SECTION 5
SPECIFICATIONS

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION OF THE PROJECT

A. This project will provide sewer to the unincorporated area of Cherry Fork, Ohio, in Adams County. Connecting all residents to a main sewer along SR 136 located from the southern section around (Latitude: 38°53' 3.10" N & Longitude: 83°36' 53.29" W) and connecting to the existing sewer in of Winchester Ohio at (Latitude: 38°56' 4.73" N & Longitude: 83°39' 10.74" W). The project will sewer the residents of Cherry Fork and be pumped into the existing sewer system of Winchester. The project will also include the transfer of existing laterals, septic tank abandonment, construction of four new lift stations, replacement of a lift station in Winchester, and force main.

B. The lift stations will be located at
   1. Pump Station #1 - “South” @ Latitude: 38°53' 2.94" N & Longitude: 83° 36' 53.16" W
   2. Pump Station #2 - “South Main” @ Latitude 38° 53' 5.5608" & Longitude: 83° 36' 56.9802" W
   3. Pump Station #3 - “Middle” @ Latitude: 38° 53' 30.24" N & Longitude: 83° 36' 50.37" W
   4. Pump Station #4 - “North” @ Latitude: 38° 54' 28.80" N & Longitude: 83° 37' 43.95" W
   5. Pump Station #5 - “Winchester” @ Latitude: 38° 56' 26.01" N & Longitude: 83° 39' 4.2" W

1.2 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.

1.3 DRAWING SCHEDULE

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

TITLE	SHEET NO.
COVER SHEET	1
GENERAL NOTES	2
LEGEND, SHEET INDEX & TABLES	3
GRAVITY SEWER OVERALL LAYOUT	4

TITLE	SHEET NO.
PNP - 01 ALIGNMENT 'A' & 'B'	5
PNP - 02 ALIGNMENT 'C' (33+00 - 55+78)	6
PNP - 03 ALIGNMENT 'D' (55+78 - 64+00)	7
PNP - 04 ALIGNMENT 'D' & 'H'	8
PNP - 05 ALIGNMENT 'E' (33+00 - 41+00)	9
PNP - 06 ALIGNMENT 'E' (41+50 - 47+49)	10
PNP - 07 ALIGNMENT 'E' & 'J'	11
PNP - 08 ALIGNMENT 'F' (100+00-108+00)	12
PNP - 09 ALIGNMENT 'G' (80+00 - 86+00)	13
PNP - 10 ALIGNMENT 'G' (86+00 - 90+99)	14
PNP - 11 ALIGNMENT 'I' (70+00 - 77+35)	15
PNP - 12 ALIGNMENT 'J' & 'L'	16
PNP - 13 ALIGNMENT 'J' (16+00 - 22+58)	17
PNP - 14 ALIGNMENT 'K' (20+00 - 26+00)	18
PNP - 15 ALIGNMENT 'K' (26+00 - 30+00)	19
FM-01 FORCE MAIN (200+00 - 222+52)	20
FM-02 FORCE MAIN (00+00 - 12+20)	21
FM-03 FORCE MAIN (12+20 - 22+20)	22
FM-04 FORCE MAIN (22+20 - 32+20)	23
FM-05 FORCE MAIN (32+20 - 52+20)	24
FM-06 FORCE MAIN (52+20 - 72+20	25
FM-07 FORCE MAIN (72+20 - 92+20)	26
FM-08 FORCE MAIN (92+20 - 112+20)	27
FM-09 FORCE MAIN (112+20 - 132+20)	28
FM-10 FORCE MAIN (132+20 - 152+20)	29
FM-11 FORCE MAIN (152+20 - 162+20)	30
FM-12 FORCE MAIN (162+20 - 172+20)	31
FM-13 FORCE MAIN (172+20 - 182+20)	32
FM-14 FORCE MAIN (182+20 - 192+20)	33
LIFT STATION (SOUTH)	34
LIFT STATION (SOUTH MAIN)	35
LIFT STATION (MIDDLE)	36
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END OF SECTION 011100

ECTION 011419 – USE OF SITE

PART 1 - GENERAL

1.1 GENERAL

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

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 their 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 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, Engineer and 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 011419

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 and equipment 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 Field Order.

B. Types of allowances include the following:

1. Lump-sum allowances.

1.3 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances.

B. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.4 USE OF ALLOWANCES

A. Use the allowances only as directed for the Owner's purposes and only by Field Orders that indicate amounts to be charged to the allowance.

B. The Contractor's related costs for products and equipment ordered by the Owner under the allowance are not part of the Contract Sum. These costs include delivery, installation, equipment rental, and similar costs.

