures.

END OF SECTION 017823

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.

C. The location of each water connection as measured along the water line from the nearest fire hydrant.

END OF SECTION 017839

SECTION 018000 - SYSTEM PERFORMANCES

PART 1 - GENERAL

1.1 GENERAL

A. It is the intent of this Contract that the final installation shall be complete in all respects.

B. The Contractor shall be responsible for all minor details, whether or not shown on the Drawings or specifically included in these Specifications.

1.2 FACILITIES

A. The facilities and equipment shall function properly and in accordance with plans, specifications and industry standards.

B. The following equipment includes, but is not necessarily limited to, the following:

1. Valves
2. Pumping Equipment
3. Pumping Controls
4. Electrical

1.3 CERTIFICATION

A. The Contractor shall provide written certification from the manufacturers and/or installers that the various major components are in working order or have been installed in accordance with the manufacturer's instructions.

END OF SECTION

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 codes, rules and regulations shall control the abandonment and demolition of tanks and the removal and disposal of debris.

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 WASTEWATER TREATMENT PLANT DEMOLITION

A. Disconnect power at the source to all electrical controls and remove all controls and panels and electrical lines (including buried service lines) that will not be used for other purposes.

B. Remove all above-ground equipment and appurtenances. Remove all pumps, interior piping, and miscellaneous components.

C. Have the contents of all tanks (including the trash trap) in the system pumped out and hauled to a publicly owned treatment plant. Sand from the filter beds, sludge deposits and soil containing sludge or sewage shall be removed and hauled to a licensed landfill.

D. Break/fracture all tank bottoms left in place in such manner that will permit surface water from ponding in the structure. If the tank bottoms retain water after being broken/fractured, bottom slabs shall be core drilled, as directed by the Engineer, or be completely removed.

E. Remove tanks from the ground or crush the sidewalls inward. No portion of the tank wall may be less than 3 feet below finished grade or ground surface.

F. Backfill voids with debris-free sand or granular material, concrete, or soil material that is compacted to 100% optimum density per ASTM D698 to prevent settling. Backfill material under pavements shall meet the requirements of ODOT Item 304.

G. Regrade area and perform restoration as required by the specifications.

H. The Owner of the Wastewater Treatment Plant will then be responsible for contacting the Northeast District Office of the Ohio EPA in Twinsburg, Ohio, in writing, stating that the public sewer connection and the plant demolition have been completed.

I. Once the wastewater treatment plant is demolished, the NPDES permit for the wastewater treatment plant will be revoked.

3.2 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.

3.3 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. Concrete shall be saw cut for the full depth of the pavement.

C. 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.

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

3.4 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 or pump stations 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.

3.5 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.

3.6 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 no increase in Contract Price.

D. Extreme care shall be used when removing existing concrete from around reinforcing steel which must be used for securing new concrete. If this reinforcing steel is damaged, the Contractor shall remove additional existing concrete until sufficient existing reinforcing steel is exposed to provide adequate embedment length in the new concrete, as approved by the Engineer.

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

3.7 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 any or all 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.

3.8 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.

3.9 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 31000.

END OF SECTION 024116

SECTION 271620 – TRACER WIRE

PART 1 - GENERAL

1.1 MATERIALS

A. All trace wire and trace wire products shall be domestically manufactured in the U.S.A.

B. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

C. All 2" HDPE force main shall be installed with tracer wire.

D. Trace wire
   1. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
   2. Directional Drilling/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with Minimum 30 mil HDPE insulation thickness.

E. Connectors
   1. All mainline trace wires must be interconnected.
   2. Direct bury wire connectors - shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
   3. Non locking friction fit, twist on or taped connectors are prohibited.

F. Termination/Access
   1. All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
   2. All grade level/in-ground access boxes shall be appropriately identified with "sewer" cast into the cap and be color coded.
   3. A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
   4. All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
   5. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

G. Grounding

1. Trace wire must be properly grounded at all dead ends/stubs.
2. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #12 red HDPE insulated copper clad steel wire connected to anode (minimum 1.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
3. When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
4. When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.
5. Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

H. Installation

1. General
   a. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
   b. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
   c. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
   d. Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5' intervals.
   e. Trace wire must be properly grounded as specified.
   f. Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace wire Termination/Access)
   g. At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. (See Grounding)
   h. Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.
   i. All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.

j. In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

I. Sanitary Force Main
1. A mainline trace wire must be installed to ensure full tracing/locating capabilities from a single connection point.
2. Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.
3. Trace wire on sanitary force mains must terminate at an approved trace wire access box color coded green and located directly above the main.

J. Testing
1. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the Contractor, Engineer and facility Owner as applicable, prior to acceptance of ownership.
2. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
3. Continuity testing in lieu of actual line tracing shall not be accepted.

K. Products
1. The following products have been deemed acceptable. Alternative products of equal specifications will also be considered for approval.
2. Copper clad Steel (CCS) trace wire
   a. Open Trench — Copperhead #12 High Strength part # 1230*-HS**
   b. Directional Drilling/Boring - Copperhead Extra High Strength part # 1245*-EHS**
   * Denotes color: B=Blue, G=Green, P=Purple
   **Denotes spool size. 500' 1000' 2500'
3. Connectors
   a. Copperhead 3-way locking connector part # LSC1230*
   b. DryConn 3- way Direct Bury Lug: Copperhead Part # 3WB-01
4. Termination/Access
   a. Non-Roadway access boxes applications: Trace wire access boxes Grade level Copperhead adjustable lite duty Part # LD14*TP.
   b. Roadway access box applications: Trace wire access boxes Grade level Copperhead Part # RB14*TP.
5. Grounding
   a. Drive in Magnesium Anode: Copperhead Part # ANO-12 (1.5 lb.)

END OF SECTION

SECTION 31000 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

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

B. The Work covered by this Section consists of:
1. making all necessary excavations for the construction of all Work;
2. preparing subgrade for foundations, slabs, walks, and pavements;
3. doing all pumping, fluming, and dewatering necessary to keep the excavations free from water;
4. providing for uninterrupted flow of existing drains and sewers, and the disposal of water from any sources during the progress of the Work;
5. supporting and protecting all structures, pipes, conduits, culverts, posts, poles, wires, fences, buildings and other public and private property adjacent to the Work;
6. removing and replacing existing sewers, culverts, pipelines and bulkheads where necessary;
7. removing after completion of the Work all sheeting and shoring or other soil support materials not necessary to support the sides of trenches;
8. removing and disposing all surplus excavated material;
9. doing all backfilling and grading, of compacting backfill to limits specified or ordered by the Engineer;
10. restoring all property damaged as a result of the Work involved in this Contract.

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

D. The Work includes:
1. constructing a structure of soil or granular material in layers to a predetermined elevation and cross section;
2. supporting and protecting all structures, pipes, conduits, culverts, posts, poles, wires, fences, buildings and other public and private property adjacent to the Work;
3. placing all fill and performing rough grading;
4. compacting fill to limits specified or ordered by the Engineer;
5. restoring all property damaged as a result of the Work involved in this Contract.

E. The Work includes low strength mortar backfill material intended for use in backfilling as shown on the Drawings.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013319 – Field Test Reporting

B. Section 311201 – Site Clearing

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. Embankment: A structure consisting of soil, granular material, shale, rock, or other approved material, constructed in layers to a predetermined elevation and cross-section.

F. 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.

G. 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.

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

I. 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, Product Data and Samples.

B. Product Data: For the following:
   1. Source-locations of all materials shall be identified to the Engineer.
   2. Source quality laboratory test of all fill materials as required to show compliance with material specifications.

C. Shop Drawings: Submit information for the following items:

1. Sheeting and bracing *(prepared and stamped by a professional engineer, registered in the State of Ohio).*
2. Dewatering system and standby equipment *(prepared and stamped by a professional engineer, registered in the State of Ohio).*
3. Cofferdams *(prepared and stamped by a professional engineer, registered in the State of Ohio).*
4. Protection methods anticipated *(prepared and stamped by a professional engineer, registered in the State of Ohio).*
5. Excavation procedures *(prepared and stamped by a professional engineer, registered in the State of Ohio).*

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

J. State of Ohio - Department of Transportation - Construction and Material Specifications, Item 304, Aggregate Base.

K. State of Ohio - Department of Transportation - Construction and Material Specifications, Material Detail 703.16, Suitable Materials for Embankment Construction.

L. State of Ohio - Department of Transportation - Construction and Material Specifications, Material Detail 703.02.A.2, Fine Aggregate for Portland Cement Concrete

1.6 QUALITY ASSURANCE

A. Qualifications

B. Regulatory Requirements

C. Certifications

D. Field Samples

E. Pre-Construction Conference

1.7 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.

C. 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.

1.8 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 13543, Environmental Protection.

1.9 SEQUENCING AND SCHEDULING

A. Refer to 013319 for testing laboratory service scheduling.

B. Provide construction sequencing schedule for excavation work.

1.10 PROHIBITION OF EXPLOSIVES

A. The use of explosives is not permitted.

1.11 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 or utility 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.

B. In addition to the locations indicated on the drawings, the Contractor is responsible for verifying the location, size and depth of all utilities which will be encountered prior to the installation of new improvements.

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 SAND PIPE EMBEDMENT

A. Fine aggregate consisting of natural sand meeting the gradation requirements of ODOT Item 703.02.A.2 or shown on the Drawings. The material shall not be lumpy or frozen, and shall be free from slag, cinders, ashes, rubbish, and other deleterious or objectionable material. Sand shall not contain a total of more than 10% by weight of loam and clay.

2.3 ONSITE BACKFILL

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

B. 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 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

2.4 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

2.5 LOW STRENGTH MORTAR BACKFILL

A. Low Strength Mortar shall comply with ODOT Item 613.

B. Submit test data that demonstrates that the proposed mix has a strength of 50 to 100 PSI at 28 days.

C. Each load shall be tested with 3 cylinders for strength test broken at 3, 7, and 28 days until the Engineer is assured that the mix will be between 50 to 100 PSI at 28 days. Thereafter, one set of strength tests shall be taken every 50 CY.

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

D. Mortar Mix Proportioning

1. The initial trial mixture shall be as follows:

Quantity of Dry Materials per Cubic Yard

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

* saturated-surface dry

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

2.6 EMBANKMENTS

A. Soils suitable for use in an embankment must conform to ODOT 703.16 and are restricted as follows:

1. Maximum laboratory dry weight shall not be less than 90 pounds per cubic foot, except that soils having maximum dry weights of less than 100 pounds per cubic foot shall not be used in the top 12 inches of embankment.
2. Soil having a liquid limit in excess of 49 are considered as unsuitable for use in an embankment.
3. Silt from excavation or borrow identified as Ohio Classification A-4b shall be considered suitable for use in an embankment only when placed at least 3 feet below the surface of the subgrade.
4. No slag, recycled Portland cement concrete or recycled asphaltic concrete products are suitable for use in an embankment.
5. Do not use any suitable material that cannot be incorporated in an 8-inch lift in the top 2 feet of the embankment.
6. Do not use shale, hard shale, or siltstone in the top 2 feet of embankment.
7. Do not use materials that cannot be satisfactorily placed and compacted to a stable and durable condition.
8. Material excavated in the work that contains excessive moisture is unsuitable for embankment construction unless dried. Dry or aerate such material before incorporating in the work. The Contractor may elect to waste this material, instead of drying it.

9. Granular material Type E as specified in ODOT 703.16.C, is not allowed.
10. No petroleum contaminated soils are suitable for use in an embankment.

2.7 ENGINEERED FILL

A. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940. The aggregate shall meet the following gradation requirements:

Sieve	Total Percent Passing
2 inch	100
1½ inch	95-100
¾ inch	70-92
3/8 inch	50-70
No. 4	35-55
No. 30	12-25
No. 200	0-8

2.8 ACCESSORIES

A. Warning Tape
1. Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; 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.

B. 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.

B. Construction Sheeting Left in Place
   1. The Contractor shall furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.
   2. Any construction sheeting and bracing which the Contractor has placed to facilitate his work may be ordered in writing by the Engineer to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating an obligation on his part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of his responsibility under this Contract.

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.

E. Unauthorized Excavation shall be filled with Class B concrete to the bottom limits of structures. Under circumstances where structural integrity is not a factor, the Engineer may authorize the filling of Unauthorized Excavation with Low Strength Mortar Backfill or Special Backfill material compacted to 100% density as specified under the compaction requirements in this Section. Such work shall be at the cost of the Contractor.

3.6 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.

3.7 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.

3.8 BACKFILL

A. 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.

3.9 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.

3.10 EMBANKMENT

A. In making fill for embankment, the surface of the existing ground shall be cleared, grubbed, stripped of organic material, plowed, compacted according to the requirements specified in this Section, and stepped on slopes so as to enable bond or firm bearing for the new fill. The materials for these fills shall be selected of approved materials free from organic matter and placed in horizontal layers not exceeding eight (8) inches in thickness when loose, each layer being thoroughly compacted. Materials shall not be placed when fill or foundation is frozen.

B. Where fill is to be placed on side slopes steeper than one (1) vertical to six (6) horizontal, steps shall be formed into the slope before any embankment is placed. These steps shall be cut at vertical intervals at no more than two (2) feet and shall have a horizontal dimension of not less than three (3) feet.

C. As fill progress, the top shall be kept crowned or sloped for drainage. No pavement shall be placed upon embankment until it meets compaction testing requirements.

D. Fills that abut or contain concrete or masonry structures shall be placed with care to avoid undue or unbalanced loads on these structures.

E. Following the completion of embankment, all slopes shall be neatly and evenly dressed to proper elevation, grade and dimension.

3.11 SUBGRADE

A. All soil subgrade shall be prepared in accordance with this subsection.

B. Drainage
   1. The surface of the subgrade shall be maintained in a smooth condition to prevent ponding of water after rains to insure the thorough drainage of the subgrade surface at all times.

C. Unsuitable Subgrade
   1. Where unsuitable subgrade or subgrade not meeting the required bearing capacity is encountered in cuts, due to no fault or neglect of the Contractor, in which satisfactory stability cannot be obtained by moisture control and compaction, the unstable material shall be excavated to the depth required by the Engineer.
   2. Suitable material required for the embankment to replace the undercut will be paid on basis of Contract Conditions relative to changes in Work.
   3. Where soft subgrade in cuts is due to the failure of the Contractor to maintain adequate surface drainage as required in this article, or is due to any other fault or neglect of the Contractor, the unstable condition shall be corrected as outlined above at no expense to the Owner.

3.12 TOLERANCES

A. The Contractor shall check the work under this item with templates, slope boards or other devices satisfactory to the Engineer. The completed work shall conform to the Drawings within the following tolerances:
   1. For subgrade, the surface shall at no place vary more than ½ inch from a ten-foot straight edge applied to the surface parallel to the centerline of the pavement, nor more than ½ inch from subgrade elevation established by construction layout stakes.

3.13 CONSTRUCTION WITH MOISTURE AND DENSITY CONTROL

A. All backfill and embankments, except rock embankments, shall be constructed using moisture and density control. All subgrade, except rock and shale in cut sections, shall be constructed using moisture and density control.

B. Backfill, embankment and subgrade material which does not contain sufficient moisture to be compacted in accordance with the requirements of Article 3.17 of this Section shall be sprinkled with water as directed by the Engineer to bring the moisture content to within the range of optimum plus or minus three (3) percent. Water shall be thoroughly incorporated into the material by means of discs or other approved equipment.

C. Backfill, embankment and subgrade material containing excess moisture shall be dried, prior to installation, to a moisture content not greater than three (3) percentage points above optimum, except that for material within the moisture content range specified herein that displays pronounced elasticity or deformation under the action of loaded construction equipment, the moisture content shall be reduced to optimum or below if necessary to secure stability. For subgrade material, these requirements for maximum moisture shall apply at the time of compaction of the subgrade and also at the time of placing pavement or subbase. Drying of wet soil shall be expedited by the use of plows, discs, or by other approved methods when so ordered by the Engineer.

3.14 COMPACTION REQUIREMENTS

A. Compaction of subgrade for sidewalks (regardless of paving material) shall be 100% of maximum dry density per ASTM D-698 in the top six (6) inches.

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

C. 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.

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

E. Fill placed within the interior of structures shall be compacted to not less than 100% of maximum dry density per ASTM D-698.

E. Embankment shall be placed and compacted in layers until the density is not less than the percentage of maximum dry density indicated in the following table determined by ASTM D-698.

EMBANKMENT SOIL COMPACTION REQUIREMENTS

Maximum Laboratory Dry Weight Pounds/Cubic Foot	Minimum Compaction Requirements Percent Laboratory Maximum
90-104.9	102
105-119.9	100
120 and more	98

G. 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.

3.15 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.
   b. Walks shall be graded to plus or minus 1/2 inch.

END OF SECTION

SECTION 311201 - SITE CLEARING

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. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.

B. Related Sections include the following:

1. Section 31000 Earthwork
2. Seeding – LCDU R & R.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Provide record drawings identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

A. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

D. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

E. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Engineer.

PART 2 - PRODUCTS – (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and

walkways, according to requirements of authorities having jurisdiction and sediment and erosion control Drawings.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.

2. Revise subparagraph above and below to suit Project.

E. Replace trees that cannot be repaired and restored to full-growth status, as determined by Engineer.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade in areas where surface improvements, pavements or drives are to be installed.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.6 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311201

SECTION 329219 - SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. Installation of seeded areas shall be to the extent shown on Contract Drawings and shall include supplying all seed, topsoil, soil conditioning materials, mulching 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.

C. Unless otherwise directed by JEDD or the Engineer, all areas outside of pavements and walks shall be seeded in accordance with this specification.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Provide copies of soils tests for both new topsoil (provided) and onsite topsoil for review and approval. This applies to all areas that require seeding, including reconditioned areas.

2. Provide location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown in the past 2 years.

3. Provide the name of the seed supplier, name and phone number, list of the seed, including varieties of seed, labels, and an analysis of the seed for review, 4 weeks prior to the start of seeding.

4. Provide soil amendments information based on soils test requirements.

5. Hydroseed mixture, mulch and application rates prior to performing the work.

1.3 QUALITY ASSURANCE

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

B. The Contractor shall have a soils test done at there expense and analyzed by a state approved testing agency. Soil tests shall be done on both the topsoil stockpiled from the

site and new topsoil brought to the site. A minimum of two (2) tests shall be done. The tests shall include percent organic matter, pH, Buffer pH, Phosphorus, Exchangeable Potassium, Calcium, Magnesium, Cation Exchange Capacity and Percent Base Saturation with recommendations for nitrogen, phosphate, potash, magnesium and lime based on plant type and use.

B. 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

B. 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.

C. 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.

D. 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.

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
Creeping Red Fescue (This shall be a blend, of 3 improved varieties; recommended variety is Boreal, Cindy Lou or Rose)	65%
Perennial Rye (This shall be a blend of 3 improved varieties; recommended varieties are Allsport, Prosport, Wilmington, TeeLee, Private or Derby Xtreme)	20%
Kentucky Bluegrass blend	15%

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.

B. If hydroseeding is used, wood fiber mulching material shall be used and shall consist of virgin wood fibers manufactured expressly from whole wood chips and shall conform to the following specifications.

- Moisture content	10.0% ± 3.0%
- Organic content	99.2% ± 0.8% O.D. Basis

- pH	4.8 ± 0.5
- Water holding capacity, minimum (grams of water per 100 grams of fiber)	1,000

Wood fiber mulching material shall be processed in such a manner as to contain no growth or germination inhibiting factors, and must contain a biodegradable green dye to aid in visual metering during application.

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.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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 or hydroseeder. 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. For seed sown with a spreader, 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. Contractor has the option to hydroseed large lawn areas, using equipment specifically designed for such application. The rate of application of wood fiber mulching materials is 40 lbs./1,000 S.F. Contractor shall not hydroseed within close proximity to buildings and structures, or when unfavorable wind conditions may blow the hydroseed material onto the structure. Contractor shall clean all areas not to be seeded of overspray.

E. 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 hydroseeder or 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. A soils test shall be required for existing lawns prior to any reconditioning.

B. 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.

C. Provide soil amendments as called for in the soils test.

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

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

F. 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.

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

H. 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 330507.14 – HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Section 330533.24 - HDPE Pipe and Fittings

1.2 DESCRIPTION

A. This section contains guidelines and specifications applicable to the installation of pipelines using horizontal directional drilling (HDD). It includes minimum requirements for design, materials, and equipment used for the horizontal directional drilling for the substantially trenchless construction of pipelines. The section also includes materials, dimensions, and other pertinent properties of pipe and required accessories. These properties provide minimum performance requirements for various components including joints.

B. Installation of pipelines shall be carried out by HDD where shown on the drawings and elsewhere by approval of the Engineer. The bore path shall be designed by the drilling contractor to ensure that pipe joints do not deflect more than 50% of manufacturer's recommended maximum deflection.