C. Field Orders authorizing use of funds from the allowances will include 5% for Contractor's related costs, taxes, insurance, and overhead & profit.

D. At Project closeout, credit unused amounts remaining in the allowances to the Owner by Change Order.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly upon delivery for damage or defects.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Pavement Restoration Allowance: $100,000 The contractor shall use reasonable care to maintain the condition of the existing pavement; however, it is reasonable that there will be some deterioration to the pavement and make it unsuitable as base for the new asphalt pavement. The pavement will be evaluated during and post construction and a recommendation made for repair to the base material. The contractor shall obtain a minimum of 3 quotes from pre-approved subcontractors to perform the base repair work for the Engineer's review and approval.

B. Power Service Allowance:

a. $50,000 for electrical service run and power drop charges to each lift station for a total of $250,000.

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 Base Bid to incorporate the Alternate into the Work. No other adjustments are made to the Base Bid.

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: "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 A – Additional cost to reroute the sanitary sewer collection system at the Winchester Lift Station through a concrete structure, furnish and install a vertical screen system, and reconnect the sewer to the wetwell.

B. Alternate B – DEDUCT Amount of change (deduct) in cost to the Base Bid for a 6-foot diameter concrete wet well in lieu of the 8-foot diameter specified in the Base Bid.

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 013119

SECTION 013216 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 PROGRESS SCHEDULE

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

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

END OF SECTION 013216

SECTION 013223 – SURVEY AND LAYOUT DATA

PART 1 - GENERAL

1.1 STAKING

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

1.2 LAYOUT OF WORK

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

END OF SECTION 013223

SECTION 013236 – VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

A. Provide all labor, materials, equipment, and services, and perform all operations necessary to furnish to the Owner a complete color audio-video 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 OPEA approved testing laboratory. Laboratory services covered under this section are for testing materials used for field constructed elements of the work. Performance testing of manufactured items and shop fabricated materials shall be covered under their respective specification section.

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

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

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

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

1.2 RELATED DOCUMENTS

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

B. The Contract Documents may include testing requirements furnished under other Sections. Work elements which may include other testing requirements are:
   1. Sanitary sewer systems.

1.3 SELECTION AND PAYMENT

A. The Contractor will employ an independent testing laboratory to perform specified testing. Payment shall be incidental to the related work bid item. The laboratory shall be mutually agreed upon by the Owner, Engineer, and Contractor. OEPA approved laboratories agreeable to the Owner and Engineer are shown in the link below:

https://epa.ohio.gov/Portals/28/documents/labcert/Combined-Lab-List.pdf

B. Employment of testing laboratory in no way relieves the Contractor of the obligation to perform work in accordance with requirements of the contract documents.

C. The testing laboratory and their personnel shall be under the direction of the Engineer's on-site representative, regardless of who employs their services.

1.4 REFERENCES

A. AASHTO T-19, Standard Method of Test for Unit Weight and Voids in Aggregate.

B. AASHTO T-37, Standard Method of Test for Sieve Analysis of mineral Filler for Road and Paving Materials.

C. AASHTO T-230, Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures.

D. ASTM C-29, Standard Method of Test for Unit Weight and Voids in Aggregate.

E. ASTM C-31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.

F. ASTM C-33, Standard Specification for Concrete Aggregates.

G. ASTM C-39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

H. ASTM C-40, Test Method for Organic Impurities in Fine Aggregates for Concrete.

I. ASTM C-42, Standard Test Methods for Obtaining and Testing Drilled Cored and Sawed Beams of Concrete.

J. ASTM C-88, Standard Test Method for Soundness of Aggregate by use of Sodium Sulfate or Magnesium Sulfate.

K. ASTM C-94, Standard Specification for Ready-Mixed Concrete.

L. ASTM C-117, Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.

M. ASTM C-136, Standard Method for Sieve Analysis of Fine and Course Aggregate.

N. ASTM C-142, Test Method for Clay Lumps and Friable Particles in Aggregate.

O. ASTM C-143, Standard Test Method for Slump of Hydraulic Cement Concrete.

P. ASTM C-172, Standard Practice for Sampling Freshly Mixed Concrete.

Q. ASTM C-173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

R. ASTM C-231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

S. ASTM C-535, Standard Test Method for Resistance to Degradation of Large-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine.

T. ASTM C-1064, Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

U. ASTM D-698, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb. (2.49-kg) Rammer and 12-inc. (305-mm) Drop.

V. ASTM D-2487, Standard Test Method for Classification of Soils for engineer purposes.

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

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

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

Z. ASTM D-4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

AA. ODOT Supplement 1021, Method of Test for Determination of the Percent of Fractured Pieces in Gravel.