1.3 QUALITY ASSURANCE

A. 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.

B. 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 including the following:

1. The installation of a minimum of 2,000 LF of gravity flow sewers and force main.
2. The installation of pipe at depth of 20 feet or greater.

C. 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.

D. 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. Prior to beginning work, the Contractor shall submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan shall include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience including back-up personnel, a list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (if applicable), and environmental protection plan and contingency plans for possible problems. The work plan shall be comprehensive, realistic, and based on actual working conditions for this particular project. The plan shall document the thoughtful planning required to successfully complete the project.

B. Specifications on material to be used shall be submitted to Engineer. Material shall include the pipe, fittings, drilling mud, drilling additives, and any other item which is to be an installed component of the project or used during construction.

C. Submittal requirements in 1.3 Quality Assurance as listed above.

PART 2 - PRODUCTS

2.1 GENERAL

A. 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 (18' nominal), bore path inside diameter, and maximum deflection capabilities of the joint.

B. 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 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.

2.3 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.

2.4 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.

2.5 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.

2.6 JOINTS

A. Joints used for directional drilling shall be boltless, flexible, and restrained. Pipe and joint seals, when properly assembled and installed, shall be capable of dependably handling the specified internal pressure as well as vacuum and external pressures that can occur in pipeline operation. Joints shall exhibit such performance attributes in straight alignment or at maximum rated joint deflection. The pipe pulling head shall be made of ductile-iron and designed and furnished by the pipe manufacturer or an approved equal. The pulling head assembly shall have the same performance characteristics as the pipe to which it is connecting. It shall also be supplied with a filling/testing port of appropriate size for testing of the pipe after it is pulled through the bore path.

B. For pipe that is installed using the Assembly Line method or Ramp Method described under Part 3, 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.

2.7 PROOF-OF-DESIGN TESTS

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Engineer must be notified three days in advance of starting work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.

B. The drawings show existing utilities that are believed to be near the directional drill alignment. There is no guarantee that these utilities are located as shown or that other utilities may not be present. The Contractor is to field locate existing utilities in advance of the work so as not to delay work and to avoid conflict or disruption of utility services.

3.2 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.

3.3 BASIC ASSEMBLY/PULLING METHODS.

A. Cartridge Assembly (Option 1). Cartridge Assembly option is defined as the assembling of individual sections of flexible restrained joint ductile iron 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 flexible restrained joint ductile iron 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 without damaging the Polyethylene Encasement. The Contractor shall repair any damage to the wrap prior to the pipe section entering the bore path.

3.4 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 flexible 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.

3.5 PIPE TESTING

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

3.6 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.

3.7 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.

END OF SECTION 330507.14

SECTION 330507.37 - PILOT TUBE MICRO-TUNNELING

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. Section 013236 – Video Monitoring and Documentation

1.2 DESCRIPTION OF WORK

A. The Contractor shall examine the geotechnical report and borings and obtain additional information as required to assure that the system provided will be capable of operating successfully given groundwater conditions, soil type, potential for obstructions and all geotechnical parameters pertinent to this type of microtunneling. Geotechnical information provided by the owner shall be relied upon by the contractor for determination of means and methods selected by contractor for bidding purposes.

B. The Contractor is responsible for furnishing the labor, equipment, and materials required to complete work by pilot tube microtunneling. This work includes but is not limited to; Microtunneling system, spoil transportation and separation, hoisting, lifting, safety, control equipment. The contractor is also responsible for all jacking and receiving pit construction and operation which includes but is not limited to:
   a. Sediment controls
   b. Re-handling and disposal of unsuitable materials
   c. Dewatering
   d. Utility adjustments / support
   e. Tests
   f. Excavation
   g. Sheeting and shoring
   h. Backfilling
   i. Cleanup
   j. Security
   k. Restoration of surface features
   l. Other related work necessary for construction as specified or as shown on drawings.

1.3 DEFINITIONS

A. Pilot Tube Microtunneling (PTMT): An alternate microtunneling system for sizes 8" to 18" and larger nominal diameter pipe. This system is a two or three stage system, which allows both trenchless guided installations of house connection sewers as well as accurate direct jacking of mainline collection sewer pipes without use a permanently installed casing.

B. Pilot Tube Microtunnel Boring Machine (MTBM): Mechanized excavating equipment which uses a remote controlled, laser or theodolite guidance system to maintain specified line and grade, a jacking system is used for thrust and mechanical drive which creates torque to both the pilot tube and the augers used for spoil removal.

C. Casing Pipe: Pipe capable of withstanding installation forces due to jacking and other construction or temporary loads in addition to permanent live and dead loads.

D. Jacking and Receiving Pits: Working pits between which casing is installed by means of microtunneling and pipe jacking.

E. Slurry Pressure Balance System: Microtunneling system that mixes excavated material with slurry in a chamber located behind the cutting head. Low pressure slurry is used to balance ground and water pressure at face of tunnel, limit settlement and convey cuttings back to ground surface. Cuttings are removed or separated and slurry is recirculated back to MTBM.

F. Earth Pressure Balance System: Microtunneling system which incorporates continuous flight auger enclosed in separate casing inside casing pipe being jacked. Positive pressure is maintained at the excavated face by regulating volume of cuttings removed relative to advance rate of MTBM.

G. Spoil: Excavated material that has been mixed with either water or slurry and pumped to surface to be separated and recycled or disposed.

H. MUTCD: Manual of Uniform Traffic Control Devices

I. TBM: Tunnel boring Machine

J. AREA: American Railway Engineering Association

1.4 QUALIFICATIONS

A. Tunneling and Microtunneling Contractors will have actively engaged in the installation of pipe using tunneling and microtunneling for a minimum of three years, during which time the Contractor will have completed at least 15,000 linear feet of microtunneling installations.

B. Field supervisory personnel employed by the Tunneling or Microtunneling Contractor will have at least two years' experience in the performance of the work and tasks as stated in the Contract Documents.

1.5 SUBMITTALS

A. Qualifications: Submit documentation showing that the Contractor and personnel meet the minimum required qualifications. Include a list of a minimum of three wastewater collection projects similar in scope and value to the project specified in the contract documents. Information must include, but not be limited to date and duration of work, location, pipe information (i.e. length, diameter, depth of installation, pipe material,

etc.), project owner information (i.e. name, address, telephone number, contact person), and the contents handled by the pipeline (water, wastewater, etc.).

B. Materials:

1. Submit pipe material reference sheets and manufacturer's certification of pipe meeting or exceeding the required specifications.

2. Submit a description of materials, grout mix, equipment and operational procedures to accomplish each grouting operation. The description may include sketches as appropriate, indicating type and location of mixing equipment, pumps, injection points, venting method, flowlines, pressure measurement, volume measurement, grouting sequence, schedule, and stage volumes.

    a. Submit a grout mix design report, including:
        1) Grout type and designation.
        2) Grout mix constituents and proportions, including materials by weight and volume.
        3) Grout densities and viscosities, including wet density at point of placement.
        4) Initial set time of grout.
        5) Bleeding, shrinkage, expansion.
        6) Compressive strength.

    b. For cellular grout, also submit the following:
        1) Foam concentrate supplier's certification of the dilution ratio for the foam concentrate.
        2) A description of the proposed cellular grout production procedures.

    c. Maintain and submit logs of grouting operations indicating pressure, density, and volume for each grout placement.

C. Tunneling Methodology: A brief description of proposed tunnel methodology for review. The description should be sufficient to convey the following:

1. Proposed method of tunnel construction and type of face support.
2. Manufacturer and type of tunneling equipment proposed. Describe type of lighting and ventilation systems.
3. Number and duration of shifts planned to be worked each day.
4. Sequence of operations.
5. Locations of access shafts and work sites. Describe method of construction for tunnel shafts.
6. Method of spoil transportation from the face, surface storage and disposal location.
7. Capacity of jacking equipment and type of cushioning.
8. Identify critical utility crossings and special precautions proposed.
9. Slurry injection system details.

D. Tunnel Shaft Schedule of Values: Cost per shaft by station, dimensions, and depth.

E. Tunnel Shafts: Submit shaft construction drawings together with calculations. As a minimum, the submittal shall include:
   1. Shaft dimensions, design criteria, and details for ground support system, such as sheeting, shoring, bracing, and stabilization, protection of the excavation, special requirements for shaft penetrations, tunnel "eye", starter and back tunnels, and seal slabs. Allowable surcharge loads and any restrictions on surcharge capacity, including live loads, shall be clearly shown on the shaft construction drawings. Thrust blocks or other reactions required for pipe jacking shall be shown, if applicable
   2. Location of shafts by station and limits of working sites
   3. Description of site security arrangements.
   4. Description of method of extending the shaft above the flood level.
   5. Any geotechnical boring undertaken by the Contractor for whatever purpose connected to the Work.
   6. Shaft design submittals by the Contractor shall be signed and sealed by a Professional Engineer registered in the State of Ohio.

F. Drawings and Calculations: Submit for record purposes, drawings, and calculations for any tunnel support system designed by the Contractor. Drawings shall be adequate for construction and include installation details. For pipe jacking and microtunneling, show pipe and pipe joint detail. Documents must be signed and sealed by a Professional Engineer registered in the State of Ohio. Calculations shall include clear statement of criteria used for the design. Engineer's review of all drawings and calculations is for information purposes and overall compliance.

G. Quality Control: Submit for review a brief description of quality control methods including"
   1. Method and frequency of survey control
   2. Example of tunnel daily log

H. When geotechnical investigations are conducted by the Contractor, submit results in both hardcopy and electronic form to the Engineer for record purposes.

I. Monitoring Plans: The Contractor shall provide monitoring plans for assessing ground movement (settlement or heave) due to drilling operations as follows:
   1. Instrumentation Monitoring Plan: Submit for review, prior to construction, a monitoring plan that includes a schedule of instrumentation design, layout of instrumentation points, equipment installation details, manufacturer's catalog literature, and monitoring report forms.
   2. Surface Settlement Monitoring Plan. Submit a settlement monitoring plan for review prior to construction. The plan shall identify the location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting formats.

J. Structures Assessment: Pre-construction and post-construction assessment reports shall be provided for critical structures, namely those located within the zone of active excavation from the proposed tunnel centerline. Photographs or a video of any existing/pre-construction damage to structures in the vicinity of the sewer alignment shall be included in the assessment reports.

K. The readings of all monitoring shall be submitted to the Engineer.

L. Daily Reports: Shift log, Pipe-jacked Tunneling Data, shall be maintained by the Contractor, and must be made available to the Engineer on request.

M. Traffic Control Plan: If traffic maintenance is required as part of the Work, a Traffic Control Plan shall be submitted. The plan shall include an outline proposed procedure and site Contractor telephone numbers for emergencies.

1.6 DESIGN CRITERIA

A. Pipe

1. Contractor is responsible for selection of the appropriate pipe and pipe joints to carry the thrust of any jacking forces or other construction loads in combination with overburden, earth and hydrostatic loads. Design of any pipe indicated on the Contract Documents considers in-place loads only and does not take into account any construction loads. The criteria for longitudinal loading (jacking forces) on the pipe and joints shall be determined by the contractor, based on the selected method of construction.

2. The jacked pipe shall be designed to withstand the thrust from the MTBM, TAM, PTMT or shield and pipe advance without damage or distortion. The propulsion jacks shall be configured so that the thrust is uniformly distributed and will not damage or distort the pipe.

3. Take into account loads from handling and storing.

4. The criteria to be used for truck loading shall be HS-20 vehicle loading distributions in accordance with AASHTO.

5. Provide pipes of diameter shown on the Contract Documents. Substitution of pipe with larger diameter to suit MTBM, TBM, or PTMT equipment availability will only be permitted if the Contractor can demonstrate to the Engineer's satisfaction that design flows and velocities can be achieved.

B. Tunnel Shafts:

1. Shaft design must include allowance for contractor's equipment and stored material and spoil stockpile as appropriate. Design must also allow for HS-20 highway loading if located in the vicinity of a paved area.
2. The shaft shall be designed to withstand full hydrostatic head without failure.
3. Shaft located within the 100-year floodplain shall be designed with a water retaining liner extending 2 feet above the 100-year flood elevation. It is acceptable if liner is stored at the site for immediate installation in lieu of its being installed at the shaft, provided that the shaft liner extends at least 2 feet above existing ground elevation.
4. Shaft cover, if used in lieu of shaft perimeter security fencing, shall be designed for a minimum 25 pounds per square foot distributed load plus a 300-pound point load.
5. Steel plate deck, if such is required, shall be designed for HS-20 loading.

PART 2 - PRODUCTS

2.1 SEWER PIPE

1. Contractor shall be responsible for selecting appropriate pipes and pipe joints to safely carry the loads imposed during construction, including jacking forces.

2. Use pipe that is round with a smooth, even outer surface, and has joints that allow for easy connections between pipes. Pipe ends shall be designed so that jacking loads are evenly distributed around the entire pipe joint and such that point loads will not occur when the pipe is installed. Pipe used for pipe jacking shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in-place loading conditions. Protect the driving ends of the pipe and joints against damage.

3. Pipe must be of a material approved by LCDU for sanitary sewer use.

2.2 SLURRY

1. Slurry will be a mixture of water and bentonite clay. The fluid will be inert. The fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the jacked pipe, and provide backfill within the annulus of the pipe and tunnel.

2. Disposal of excess slurry and spoils will be the responsibility of the Contractor who must comply with all relevant regulations, right-of-way, workspace, and permit agreements. Excess slurry and spoils will be disposed at an approved location. The Contractor is responsible for transporting all excess slurry and spoils to the disposal site and paying any disposal costs. Excess slurry and spoils will be transported in a manner that prevents accidental spillage onto roadways. Excess slurry and spoils will not be discharged into sanitary or storm drain systems, ditches or waterways.

3. Mobile spoils removal equipment capable of quickly removing spoils from the Microtunneling machine face will be present during drilling operations to fulfill the requirements of item above.

4. The Contractor will be responsible for making provisions for a clean water supply for the mixing of the slurry.

2.3 GROUTING MATERIALS: Prepare mixes that satisfy the required application. Materials used in grout mix shall meet the following standards

1. Cementitious Material

   a. Portland Cement: ASTM C 150, Type II, unless the use of Type III is authorized by the Engineer; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.

   b. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in the form of Na2O + 0.658K20.

2. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

3. Fine Aggregate: ASTM C 33. Determine the potential reactivity of fine aggregate in accordance with the Appendix to ASTM C 33.

4. Fluidifier: Use a fluidifier meeting ASTM C 937 that holds the solid constituents of the grout in colloidal suspension and is compatible with the cement and water used in the grouting operations.

5. Admixtures

    a. Use admixtures meeting ASTM C 494 and ASTM C 1017 as required, to improve pumpability, to control time of set, to hold sand in suspension and to reduce segregation and bleeding.

    b. For cellular grout, do not use foam or admixtures that promote steel corrosion.

    c. Ensure that admixtures used in a mix are compatible. Provide written confirmation from the admixture manufacturers of their compatibility.

6. Water Reducers: ASTM C 494, Type A

    a. Water Reducing Retarders: ASTM 494, Type D

    b. High Range Water Reducers (Superplasticizers): ASTM C 494, Types F and G

7. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement

8. Grout Type Applications

    a. Grout for pressure grouting and back grouting: Sand-cement mortar mix.

    b. Grout for annular grouting: Low density (cellular) grout or sand-cement mortar mix.

    c. Ground stabilization: Sand cement mortar mix.

9. Do not include toxic or poisonous substances in the grout mix or otherwise inject such substances underground.

10. Provide grout that meets the following minimum requirements
    a. Minimum 28-day unconfined compressive strength: 1000 psi for sand-cement mortar grout; 300 psi for cellular grout.
    b. Determine strength by ASTM C.

PART 3 - EXECUTION

3.1 CONSTRUCTION OPERATIONS CRITERIA

A. Use methods for microtunneling and pipe-jacked tunneling operations that will minimize ground settlement. Select a method which will control flow of water and prevent loss of soil into the tunnel and provide stability of the face under anticipated conditions.

B. The Pilot Tube Microtunneling system shall utilize a two or three phase system as described below.

1. Three Phase System

a. Phase 1 – A rigid steel pilot tube in approximately one-meter lengths shall be installed through the ground from the drive shaft to the receiver shaft by earth displacement with the jacking frame. The alignment of the pilot tube shall be established with a theodolite mounted at the rear of the drive shaft and accurately set to the desired line and grade. The theodolite shall view a lighted target in the lead or steering pilot tube. A camera shall be fitted to the theodolite and shall transmit the image of the crosshair and the target onto a monitor screen to be viewed in the drive shaft by the operator. As the operator advances the pilot tube through the earth the center of the target will drift from the crosshair as a result of the biased or slanted leading tip of the pilot tube. The operator shall rotate the pilot tube as required to orient the slanted steering tip toward the crosshair and continue to advance the pilot tube until it reaches the receiver shaft.

b. Phase 2 – An enlargement casing with an outside diameter up to 1 ½" larger than the product pipe shall be rigidly connected to the final pilot tube and advanced into the earth behind the pilot tube. An auger shall be used inside the enlargement casing to remove the material being excavated. The auger shall be contained inside the limits of the enlargement casing as it progresses along the proposed alignment. A train of temporary steel casings with an outside diameter very similar to the enlargement casing and used to move the enlargement casing from the drive shaft to the receiver shaft. The enlargement casing will cut a bore hole from the drive shaft to the receiver shaft and the temporary casings will case the hole as it is cut. Each temporary casing shall be fitted with an internal auger to transport the excavated material to the drive shaft where it shall be removed from the shaft and disposed of at an approved location. The pilot tubes shall be recovered in the receiver shaft as the temporary casings are installed.

c. Phase 3 – The product pipe shall then be installed directly behind the final temporary casing pipe with the jacking frame. The casing pipes and augers shall be recovered in the receiver shaft as the product pipe is installed.

2. Two Phase System

   a. Phase 1 – The pilot tube shall be installed in the same manner described Phase 1 of the Three Pass System.
   b. Phase 2 – The enlargement casing shall be installed in the same manner described in Phase 2 of the Three-Phase System. Each product pipe shall be fitted with an internal protective-casing pipe to house the auger and prevent damage to the product pipe. The product pipe shall be installed directly behind the enlargement casing with the internal casing rigidly connected to the auger chamber of the enlargement casing. The internal casing shall be manufactured such that the excavated material does not leak excessively into the product pipe. The internal casing shall be fitted with a protective shoe to protect the product pipe from damage and to support the casing and auger at the centerline of the pipe. The product pipe shall be advanced along the proposed alignment with the jacking frame thus progressing the enlargement casing from the drive shaft to the receiver shaft with the pilot tubes being recovered in the receiver shaft. The excavated material shall be funneled into and conveyed through the internal casing to the drive shaft where it shall be removed from the shaft and disposed of at an approved location. Upon reaching the receiver shaft the enlargement casing shall be removed and the internal casings and augers retracted and recovered at the drive shaft.

C. Conduct tunneling operations in accordance with applicable safety rules and regulations, OSHA standards and Contractor's safety plan. Use methods, which include due regard for safety of workmen, adjacent structures, utilities, and the public.

D. Maintain clean working conditions on the project site.

E. For tunneling under high traffic areas, perform the installation so as to avoid interference with the operation of manufacturing facilities, except as approved by the owner of the facility.

3.2 LOCATION OF TUNNEL SHAFTS

1. The number of tunnel shafts shall be kept to a minimum and shall be typically sited at proposed manhole locations.

2. When shaft sites are indicated on the Contract Documents, the Contractor may alter locations of shaft sites as needed for construction operations. Relocation shall be subject to the Engineer's approval.

3. Locate shafts and associated work areas to avoid blocking driveways and cross streets, and to minimize disruption to business and commercial interests. Avoid shaft locations near areas identified as residential or potentially contaminated.

4. Locate shafts and associated work areas to avoid any major utility relocations. Any required utility relocations for shaft construction shall be coordinated by the Contractor with the utility owner.

5. The Contractor shall verify all existing utilities, pipelines, and structures in the project area, and take all precautions and measures to protect them during the installation, subsequent tunneling and backfilling of the shafts after completion of sanitary sewer installations.

6. Plan shaft locations to minimize interference with storm drainage channels, ditches, water mains, sanitary sewers, storm water sewers or culverts, which, if damaged, could result in ground washout or flooding of shafts and tunnels.

3.3 GROUNDWATER CONTROL MEASURES: Provide groundwater control measures when necessary to perform the work.

3.4 EQUIPMENT

1. Full directional guidance of a shield, TBM, or MTBM is a prerequisite of this method of construction.

2. The Contractor shall be responsible for selection of tunneling equipment which, based on past experience, has proven to be satisfactory for excavation of the soils to be encountered.

3. The Contractor shall employ tunneling equipment that will be capable of handling the various anticipated ground conditions and is capable of minimizing loss of soil ahead of and around the machine and shall provide satisfactory support of the excavated face.