AB. ODOT Supplement 1029, Method of Test for Determining the Percentage of Deleterious Materials in Course Aggregate.

AC. ODOT Supplement 1036, Method of Test for Determination of Percent Air Voids in Compacted Dense Bituminous Paving Mixtures.

AD. ODOT Supplement 1044, Mix Design Method for Bituminous Aggregate Base.

AE. Uni-Bell PVC Pipe Association UNI-B-6-98 for Low Pressure Air Testing of Installed Sewer Pipe.

AF. ASTM – C969 – Standard practice for infiltration and exfiltration acceptance of installed concrete sewer pipe.

1.5 SUBMITTALS

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

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

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

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

1.6 QUALITY ASSURANCE

A. Except as otherwise indicated, the testing laboratory engaged shall be prequalified by the OEPA 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.
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 40º F. (4º C.) and below, and when 80º F. (27º C.) and above; and each time a set of compression test specimens is made.
e. Compression Test Specimen: ASTM C-31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
f. Compressive Strength Tests: ASTM C-39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days.
i. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

ii. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

g. Two (2) tests beams shall be made for each 250 square yards of concrete pavement and/or slabs on grade placed.

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

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

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

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

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

C. Pavement

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

D. Asphalt

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

E. Sewers

1. Deflection Testing
   a. All thermoplastic gravity sanitary sewer pipe shall be tested for allowable deflection.
   b. Deflection tests shall be performed before final acceptance and no sooner than thirty (30) days after installation of final backfill
   c. Maximum allowable pipe deflection shall be five (5) percent of the average inside diameter for the size and class of pipe specified.

d. Acceptance testing shall be performed with a non-adjustable “go, no-go” mandrel with a minimum of eight (8) contact points. Adjustable mandrels for acceptance testing shall be used only with permission of the Engineer.

e. The mandrel size shall be ninety-five (95) percent of the average inside diameter for the size and class of pipe specified.

f. If the "go, no-go" mandrel will not pass through a section of pipe a deflectometer or adjustable mandrel may be used to determine the extent and/or severity of the non-acceptable area. A “go, no-go” mandrel shall be re-run through the pipe section for final acceptance testing at no additional cost to the Owner.

g. The Contractor or subcontractor performing the test shall be experienced and qualified to perform deflection testing with the equipment and procedures utilized. The contractor shall provide all labor, materials, tools and equipment necessary to clean and test all sections of sewer pipe, locate deficient areas, repair, deficient areas, and retest all repaired areas.

h. All sewer runs shall be cleaned prior to testing.

i. The acceptance test shall be performed without mechanical pulling devices.

j. All pipe failing the deflection test shall be exposed, repaired or replaced and retested at no additional cost to the Owner.

2. Leakage Testing

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

b. The Contractor shall perform sufficient tests to determine that the installation of all pipe materials have been as specified and that test results are in accordance with those required for approval of the installation.

c. The Contractor shall furnish all pressure gauges, suitable pump or pumps, pipes, test heads, and any other apparatus and materials used for these tests. These tests are to be considered as part of the work, and no additional compensation shall be made.

d. The tests shall be conducted under the direction of the Engineer or an appointed agent. Any testing done without direction and supervision as specified shall not be considered as a proper means of approval.

e. The Contractor may obtain water for testing as may be required by observing the rules and regulations enforced in the municipality in which the work is being done.

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

3. Infiltration and Exfiltration Testing

a. All sewers shall be tested using an exfiltration test or, where specifically allowed in writing by the Engineer, an infiltration test.

b. All sewers shall be tested. No visible leakage in the sewers or manholes shall be permitted.

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

d. Each manhole run shall be tested separately.

4. Exfiltration Testing

a. The test shall be performed first with a minimum head of water of three (3) feet above the top of the high end of the sewer or two (2) feet above the high end of the highest lateral in the section or sections to be tested, or three (3) feet above the existing groundwater elevation, whichever is higher.

b. The exfiltration test shall be conducted between two manholes by sealing the downstream end of the test section and all inlet sewers at the upstream manhole with pipe stoppers.

c. The average internal pressure in the system shall not exceed 11.6 feet of water or 5 psi and the maximum internal pipe pressure at the lowest end shall not exceed 23 feet of water or 10 psi.

d. Water shall be added to the pipe section at a steady rate from the upstream manhole to allow air to escape from the sewer until the water is at the specified level above the crown of the pipe. The water may stand in the pipe and manhole up to seventy-two (72) hours prior to measurement of leakage to allow for absorption by the pipe and bleeding of air. After absorption into the pipe and manhole has stabilized, the water in the upstream manhole shall be brought to test level.