4. The TBM used for pipe-jacking shall conform to the shape of the tunnel with a uniform perimeter that is free of projections that could produce over- excavation or voids. An appropriately sized overcutting head may be provided to facilitate steering. In addition it shall:

    a. Be capable of full face closure.

    b. Be equipped with appropriate seals to prevent loss of bentonite lubricant.

    c. Be capable of correcting roll by reverse drive or fins.

    d. Be designed to handle adverse ground conditions including ground water inflow.

    e. Be equipped with visual display to show the operator actual position of TBM relative to design reference.

5. If a hand shield is used for pipe-jacked tunneling (with or without attached mechanized excavating equipment), the shield must be capable of handling the various anticipated ground conditions. In addition, the shield shall:

a. Conform to the shape of the tunnel with a uniform perimeter that is free of projections that could produce over-excavation or voids. An appropriately-sized overcutting head may be provided to facilitate steering.

b. Be designed to allow the face of the tunnel to be closed by use of gates or breasting boards without loss of ground.

6. In the case of MTBM, use a spoil transportation system which:

a. Either balances the soil and ground water pressures by the use of a slurry or earth pressure balance system; system shall be capable of adjustments required to maintain face stability for the particular soil condition and shall monitor and continuously balance the soil and ground water pressure to prevent loss of slurry or uncontrolled soil and ground water inflow, or, in the case of a slurry spoil transportation system:

1) Provides pressure at the excavation face by use of the slurry pumps, pressure control valves, and a flow meter.

2) Includes a slurry bypass unit in the system to allow the direction of flow to be changed and isolated, as necessary.

3) Includes a separation process designed to provide adequate separation of the spoil from the slurry so that slurry with sediment content within the limits required for successful tunneling can be returned to the cutting face for reuse. Appropriately contain spoil at the site prior to disposal.

4) Uses the type of separation process suited to the size of tunnel being constructed, the soil type being excavated, and the workspace available at each work area for operating the plant.

5) Allows the composition of the slurry to be monitored to maintain the slurry weight and viscosity limits required.

b. In the case of a cased auger earth pressure balance system, the system shall be capable of adjustments required to maintain face stability for the particular soil condition to be encountered. Monitor and continuously balance the soil and ground water pressure to prevent loss of soil or uncontrolled ground water inflow.

1) In a cased auger spoil transportation system; manage the pressure at the excavation face by controlling the volume of spoil removal with respect to the advance rate. Monitor the speed of rotation of the auger flight, and the addition of water.

c. Provide an MTBM which includes a remote control system with the following features:

1) Allows for operation of the system without the need for personnel to enter the tunnel. Has a display available to the operator, at a remote operation console, showing the position of the shield in relation to a design reference together with other information such as face pressure, roll, pitch, steering attitude, valve positions, thrust force, and cutter head torque; rate of advance and installed length.

2) Integrates the system of excavation and removal of spoil and its simultaneous replacement by pipe. As each pipe section is jacked forward, the control system shall synchronize all of the operational functions of the system.

d. Provide an MTBM that includes an active direction control system with the following features:

1) Controls line and grade by a guidance system that relates the actual position of the MTBM to a design reference (e.g., by a laser beam transmitted from the jacking shaft along the pipe to a target mounted in the shield.)

2) Provides active steering information that shall be monitored and transmitted to the operating console.

3) Provides positioning and operation information to the operator on the control console.

e. Use generator which is suitably insulated for noise reduction in residential or commercial areas. Use of generator must be in accordance with City/Parish noise ordinance.

7. In the case of PTMT the following are minimum major components required:

a. Line and Grade Control System - The control system shall include but not be limited to a theodolite, lighted target, camera, and monitor screen. The equipment must be capable of installing the pipe to the desired line and grade.

b. Jacking Frame - The jacking frame shall possess adequate strength to advance the pilot tube, the enlargement casing and the string of product pipe from the drive shaft to the receiver shaft. The jacking force shall be easily regulated down to the safe working load rating of the pipe. The frame shall develop a uniform distribution of jacking forces on the end of the pipe. The auger motor shall possess adequate torque to steer the pilot tube and adequate torque and speed to effectively auger the excavated material from the face of the bore to the drive shaft.

c. Pilot Tube - The pilot tubes shall be constructed of steel in rigid but short sections to accommodate the small drive and receiver shafts. The tubes shall rigidly connect to each other, the steering tip and the enlargement casing and have a clear inside diameter large enough to adequately view the lighted target. The tubes shall withstand the torque encountered in the steering process.

d. Enlargement Casing - The enlargement casing shall be constructed of steel to a diameter just larger than the product pipe and have a leading connection compatible with the pilot tube. The leading face of the casing shall possess several large openings for the soil to enter as it advances along the proposed alignment. An internal auger chamber shall funnel the excavated material into the temporary full diameter casings of the Three-Phase Process or into the internal auger casings of the Two-Phase Process. Structural members shall connect the leading edge of the casing to the pilot tube connections.

e. Soil Transportation System - The soil transportation system shall consist of an auger train operating inside the full diameter temporary steel casings of the Three-Phase System and an internal casing and auger train operating inside the product pipe. The internal casings of the Two-Phase Process shall be manufactured to minimize leakage of the excavated material into the product pipe.

f. Soil Removal - A soil removal system shall be provided to safely remove the excavated material from the drive shaft to the surface.

g. Hydraulic Power Unit - The hydraulic power unit shall rest on the surface and be connected to the jacking frame by hoses. The unit shall meet all applicable noise standards.

h. Lubrication System - A lubrication system shall be employed to minimize pipe friction to insure that pipe can be installed from the drive shaft to the receiver shaft within the safe working load rating of the pipe. The system may also be required to minimize the torque required to transport the excavated material to the drive shaft

8. Provide a pipe jacking system with the following features:

a. Has the main jacks mounted in a jacking frame located in the starting shaft.

b. Has a jacking frame which successively pushes a string of connected pipes following the tunneling excavation equipment towards a receiving shaft.

c. Has sufficient jacking capacity to push the tunneling excavation equipment and the string of pipe through the ground. Incorporate intermediate jacking stations, if required.

d. Develops a uniform distribution of jacking forces on the end of the pipe by use of spreader rings and packing, measured by operating gauges.

e. Provides and maintains a pipe lubrication system at all times to lower the friction developed on the surface of the pipe during jacking.

9. Use thrust reactions for pipe jacking that are adequate to support the jacking pressure developed by the main jacking system. Special care shall be taken when setting the pipe guide rails in the jacking shaft to ensure correctness of the alignment, grade, and stability.

10. Provide equipment to maintain proper air quality of manned tunnel operations during construction in accordance with OSHA requirements.

11. Enclose lighting fixtures in watertight enclosures with suitable guards. Provide separate circuits for lighting and other equipment,

12. Electrical systems shall conform to requirements of National Electrical Code - NFPA 70.

3.5 PIPE-JACKED TUNNELING DATA

1. Maintain shift logs of construction events and observations. The Engineer shall have access to the Contractor's logs with regard to the following information:

   a. Location of boring machine face or shield by station and progress of tunnel drive during shift.

   b. Hours worked per shift on tunneling operations.

   c. Completed field forms for checking line and grade of the tunneling operation, showing achieved tolerance relative to design alignment. Steering control logs will generally be acceptable.

   d. Maximum pipe jacking pressures per drive.

   e. Location, elevation and brief soil descriptions of soil strata.

   f. Ground water control operations and piezometric levels.

   g. Observation of any lost ground or other ground movement.

   h. Any unusual conditions or events.

   i. Reasons for operational shutdown in the event a drive is halted.

3.6 TUNNEL SHAFT CONSTRUCTION

1. Ground support systems shall be in accordance with the following:

   a. Liner elements, bracing and shoring structural members shall be installed at the locations and in the method sequence and tolerances defined on shaft construction drawings as the excavation progresses.

b. The bracing and shoring shall be in contact with the liner to provide full support as shown in shaft construction drawings. Any modifications to liner, bracing and shoring shall be evaluated, checked and approved by Contractor's Professional Engineer, and submitted to the Engineer.

c. A seal slab shall be installed as soon as final depth and stable bottom conditions have been reached and accepted by the Engineer. The seal slab shall be capable of withstanding the full piezometric pressure, either by pressure relief using under drains, or in the case of more permeable ground condition, by the use of a structural reinforced slab. In either case, the seal slab shall be constructed in accordance with the design provided by the Contractor's Professional Engineer.

d. The entire shaft shall be designed and constructed to appropriate factors of safety against yield, deformation, or instability as determined by Contractor's Professional Engineer, and shall withstand a full hydrostatic head without failure.

e. Special framing, bracing or shoring required around tunnel "eyes" or other penetrations shall be in-place according to shaft construction drawings before the liner or any bracing or shoring at the penetration is cut or removed.

2. Install suitable thrust or reaction blocks as required for pipe jacking equipment.

3. Provide drainage from shafts while work is in progress and until adjacent pipe joints have been sealed and the shaft is backfilled.

4. Divert surface water runoff and discharge from dewatering system away from the shaft. Protect the shafts from infiltration or flooding.

5. Each surface work site is to be surrounded by a security fence, which shall be secure at any time the site is unattended by Contractor's personnel.

6. In addition to the above, the shaft, when not in use shall be protected by a second security fence at the perimeter of the shaft.

7. A shaft which is constructed more than 60 days in advance of its intended use shall be covered by a steel plate deck designed by the Contractor's Professional Engineer, and the surface restored to permit full traffic flow during the time the shaft is not in use. All other Contractor's material including portable concrete traffic barriers, traffic control system, fencing and other materials and equipment must be removed from the site and reinstalled at the time the shaft is re-opened for use.

8. Backfill and compaction of the shaft shall be provided and Grouting of manhole or structure annular space will be permitted in cases where insufficient workspace exists.

9. Remove the shaft liner above the level of 8 feet below ground surface, unless otherwise indicated on the Contract Documents. Maintain sufficient ground support to meet excavation safety requirements while removing the shaft structure.