e. The leakage rate shall be determined by measurement of the drop in water elevation measured in the upstream manhole and the loss of water calculated. The test period shall be a minimum of sixty (60) minutes duration. Use the following table to determine loss of water as measured in the manhole:

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

1-5/8	0.13	12.72	19.89
1-3/4	0.14	13.71	21.42
1-7/8	0.16	14.69	22.90
2	0.17	15.67	24.48

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

6. Allowable Leakage
   a. The maximum allowable leakage for either infiltration or exfiltration shall be *(50)* gallons per inch of internal pipe diameter per mile per day.
   b. If actual leakage measured exceeds the limits specified, the Contractor must locate and repair or remove and replace the defective pipe sections to the satisfaction of the Engineer and retest the section accordingly at no additional cost to the Owner.

   c. All sanitary manholes shall be tested separately by using an exfiltration test (or infiltration test where groundwater conditions permit) to two (2) feet above the highest joint with no measurable leakage for a one-hour test.

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

d. The sewer shall be flushed and cleaned prior to testing to clean out any debris. The pipe surface should be wet for more consistent results.

e. The section of pipe to be tested shall be plugged at each end and the ends of laterals, stubs and fittings to be included in the test section shall be plugged and securely braced to prevent air leakage, and possible blowouts.

f. Equipment used shall meet the following minimum requirements and be approved by the Engineer:
   i. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
   ii. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
   iii. All air used shall pass through a single control panel.
   iv. Three (3) individual hoses shall be used for the following connections:
      a). From control panel to pneumatic plugs for inflation.
      b). From control panel to sealed line for introducing the low pressure air.
      c). From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

g. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be used for the test. The sealed pipe shall be pressurized to 9 psig. The plugs must hold against this pressure without having to be braced. No persons shall be allowed in the alignment of the pipe during plug testing.

h. After a manhole to manhole run of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole. Low pressure air shall be slowly introduced into this sealed line until the internal air pressure reaches approximately 4 psig greater than the average groundwater back pressure, but not greater than 9 psig for PVC pipe or 5 psig for RCP.

i. In areas where groundwater is known to exist, the Contractor must determine the average groundwater back pressure. The Contractor shall install a 1/2-inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sanitary sewer lines entering the manhole. See Figure No. 1. This shall be done at the time the sanitary sewer line is installed or install an 8-inch diameter stand pipe outside of the manhole backfilled with a column of clean stone of 2-inch minimum diameter to subgrade. Immediately prior to the performance of the low pressure air test, the ground water back pressure shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The plastic tube shall be vertical and a measurement of the height, in feet of water over the invert of the pipe shall be taken after the water has

stopped rising in this plastic tube. This height, divided by 2.307, will equal the average groundwater back pressure.

j. At least two (2) minutes shall be allowed for the air to stabilize when the specified internal air pressure has been obtained. When the pressure has stabilized and is at or above 3.5 psig, the air hose from the control panel to the air supply shall be disconnected. The portion of the line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average groundwater back pressure calculated) shall not be less than the time in the tables in Reference Table 1.

k. If a one (1) psi drop in pressure does not occur within the test time, the line has passed. If the pressure drop is more than one (1) psi during the test time, the line is presumed to have failed the test. If the line fails the test, segmented testing may establish the location of any leaks.

l. The Contractor must repair the leak or remove and replace the defective pipe section and re-test the section to the satisfaction of the Engineer at no additional cost to the Owner.

m. The pneumatic plugs must be installed in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or a plug, which is partially deflated before the pipe pressure is released, can be dangerous.

n. The Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

o. Pressurizing equipment shall include a regulator or relief valve set at no higher than 9 psig for PVC pipe or 5 psig for RCP pipe to avoid over-pressurizing and damaging an otherwise acceptable line.

p. No one shall be allowed in the trench or manholes during testing.

q. Plugs shall not be removed until all pressure has been released.

r. All sanitary manholes shall be tested separately by using an exfiltration test (or infiltration test where groundwater conditions permit) to two (2) feet above the highest joint with no measurable leakage for a one-hour test.

s. The air test data sheet marked Exhibit “A” at the end of this section shall be filled out for each section of piping tested in this manner.

t. Testing concrete pipe sewer lines by the low pressure air test method will be per ASTM C924-02 and C1103.