3.7 EXCAVATION AND JACKING OF PIPE

1. Tunnel Excavation

   a. Keep tunnel excavation within the servitudes and rights-of-way indicated on the Contract Documents and to the lines and grades designated on the Contract Documents.

   b. Perform tunneling operations in a manner that will minimize the movement of the ground in front of and surrounding the tunnel. Prevent damage to structures and utilities above and in the vicinity of the tunneling operations.

   c. Open-face excavations:
      1) Keep the face breasted or otherwise supported and prevent falls, excessive raveling, or erosion. Maintain standby face supports for immediate use when needed.
      2) During shut-down periods, support the face of the excavation by positive means; no support shall rely solely on hydraulic pressure.

   d. Closed-face excavation:
      1) Carefully control volume of spoil removed. Advance rate and excavation rate to be compatible to avoid over excavation or loss of ground.
      2) When cutting head is withdrawn or is open for any purpose, keep excavated face supported and stabilized.

   e. Excavated diameter should be a minimum size to permit pipe installation by jacking with allowance for bentonite injection into the annular space.

   f. Whenever there is a condition encountered which could endanger the tunnel excavation or adjacent structures, operate without intermission including 24- hour working, weekends and holidays, until the condition no longer exists.

   g. The Contractor shall be responsible for damage due to settlement from any construction-induced activities. Replacement of all damaged areas shall be the responsibility of the Contractor at no additional cost to the Owner.

2. Pipe Jacking

   a. Cushion pipe joints as necessary to transmit the jacking forces without damage to the pipe or pipe joints.

   b. Maintain an envelope of bentonite slurry around the exterior of the pipe during the jacking and excavation operation to reduce the exterior friction and possibility of the pipe seizing in place.

c. If the pipe seizes up in place and the Contractor elects to construct a recovery access shaft, approval must be obtained from the Engineer. Coordinate traffic control measures and utility adjustments as necessary prior to commencing work.

d. In the event a section of pipe is damaged during the jacking operation, or joint failure occurs, as evidenced by inspection, visible ground water inflow or other observations, the Contractor shall submit for approval his methods for repair or replacement of the pipe. Any pipe damaged or misaligned shall be removed and replaced by the Contractor at no additional cost to the Owner.

e. Overcutting shall be remedied by grouting along the entire length of the installation

f. All tunneled pipes 36-inches in diameter or larger shall have grout injection ports built into the pipe at the 12 o'clock position for pumping slurry during the pipe installation and for grouting the annular space once the tunneling is complete

3.8 GROUTING

1. Preparation
   a. Notify the Engineer at least 24 hours in advance of grouting operations.
   b. Select and operate grouting equipment to avoid damage to new or existing underground utilities and structures.
   c. In selection of grouting placement consider pipe flotation, length of pipe, length of tunnel, depth from surface, and type of sewer pipe, type of pipe blocking and bulkheading, grout volume and length of pipe to be grouted between bulkheads.
   d. The Contractor is to ensure there is no water in the annular space between the carrier pipe and the tunnel liner prior to pumping the cellular grout into the annular space
   e. Operate any dewatering systems until the grouting operations are complete

2. Equipment
   a. Batch and mix grout in equipment of sufficient size and capacity to provide the necessary quality and quantity of grout for each placement stage.

   b. Use equipment for grouting of a type and size generally used for the work, capable of mixing grout to a homogeneous consistency, and providing means of accurately measuring grout component quantities and accurately measuring pumping pressures. Use pressure grout equipment, which delivers grout to the injection point at a steady pressure.

3. Pressure Grouting for Jacked or Pulled Pipe:
    a. For jacked pipe 60 inches in diameter or greater, pressure grout the annulus after installation, displacing the bentonite lubrication. Jacked or pulled pipes less than 60-inch diameter may be left ungrouted unless the excavated diameter exceeds the external pipe diameter by more than one inch.

    b. Inject grout through grout holes in the sewer pipe. Drilling holes from the surface or through the carrier pipe walls is not allowed. Perform grouting by injecting it at the pipe invert with bentonite displacement occurring through a high point tap or vent.

    c. Control ground water as necessary to permit completion of grouting without separation of the grout materials.

    d. Pump grout until material discharging is similar in consistency to that at point of injection.

4. Pressure Grouting for Shaft Liner:
    a. If required, perform grouting operations to fill voids outside of the shaft liner.
    b. For nonexpendable primary liners installed by hand mining or in shafts, grout once every 4 feet or more frequently if conditions dictate.
    c. Control grout pressures so that shaft liner is not overstressed, and ground heave is avoided.
    d. For liner requiring grout, perform back grouting once each shift, or more often if required to ensure that all voids are filled.

5. Ground Stabilization Grouting:
    a. Completely fill voids outside the limits of excavation caused by caving or collapse of ground. Fill with gravity or pressure injected sand-cement grout as necessary to fill the void.
    b. Completely fill voids outside the limits of excavation caused by caving or collapse of ground. Fill with gravity or pressure injected sand-cement grout as necessary to fill the void.
    c. Verify that the void has been filled by volumetric comparisons and visual inspection. In the case of settlement under existing slabs, take cores as directed by the Engineer, at no additional cost to the Owner, to demonstrate that the void has been filled.

6. Field Quality Control:
    a. Pressure Grouting for Shaft Liners. For each shaft, make one set of four compressive test specimens for each 30-foot depth and one set for any remaining portion less than a 30-foot increment.

    b. Pressure Grouting for Jacked Pipe. Make one set of four compressive test specimens for every 400 feet of jacked pipe pressure grouting.

    c. Pressure Grouting for Pulled Pipe. Make one set of four compressive test specimens for every 400 feet of pulled pipe pressure grouting.

d. Ground Stabilization Grouting. Make one set of four compressive test specimens for every location where ground stabilization grouting is performed.

3.9 CONTROL OF LINE AND GRADE

a. Construction Control:

1) Contractor shall check baselines and control points at the beginning of the Work and report any errors or discrepancies to the Engineer.

2) Use the baselines and control points indicated on the Contract Documents to establish and maintain construction control points, reference lines and grades for locating tunnel, sewer pipe, and structures. These control points are given to assist the Contractor and if deemed necessary the Contractor should establish additional control points or benchmarks in order to perform the work accurately.

3) Establish construction control points sufficiently far from the work so as not to be affected by ground movement caused by pipe-jacked tunneling operations.

b. Bench Mark Movement. The Contractor shall ensure that if settlement of the ground surface occurs during construction which affects the accuracy of the temporary benchmarks the Contractor shall detect and report such movement and reestablish temporary bench marks.

c. Line and Grade

1) Check and record the survey control for the tunnel against an above-ground undisturbed reference at least once for each 250 feet of tunnel constructed.

2) Record the exact position of the MTBM, TBM, PTMT or shield after each shove to ensure the alignment is within specified tolerances. Make immediate correction to alignment before allowable tolerances are exceeded

3) When excavation is off line or grade, make alignment corrections to avoid reverse grades in gravity sewers. A belly in the tunnel which will hold water is not acceptable and shall be replaced at no additional cost to the Owner.

a) The sewer pipe shall not vary more than plus or minus one inch (1) in elevation or plus or minus six inches (6) horizontally from the established line and grade (as shown on the Contract Documents) at any point between manholes, including the receiving end. The installed pipe shall not hold water

b) Pipe installed outside tolerances and subsequently abandoned shall first be fully grouted

3.10 MONITORING

a. Instrumentation Monitoring. Instrumentation specified shall be accessible at all times to the Engineer. Readings shall be submitted promptly to the Engineer.

1) Install and maintain an instrumentation system to monitor and detect movement of the ground surface and adjacent structures. Establish vertical control points at a distance from the construction areas that avoids disturbance due to ground settlement.

2) Installation of the instrumentation shall not preclude the Engineer, through an independent contractor or consultant, from installing instrumentation in, on, near, or adjacent to the construction work. Access shall be provided to the work for such independent installations.

3) Instruments shall be installed in accordance with the Contract Documents and the manufacturer's recommendations.

4) Monitoring locations given on the Contract Documents are not inclusive and are given to assist the Contractor. Additional locations may need to be established by the Contractor. The Contractor is responsible for ail construction induced ground movement and the monitoring thereof.

b. Surface Settlement Monitoring

1) Establish monitoring points on all critical structures.

2) Minimum monitoring points are indicated on the Contract Documents.

3) Record location of settlement monitoring points with respect to construction baselines and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.

4) Ground surface elevations shall be recorded on the centerline ahead of the tunneling operations at a minimum of 100-foot intervals or at least three locations per tunnel drive. For sewers greater than 60-inch diameter, also record similar data at approximately 20 feet each side of the centerline. Settlement monitoring points must be clearly marked by studs or paint for ease of locating.

5) Monitoring points to measure ground elevation are required at a distance of 0 feet, 10 feet and 20 feet from the perimeter of the shaft on each of four radial lines, the radial lines being at 90 degrees to each other.

6) Railroads. Monitor ground settlement of track subbase at centerline of each track.

7) Utilities and Pipelines. Monitor ground settlement directly above and 10 feet before and after the utility or pipeline intersection.

c. Reading Frequency and Reporting. The Contractor shall submit to the Engineer, records of readings from the various instruments and survey points.

1) Instrumentation monitoring results to be read at the frequency specified and unless otherwise specified, shall be started prior to the zone of active excavation reaching that point, and shall be continued until the zone of active excavation has passed and until no further detectable movement occurs.

2) Surface settlement monitoring readings shall be taken:
   a) Prior to the zone of active excavation reaching that point.
   b) When the tunnel face reaches the monitoring point (in plan)
   c) When the zone of active excavation has passed and no further movement is detected.

3) All monitoring readings shall be submitted promptly to the Engineer.

4) Immediately report to the Engineer any movement, cracking, or settlement which is detected.

5) Following completion but prior to final acceptance, make a final survey of all monitoring points.

3.10 SITE RESTORATION: All surfaces affected by the Work shall be restored to their preconstruction conditions. Performance criteria for restoration work will be similar to those employed in traditional open excavation work.

3.11 POST CONSTRUCTION EVALUATION

a. The Contractor shall provide a set of Field Record Drawings including both alignment and profile to the Engineer. Drawings should be developed from actual field readings. Raw data should be available for submission at any time upon request. As part of the Field Record Drawing, the Contractor shall specify the tracking equipment used, including method of confirmatory procedure used to ensure the data was captured. Field Record Drawings having survey data shall be stamped by a Professional Land Surveyor registered in the State of Ohio.

b. All fittings, valves, manholes, connections, etc., including all critical structure monitoring points as shown on Contract Documents, shall be located by GPS and based on the Ohio State Plane coordinate system as shown on Contract Documents and shall be provided on the Field Record Drawings. No landmarks shall be used. The record drawings shall be stamped by a Professional Land Surveyor registered in the State of Ohio.

c. The Contractor, prior to construction shall provide a schedule of values. On this schedule of values, the Contractor shall itemize the cost by station, diameter and depth for each tunnel shaft necessary to complete the work and any additional shafts required for construction operations.

END OF SECTION 330507.37

SECTION 330533.24 – HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work covered by this Section includes but is not limited to high-density polyethylene Iron Pipe Size pressure pipe intended for the transportation of sewage.

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.

Section 271620 Tracer Wire

Section 330507.1 Horizontal Directional Drilling

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 C901	Polyethylene (PE) Pressure Pipe & Tubing
2. ASTM D3261	Butt Heat Fusion PE Fittings for PE Pipe and Tubing
3. ASTM D3350	Standard Specification for PE Pipe & Fittings Materials
4. ASTM D1238	Melt Flow Index
5. ASTM D1505	Density of Plastics

6.	ASTM D2837	Hydrostatic Design Basis
7.	NSF Std. #14	Plastic Piping Components &Y Related Materials
8.	ASTM D2657	Standard Practices for Heat Fusion Joining of Polyolefin Pipe and Fittings
9.	ASTM D273	Standard Specifications for Polyethylene (PE) Plastic Tubing
10.	ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and application instructions in accordance with specifications. Include the following:

1. Melt Flow Index ASTM D1238
2. Density ASTM D1505

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

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer

1. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE 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.
2. Qualified manufacturers shall be: Performance Pipe manufactured by Chevron Phillips Chemical Company LP or equal as approved by the Engineer.

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 marking shall be examined and checked for accuracy.

c. Pipe ends shall be checked to ensure they are cut square and clean.
d. Subject inside surface to a "reverse bend test" to ensure the pipe is free of oxidation (brittleness).

C. Testing

1. The polyethylene pipe manufacturer shall provide certification that stress regression testing has been performed on the specific polyethylene resin being utilized in the manufacture of this product. This stress regression testing shall have been done in accordance with ASTM D2837 and the manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi as determined in accordance with ASTM D2837.

D. Compatibility

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

2.2 HDPE PIPE

A. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification per ASTM D3350.

B. All force main piping to be 2" HDPE DR 11 pressure rated for 150 psi. PVC pipe installed within flushing manholes shall be 2" Schedule 80 pipe.

C. High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C901/C906.

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. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 9.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

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

2.3 FITTINGS

A. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

B. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

C. All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. No size on size wet taps shall be permitted.

D. All transition from HDPE pipe to PVC pipe shall be made per the approval of the Engineer and per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter within a carbon steel back-up ring assembly shall be used for pipe type transitions.
   1. Transition from HDPE to PVC and valves shall be approved by the Engineer before installation.
   2. No solid sleeves shall be allowed between such material transitions.
   3. The pipe supplier must certify compliance with the above requirements.

2.4 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. The letters PE followed by the polyethylene grade in accordance with ASTM D1248 followed by the hydrostatic design basis in 160's of psi, e.g., PE 3408.
   5. Manufacturing standard reference, e.g., AWWA C901 or D-3035, as required.
   6. A production code from which the date and place of manufacture can be determined.
   7. Color identification, either stripped by co-extruding longitudinal identifiable color markings or shall be solid in color and as follows:
      a. GREEN – Sanitary Sewer

B. Tracing Wire: All HDPE force main pipe shall be installed with tracer wire.

PART 3 - EXECUTION

3.1 JOINTING METHOD

A. The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657. All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints in the present of the inspector.

B. Lengths of pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipe so joined shall be made from the same class and type of raw material made by the same raw material supplier.

C. On days butt fusions are to be made, the first fusion shall be a trial fusion in the presence of an inspector. The following shall apply:

1. Heating plates shall be inspected for cuts and scrapes. The plate temperature shall be measured at various locations to ensure proper heating/melting per manufacturer's recommendations and approval by the inspector.
2. The fusion or test section shall be cut out after cooling completely for inspection.
3. The test section shall be 12' or 30 times (minimum) the wall thickness in length and 1" or 1.5 times the wall thickness in width (minimum).
4. The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (i.e., -joint shall have visible molded material between walls of pipe). Joint spacing between the walls of the two ends shall be a minimum of 1/16" to a maximum of 3/16".

D. The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation apply a bitumastic coating to bolts and nuts.

3.2 INSTALLATION

A. High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the manufacturer recommendations. A factory qualified joining technician as designated by the pipe manufacturer shall perform all heat fusion joints.

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 polyethylene 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. The pipe shall be joined by the method of thermal butt fusion, as outlined in PART 3 – Execution, Section 3.1 Joining Method. All joints shall be made in strict compliance with the manufacturer's recommendations.

L. Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps and tanks shall be through flanged connections which shall consist of the following.

1. A polyethylene flange shall be thermally butt-fused to the stub end of the pipe.
2. A 316 stainless steel back-up ring shall mate with a 316 stainless steel flange.
3. 316 stainless steel bolts and nuts shall be used.

M. Flange connections shall be provided with a full-face neoprene gasket.

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

O. 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.

P. Open Trench Installation:

1. Trenching and bedding shall be per detail shown on the drawings.
2. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16" per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.
3. Good alignment shall be preserved during installation. Deflection of the pipe shall occur only at those places on design drawings and as approved by the Engineer. Fittings, in addition to those shown on the Drawings, shall be used only if necessary or required by the Engineer.

4. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".
5. Precautions shall be taken to prevent flotation of the pipe in the trench.
6. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the side of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.
7. All joints shall be restrained unless otherwise directed by the Engineer.

3.3 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.

3.4 TESTING METHOD

A. All HDPE mains shall be field-tested. Contractor shall supply all labor, equipment, material, gages, pumps, meters and incidentals required for testing. Each main shall be pressure tested upon completion of the pipe laying and backfilling operations, including placement of any required temporary roadway surfacing.

B. All mains shall be tested at 150 percent of the operating design pressure of the pipe unless otherwise approved by the Engineer.

C. Pressure testing procedure shall be per Manufacturer's recommendations or as follows:

1. Fill line slowly with water. Maintain flow velocity less than 2 feet per second.
2. Expel air completely from the line during filling and again before applying test pressure. Air shall be expelled by means of taps at point of highest elevation.
3. Apply initial test pressure and allow to stand without makeup pressure for two to three hours, to allow for diametric expansion or pipe stretching to stabilize.
4. After this equilibrium period, apply the specified test pressure and turn the pump off. The final test pressure shall be held for one to three hours.
5. Upon completion of the test, the pressure shall be bled off from a location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the resident project representative and the inspector at the point where the pressure is being monitored and shall show on the recorded pressure read-out submitted to the Engineer of Record.

D. Allowable amount of makeup water for expansion during the pressure test shall conform with Table 3 of the Plastic Pipe Institute Handbook in Chapter 2. If there are no visual leaks or significant pressure drops during the final test period, the installed pipe passes the test.

E. If any test of pipe laid disclosed leakage significant pressure drop greater than the manufacturer's recommended loss, the Contractor shall, at his/her own expense, locate and repair the cause of leakage and retest the line. The amount of leakage, which will be permitted, shall be in accordance with AWWA C600 Standards.

F. All visible leaks are to be repaired regardless of the amount of leakage.

G. The Contractor must submit his plan for testing to the Engineer for review at least ten (10) days before starting the test and shall notify the inspector a minimum of 48 hours prior to test.

END OF SECTION 330533.24

SECTION 333217 - PROGRESSIVE CAVITY GRINDER PUMP

PART 1 – GENERAL

1.1 GENERAL DESCRIPTION: The Contractor shall furnish a complete factory-built and tested duplex explosion proof grinder pump unit consisting of a grinder pump core suitably mounted on an integral stand of stainless steel, electrical power supply cable, pump removal harness, discharge assembly/shut-off valve, anti-siphon valve/check valve assembly, electrical alarm assembly and all necessary internal wiring and controls. A spare (shelf) pump shall also be provided.

1.2 SUBMITTALS: Furnish shop drawings per specification Section 013323 - Shop Drawings, Product Data and Samples. Submit design calculations to support design of anchoring lugs ability to prevent an empty wet well from floating during high ground water level conditions when anchored to the concrete anti-floatation slab shown on the drawings.

1.3 MANUFACTURER: Explosion proof grinder pumps, wet well and controls shall be provided by a single supplier. Manufacturer shall be Environment One Corporation or approved equal.

1.4 EXPERIENCE CLAUSE: The equipment furnished hereunder shall be the product of a company with at least 10 years experienced in the design and manufacture of grinder pumps specifically designed for use at the specified operation conditions.

1.5 OPERATING CONDITIONS: The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.6 WARRANTY: The grinder pump Manufacturer shall provide a part(s) and labor warranty on the complete grinder pump and accessories, including, but not limited to, the panel for a period of 24 months after final acceptance. Any manufacturing defects found during the warranty period will be corrected by the Manufacturer at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PUMP: The explosion-proof pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically

compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material.

2.2 GRINDER: The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft. The grinder impeller shall be a one-piece, cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 - 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.

This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second.

3. The inlet shroud shall have a diameter of no less than 5 inches.

4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping. A 2" stainless steel male discharge hub shall be provided on the exterior of the wet well for connection to the 2" HDPE force main. See detail on drawings.

2.3 ELECTRIC MOTOR: Each motor shall be 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated

and listed by Underwriters Laboratories, Inc. for the application. The wet portion of the motor armature shall be 300 Series stainless steel. Oil-filled motors will not be accepted.

2.4 MECHANICAL SEAL: The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.5 DISCHARGE HOSE AND DISCONNECT/VALVE: All discharge fittings and piping shall be constructed of polypropylene, EPDM or PVC. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal.

2.6 ELECTRICAL SUPPLY CABLE (ECS): The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The wetwell accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 75' (for PS#1) and 40' (for PS#2) of useable ESC outside the station, to connect to the alarm panel. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required.

2.7 CHECK VALVE: The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi. Ball-type check valves are unacceptable.

2.8 ANTI-SIPHON VALVE: The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. The anti-siphon port diameter shall be no less than 60 percent of the inside diameter of the pump discharge piping.

2.9 CORE UNIT: The grinder pump shall be an easily removable core assembly containing pump, motor, grinder, all motor controls, level controls, check valve, anti-siphon valve, and wiring. The watertight integrity of the core unit shall be established by a 100 percent factory test at a minimum of 5 PSIG.

2.10 CONTROLS: All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Wastewater level sensing controls shall be housed in a separate enclosure from the motor starting controls. The level sensor housing must be sealed via a radial type seal. The level sensing control housing must be integrally attached to pump assembly so that it may be removed from the tank with the pump and in such a way as to minimize the potential for the accumulation of grease, debris accumulation, etc. The level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer.

Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be radial sealed with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.

All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump on/off and high-level alarm functions shall not be controlled by the same switch. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes.

2.11 CONTROL/ALARM PANEL: Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel.

The alarm panel shall contain one 15-amp, double-pole circuit breaker for each of the pump core's power circuits and one 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.