8. Hydrostatic Testing – Pressure Pipe, For Water Main and Force Main

a. The pipe to be tested must be sufficiently backfilled to prevent movement while under test pressure.

b. Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure. A cure time of seven (7) days is recommended when Type I Portland

Cement is used; three (3) days is recommended when Type III high-early Portland Cement is used.

c. Test ends should be restrained to withstand the appreciable thrusts that are developed under test pressure.

d. Air pressure testing of installed pressure pipe is expressly prohibited.

e. Any testing performed without the knowledge of the Engineer shall not be considered a test for the purpose of this specification.

f. The hydrostatic testing sheet marked "Exhibit D" following this section shall be filled out for each section of piping tested in this manner.

g. After the pipe has been installed and partially backfilled (if applicable) subject all newly installed pipe, or any valved sections of it in such lengths of the force main as determined by the responsible agency, unless otherwise specified, to a hydrostatic pressure test equal to 1-1/2 times the line working pressure (50% over the working pressure) but not less than 1.25 times the working pressure at the highest point along the test section; but, in no case, shall such force mains be tested at less than 150 pounds per square inch.. The duration of each test shall be at least 2 hours.

h. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a booster pump connected to the pipe in a manner satisfactory to the Engineer. The duration of the test shall be for a minimum of sixty (60) minutes.

i. No pipe installation will be accepted unless the leakage rate for the section of pipe being tested does not exceed a rate as shown on hydrostatic test chart, during a 24-hour test duration.

j. The Contractor shall furnish suitable means for determining the quantity of water lost by leakage during the test.

9. Manhole Vacuum Testing

a. Temporarily plug all pipe entering the manhole. Each plug must be installed at a location beyond the manhole/pipe gasket (i.e. outside the manhole wall), and shall be braced to prevent the plug or pipe from being drawn into the Manhole.

b. The test head shall be placed inside the rim of the cast iron frame at the top of the manhole and inflated, in accordance with the manufacturer's recommendations.

c. A vacuum of at least 10 inches of mercury (10" Hg) shall be drawn on the manhole. Shut the line on the vacuum line to the manhole and shut off the pump or disconnect the vacuum line from the pump.

d. The pressure gauge shall be liquid filled, having a 3.5" diameter face with a reading from zero to thirty inches of mercury.

e. The manhole shall be considered to pass the vacuum test if the vacuum reading does not drop more than 1" Hg (i.e from 10" to 9" Hg) during the Table 1 minimum test time.

f. If a manhole fails the vacuum test, the manhole shall be repaired with non-shrinkable grout or other material or method approved by the engineer. The manhole surfaces shall be properly prepared prior to any repairs. Once the repair material has cured according to the manufacturer's recommendations, the vacuum test shall be repeated. This process shall continue until a satisfactory test is obtained.

g. All temporary plugs and braces shall be removed after each test.

10. Video Inspection

a. The Contractor shall survey and/or inspect new sanitary sewer systems with digital cameras or color pan and tilt CCTV imagery as specified in order to record all relevant features and confirm their structural and service condition. Surveys/Inspections of sewer systems shall be carried out in compliance with the NASSCO PACP reporting format and coding standards.

b. All CCTV operator(s) responsible for direct reporting of sewer condition shall have a minimum of 3 years previous experience in surveying, processing, and interpretation of data associated with CCTV surveys/inspections. If requested by the Engineer, the Contractor shall provide the designated representative with written documentation that all CCTV survey operators meet these experience requirements which shall include a list of projects undertaken as well as client name and telephone number for reference.

c. Contractor shall provide OWNER with one digital copy of all CCTV inspections and reports.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 SEQUENCING AND SCHEDULING

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

3.2 LABORATORY TEST RESULTS

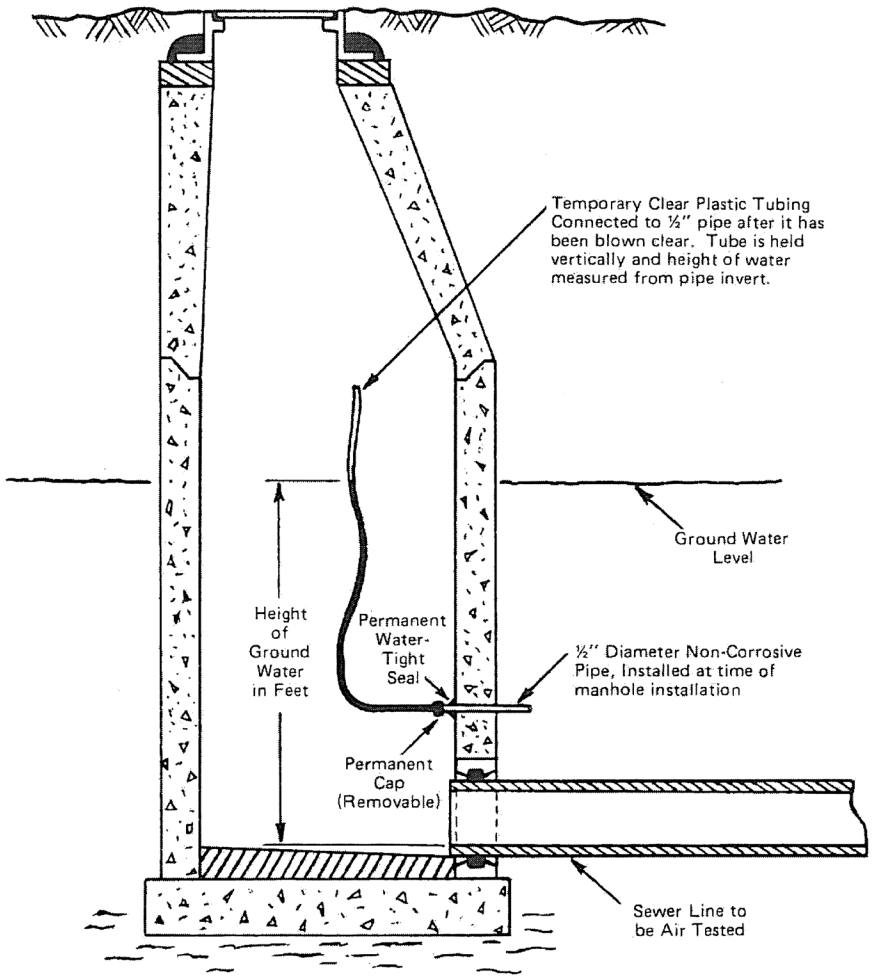
A. The testing laboratory shall submit a certified written report of each inspection, test, or similar service concurrently to the Owner, Engineer, and Contractor.

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

END OF SECTION 013319

FIGURE NO. 1

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



AIR TEST DATA SHEET
PIPE TESTING FORM

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

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

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

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

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

REMARKS:

TABLE I

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

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

for size and length of pipe indicated for Q = 0.0015

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

TABLE II

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

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

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

CT CONSULTANTS, INC.
HYDROSTATIC LEAKAGE TEST

JOB. NO. _____ PROJECT: _____

CONTRACTOR: _____ CLIENT: _____

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

FROM STATION _____ TO STATION _____ ON _____

WATERLINE SIZE _____ TYPE _____

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

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

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

2nd TEST _____, _____ AND _____
PASS / FAIL PRESSURE LOST GALLONS LOST

APPROVED BY _____
(INSPECTOR)

COMMENTS: _____

_____

ALLOWABLE LEAKAGE PER 1,000 FEET OF WATERMAIN:

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

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

CT Consultants
engineers | architects | planners

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

JOB NO. _____ **STREET:** _____

CONTRACTOR: _____ **PROJECT REP:** _____

MANHOLE VACUUM TEST

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

TABLE 1 – Minimum Test Times for Various Manhole Diameter

Depth	Diameter, in.								
(ft)	30	33	36	42	48	54	60	66	72
Time(s)									
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
	39	42	49	59	69	81	91	101	113
	42	45	53	63	74	87	98	108	121

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

PROJECT REP: _____

DATE: _____

SECTION 013323 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor shall submit detailed drawings, acceptable catalog data, specifications and material certifications for all equipment and materials specified or required for the proper completion of the work.

B. The intent of these items is to demonstrate compliance with the design concept of the work and to provide the detailed information necessary for the fabrication, assembly and installation of the work specified. It is not intended that every detail of all parts of manufactured equipment be submitted, however sufficient detail will be required to ascertain compliance with the specifications and establish the quality of the equipment proposed.

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

C. It is emphasized that the Engineer/Architect's review of Contractor's submitted data is for general conformance to the contract drawings and specifications but subject to the detailed requirements of drawings and specifications. Although the Engineer/Architect may review submitted data in detail, such review is an effort to discover errors and omissions in Contractor's drawings. The Engineer/Architect's review shall in no way relieve the Contractor of his obligation to properly coordinate the work and to Engineer/Architect the details of the work in such manner that the purposes and intent of the contract will be achieved. Such review by the Engineer/Architect shall not be construed as placing on him or on the Owner any responsibility for the accuracy and for proper fit, functioning or performance of any phase of the work included in the contract.

D. Shop Drawings shall be submitted in proper sequence and with due regard to the time required for checking, transmittal and review so as to cause no delay in the work. The Contractor's failure to transmit appropriate submittals to the Engineer/Architect sufficiently in advance of the work shall not be grounds for time extension.

E. The Contractor shall submit Shop Drawings for all fabricated work and for all manufactured items required to be furnished in the Contract in accordance with the General Provisions and as specified herein. Shop Drawings shall be submitted in sufficient time to allow at least twenty-one (21) calendar days after receipt of the Shop Drawings from the Contractor for checking and processing by the Engineer/Architect.