The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to

maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button). The audible alarm shall be provided with a manual on-off switch.

The high-level alarm system shall operate as follows:

1. The panel will go into alarm mode if either pump's alarm switch closes. During the initial alarm mode both pumps will run and the alarm light and buzzer will be delayed for a period of time based on user settings (default is 3-1/2 minutes). If the station is still in high-level alarm after the delay, the light and buzzer will be activated.
2. The audible alarm may be silenced by means of the externally mounted push-to-silence button.
3. The visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm switch for both pumps.

The entire alarm panel, as manufactured and including all of the following shall be listed by Underwriters Laboratories, Inc.

Provides protection from the following operating conditions:

- **Low Voltage (Brownout) Protection** – A lockout cycle will prevent the motor from operating and will illuminate the Trouble LED if:
  - the incoming AC Mains voltage drops below a predetermined minimum, typically 12% of nameplate (211 volts for a 240 volt system) for 2 to 3 seconds, regardless of whether the motor is running
  - the lockout cycle will end if the incoming AC Mains voltage returns to a predetermined value, typically 10% of nameplate (216 volts for a 240 volt system).

  The system continues to retest the voltage every second indefinitely. If the lockout cycle has been initiated and the voltage comes back above the predetermined starting voltage, the system will function normally. The Trouble LED remains illuminated during a Brownout condition and a corresponding Brownout message will be displayed on the LCD screen. The LED will turn off when the Brownout condition ends and the LCD message remains latched until the panel is reset. The audible and visual alarm will not be activated unless there is a high wastewater level in the tank.

- **Run Dry Protection** – A 20-minute lockout cycle will prevent the motor from operating and will illuminate the Trouble LED when the wastewater level in the tank is below the pump inlet shroud. A corresponding Run Dry message will be displayed on the LCD screen. The condition is rechecked every 20 minutes and the LCD message remains latched. If the condition is satisfied, the pump is allowed to cycle normally and the Trouble LED will go out, but the LCD message remains latched. The LCD message will remain latched until the panel is reset. If the condition is not satisfied after 3 consecutive attempts, the visual alarm will be activated until the panel is reset or until there is one cycle of normal operation. If a high level condition is presented at any time, a pump run cycle will be activated.

- **High System Pressure Protection** – A 20-minute lockout cycle will prevent the motor from operating and will illuminate the Trouble LED when the pressure in the discharge line is atypically high (closed valve or abnormal line plug). A corresponding Overpressure message will be displayed on the LCD screen. The condition is rechecked every 20 minutes. If the condition is satisfied, the pump is allowed to cycle normally and the Trouble LED will turn off, but the LCD message remains latched. The LCD message will remain latched until the panel is reset. If the condition is not satisfied after 3 consecutive attempts, the pump is locked out indefinitely and the audible and visual alarm will be activated. The LCD message and alarms will remain latched until the condition is removed and the panel is reset.

In all of the above cases, if more than one error condition is presented, the LCD message depicting the most recent error condition will be displayed.

Contains the following features:

- Alarm Activated Dry Contacts – Normally open relay contact closes upon alarm activation.
- Alarm Activated Contacts for Remote Indoor Alarm Module – Will work with or without power to the alarm panel and is designed to work with E/One's Remote Sentry.
- Includes Inner Door Dead Front
- Separate LED's for each condition
- High/Low Voltage monitoring with Trouble indication
- High/Low Wattage monitoring with Trouble indication
- Extended Run Time monitoring with Trouble indication
- Cycle/Event Counter
- Run Time Counter (Hour Meter)
- Run Time Limit — time adjustable, user-selected options: 10 minutes (default) to 120 minutes in 1-minute intervals
- Power-up Delay — time adjustable, user-selected options: None (default), to 300 minutes in 1-minute intervals
- Alarm Delay — time adjustable, user-selected options: zero to 10 minutes in 30-second increments; 4 minutes is default
- System self-test diagnostic
- User-selectable Alarm latch
- User-selectable Protect Mode disable
- User-selectable buzzer timer
- Ready LED to indicate AC power to the station is satisfactory
- Pump Run LED to indicate pump is operating (LCD indicates which pump is running)
- Trouble LED indicator and predictive Visual Alarm notification ("blinking" alarm lamp; clears on Normal cycle)
- High Level Alarm LED indicator (LCD indicates which pump is in alarm)
- Manual Run switch to manually activate pumps
- Lead/Lag indication (LCD indicates which pump is lead)
- Menu-driven programmable controller with navigation overlay-type buttons (Enter,

Scroll, Up, Down)

- Normal Operation LED and Mode button for Mode status
- Pump Performance menu LED with LCD display of the following pump performance statistics:
    - Real-time Voltage
    - Real-time Amperage
    - Real-time Wattage
    - Minimum/Maximum/Average Voltage
    - Minimum/Maximum/Average Amperage
    - Minimum/Maximum/Average Wattage
    - Minimum/Maximum Run-time
    - Average Run-time
    - Last Run-time
    - Cycle/Event Counter
    - Run Time Counter (Hour Meter)
- Diagnostics Menu LED
- Initialize System Menu LED
- Run Limit Menu LED
- Alarm Delay Menu LED
- Power Delay Menu LED
- Pump alternating options (no alternation, adjustable time based and test)
- Pump alternating time options — 24 hours to 72 hours in 12-hour increments

2.12 WET WELL

The wet well shall be custom design, molded of fiberglass reinforced polyester resin with a high density polyethylene accessway. Accessway corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250" thick (minimum). All polyethylene seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

The tank shall be furnished with fitting to accept the 8" diameter influent sewer. The tank capacities shall be as shown on the contract drawings. The tank shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be have a load rating of 150 lbs. per square foot.

The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation, no field penetrations will be acceptable.

All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 2" Male NPT fitting. The

discharge piping shall include a stainless steel ball valve rated for 235 psi WOG. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 75' (for PS#1) and 40' (for PS#2) of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

The wet well shall be provided with a sufficient number of lugs to anchor the fiberglass wet well to the concrete slab shown on the drawings. The anchoring system shall be designed to withstand an uplift force when the wet well is empty and ground water is at an elevation equal to the finished grade at the pump station.

2.14 ACCESSORIES: One (1) spare pump shall be furnished. The pump shall be properly packaged for storage by the Owner. Provide one set of special tools required for complete service and maintenance.

2.15 ADDITIONAL ACCESSORIES: Pressure Gauge and Connection. A single pressure gauge shall be installed on the 2" discharge force main in Flushing Manhole No. 1 as indicated on the drawings. The gauge shall be positioned such that it can be read without entering the manhole.

Gauge connection shall be 1/2 inch in diameter. The connection shall include a shut-off needle valve. The open end on the gauge connection shall be plugged to prevent the accumulation of debris.

Pressure gauge shall be liquid filled with snubber and diaphragm seals. Liquid shall be silicone, capable of withstanding a temperature range of -60F to +150F. The gauge shall be adequately sized to indicate discharge pressure. The gauge shall be properly installed on the pump discharge lines. The gauge shall operate over a range of 0 to 100 psig pressure. Gauges shall be a product of H.O. Trerice, Ashcroft, or equal.

2.16 SERVICEABILITY: The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.17 OSHA CONFINED SPACE: All maintenance tasks for the grinder pump must be possible without entry into the grinder pump tank (as per OSHA 1910.146 Permit-required confined spaces

2.18 SAFETY: The grinder pump system shall be rated for Class 1, Division 1, Group D, Intrinsically Safe environment.

PART 3 – EXECUTION

3.1 FACTORY TEST: All components of the pump station shall be given an operational test at the pump station Manufacturer's facility to check for excessive vibration, for leaks in the piping or seals and for correct operation of the automatic control system and all auxiliary equipment. The pump suction and discharge lines shall be coupled to a reservoir and the pumps shall recirculate water for at least one hour under simulated service conditions.

The automatic controls shall be adjusted to start and stop the pumps at approximately the levels required by the job conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating. The Engineer and/or Owner reserve the right to witness these tests.

Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, speed indicator and a vibrometer capable of measuring both amplitude and frequency.

A description of test equipment must be included with submittal data.

Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. Copies of the following items shall be included in the Operations and Maintenance Manual: Certified pump curves, integral level control performance, continuity to ground and acoustic tests of the rotating components.

The Engineer reserves the right to inspect such testing procedures with representatives of the Owner at the Manufacturer's facility.

3.3 DELIVERY: All grinder pump core units shall be delivered to the job site with the level controls completely assembled/attached and integrated with the pump core including wiring and factory testing. Grinder pump cores must also be boxed for ease of handling.

3.4 INSTALLATION: Remove packing material. User instructions MUST be given to the OWNER. Hardware supplied with the unit, if required, will be used at installation. The tank shall also be suitably vented per acceptable codes.

The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the Contractor. An alarm device is required on every installation. It will be the

responsibility of the Contractor and the Engineer to coordinate with the individual property owner(s) to determine the optimum location for the alarm panel.

The Contractor shall mount the alarm device in a conspicuous location, as per national and local codes. The alarm panel will be connected to the grinder pump as shown on the contract drawings. The power and alarm circuits must be on separate power circuits.

To prevent flotation, the wet well shall be bolted to a concrete slab located at the bottom of the excavation.

3.5 START-UP AND FIELD TESTING: The Manufacturer shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the OWNER'S personnel in the operation and maintenance of the equipment before the stations are accepted by the OWNER.

All equipment and materials necessary to perform testing shall be the responsibility of the Contractor. The Manufacturer shall make final adjustments, provide initial start-up, and instruct the Owner's personnel in the operation and maintenance of the equipment.

The services of a trained, factory-authorized technician shall be provided at a rate of 40 hours for every 100 grinder pump stations supplied. Upon completion of the installation, the authorized factory technician(s) will perform the following test on each station:

1. Make certain the discharge shut-off valve in the station is fully open.

2. Turn ON the alarm power circuit and verify the alarm is functioning properly.

3. Turn ON the pump power circuit. Initiate the pump operation to verify automatic on/off controls are operative. The pump should immediately turn ON.

4. Consult the Manufacturer's service manual for detailed start-up procedures.

Upon completion of the start-up and testing, the Manufacturer shall submit to the Engineer the start-up authorization form describing the results of the tests performed for each grinder pump. Final acceptance of the system will not occur until authorization forms have been received for each pump installed and any installation deficiencies corrected.

PART 4 - OPERATION AND MAINTENANCE

4.1 MANUALS: The Manufacturer shall supply four copies of operation and maintenance manuals to the OWNER, and one copy of the same to the Engineer.

END OF SECTION