F. It is the responsibility of each Prime Contractor to furnish to all other Prime Contractors and especially the General Construction Contractor reviewed Shop Drawings for guidance in interfacing the various trades; i.e., sleeves, inserts, anchor bolts, terminations, and space requirements.

G. No work shall be performed requiring Shop Drawings until same have been reviewed by Engineer/Architect.

H. Accepted and reviewed Shop Drawings shall not be construed as approval of changes from Contract plan and specification requirements.

I. The Engineer/Architect will review the first and second Shop Drawing item submittals at no cost to the Contractor. Review of the third submittal and any subsequent submittal will be at the Contractor's expense. Payment will be deducted from the Contract amount at a rate of 2.8 times direct labor cost plus expenses.

1.2 SUBMITTAL PROCEDURE

A. All required submissions shall be made to the Engineer/Architect by the Prime Contractor(s) only. Any data prepared by subcontractors and suppliers and all correspondence originating with subcontractors, suppliers, etc., shall be submitted through the Contractor.

B. Contractor shall review and approve all Shop Drawings prior to submission. Contractor's approval shall constitute a representation to Owner and Engineer/Architect that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents.

C. Submittal Preparation: Mark each submittal with a permanent label or page for identification. Provide the following information on the label for proper processing and recording of action taken:

1. Location
2. Project Name
3. Contract
4. Name and Address of Engineer/Architect
5. Name and Address of Contractor
6. Name and Address of Subcontractor
7. Name and Address of Supplier
8. Name of Manufacturer
9. Number and Title of appropriate Specification Section
10. Drawing Number and Detail References, as appropriate.
11. Submittal Sequence or Log Reference Number.

    a. Provide a space on the label for the Contractor's review and approval markings and a space for the Engineer/Architect's "Action Stamp".

D. Each Shop Drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor:

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

_____ _____

Signature Date

_____

Company

E. Shop Drawings shall be submitted in not less than six (6) copies to the Engineer/Architect at the address specified at the Preconstruction Conference. Single mylar or sepia reproducible copies of simple Shop Drawings may be submitted with prior approval of the Engineer/Architect.

F. At the time of each submission, Contractor shall in writing identify any deviations that the Shop Drawings or samples may have from the requirements of the Contract Documents.

G. Drawings shall be clean, legible and shall show necessary working dimensions, arrangement, material finish, erection data, and like information needed to define what is to be furnished and to establish its suitability for the intended use. Specifications may be required for equipment or materials to establish any characteristics of performance where such are pertinent. Suitable catalog data sheets showing all options and marked with complete model numbers may, in certain instances, be sufficient to define the articles which it is proposed to furnish.

H. For product which require submittal of samples, furnish samples so as not to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted. Properly label samples, indicating the material or product represented, its place of origin, the names of the vendor and Contractor and the name of the project for which it is intended. Ship samples prepaid. Accompany samples with pertinent data required to judge the quality and acceptability of the sample, such as certified test records and, where required for proper evaluation, certified chemical analyses.

1.3 REVIEW PROCEDURE

A. Engineer/Architect will review with reasonable promptness all properly submitted Shop Drawings. Such review shall be only for conformance with the design concept of the Project and for compliance with the information given in the plans and specifications and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.

B. The review of a separate item as such will not constitute the review of the assembly in which the item functions. The Contractor shall submit entire systems as a package.

C. All Shop Drawings submitted for review shall be stamped with the Engineer/Architect's action and associated comments.

D. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer/Architect will review each submittal, mark to indicate action taken, and return accordingly. Compliance with specified characteristics is the Contractor's responsibility.

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

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

E. No submittal requiring a Change Order for either value or substitution or both, will be returned until the Change Order is approved or otherwise directed by the Owner.

APPLICATION FOR USE OF SUBSTITUTE ITEM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____
Page	Paragraph	Description

A. The undersigned requests consideration of the following as a substitute item in accordance with Article 6.05 of the General Conditions.

_____

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

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

D. Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

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

1. The proposed substitute does not affect dimensions shown on Drawings.

2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.

3. The proposed substitution will have no adverse affect on other contractors, the construction schedule, or specified warranty requirements. (If proposed substitution affects construction schedule, indicate below using + or -)

_____ CONSECUTIVE CALENDAR DAYS

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

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

E. Signature: _____

Firm: _____

Address: _____

_____

Telephone: _____ Date: _____

Attachments: _____

_____

_____

_____

For use by ENGINEER:

_____Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp.
_____Accepted as evidenced by included CHANGE ORDER.
_____Not accepted as submitted. See Remarks.
_____Acceptance requires completion of submittal as required for SHOP DRAWINGS.
_____Not accepted. Do not resubmit.

By: _____ Date: _____

Remarks: _____

_____

_____

_____

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_____

_____

_____

APPLICATION FOR USE OF "OR-EQUAL" ITEM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____
Page	Paragraph	Description

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

_____

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

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

D. Signature: _____

Firm: _____

Address: _____

_____

Telephone: _____ Date: _____

Attachments: _____

_____

_____

_____

For use by ENGINEER:

_____Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp.
_____Accepted as evidenced by included CHANGE ORDER.
_____Not accepted as submitted. See Remarks.
_____Acceptance requires completion of submittal as required for SHOP DRAWINGS.
_____Not accepted. Do not resubmit.

By: _____ Date: _____

Remarks: _____

END OF SECTION 013323

SECTION 013326 – PRODUCT TESTING AND CERTIFYING

PART 1 - GENERAL

1.1 QUALITY OF MATERIALS

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

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

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

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

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

1.2 QUALITY ASSURANCE

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

1.3 EXPERIENCE CLAUSE REQUIREMENT AND PERFORMANCE BONDS FOR MANUFACTURER

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

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

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

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

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

END OF SECTION 013326

SECTION 013326.01 - QUALITY CONTROL PLAN

PART 1 - GENERAL

1.1 QUALITY CONTROL

A. The Contractor shall be responsible for the quality of all materials incorporated into the project work and shall be responsible for all costs of testing and certification of same. The Contractor shall provide the City Engineer a list of three (3) local qualified firms for the City to select from to be the Contractor's testing firm.

B. The Contractor shall provide the Engineer with a Quality Control Plan in which his testing methods/procedures are defined. Said Plan shall meet with the approval of the Engineer and include identification of laboratories, types of testing, and the tentative amount and scheduling of each.

All certifications of tests and/or gradations for materials to be utilized in the work and all quality control testing shall be performed by an independent laboratory (not affiliated with, owned by, or managed by the Contractor). The laboratory shall be accredited by the AASHTO Materials Reference Laboratory for the type of testing performed.

C. The Owner may perform field Quality Assurance testing; however, such testing shall not relieve the Contractor from the responsibility of Quality Control testing or from supplying certificates from manufacturers or suppliers to demonstrate compliance with the specifications. It is intended that the testing by the Contractor and the Owner be complimentary toward a quality project; however, the Contractor may not assume the Owner will test or that any tests will be done in lieu of the Contractor's own Quality Control testing. In the same sense, the Contractor may not rely on Owner Quality Assurance testing as a basis of acceptance or approval of his work nor may any Owner performed testing be reflected in his submitted plan.

1.2 TEST CRITERIA

A. The following tests at a minimum shall be included with the Contractor's Quality Control Plan in accordance with the specifications:

1. Aggregates

a. For each material and/or different source, the laboratory shall perform soundness, gradation, and other tests for all parameters specified. Aggregates incorporated into concrete or asphalt mixes shall also be tested for moisture content daily.

2. Compaction Tests

a. Compaction tests or field density tests shall be taken on all embankment, trench backfill, subgrade, and subbase materials.
b. Minimum testing shall be as follows:

Embankment testing shall be at least one (1) test/5000 S.F. of each lift;
Trench backfill testing shall be at least one (1) test/50 L.F. of each lift;
Subgrade and/or subbase testing shall be at least one (1) test/200 L.F. of pavement or /5000 S.F. of slabs; subject to greater frequency due to soil conditions or Engineer's direction.

c. Proctors or relative density tests shall be performed as often as necessary for the differing soils or granular materials utilized. Proctors shall be run with a minimum of 5 points. Test reports shall show the wet (bulk) weight, dry weight, wet (bulk) density, dry density, moisture content weight and moisture content percentage. Both the dry curve and the wet curve shall be plotted. The source materials shall be tested for gradation, Atterberg limits, shore-hydrometer and moisture content.

3. Concrete Mix Design

   a. For each type of concrete, the laboratory shall perform the necessary mix design providing all test data as required by the specifications.

4. Concrete Field and Laboratory Tests

   a. The laboratory shall cast concrete cylinders and test beams:
      1) One set of four cylinders per 50 C.Y. with a minimum of two sets per day. The cylinders shall be broken: one at 7 days, two at 28 days, one at 56 days, unless otherwise directed by the Engineer.
      2) One beam per 50 C.Y. with a minimum of two beams per day.
   b. Temperature and unit weight shall be run on fresh concrete at intervals sufficient for the type of structure being placed and a minimum of once per day. Bulk weight, bucket weight, (tare), net weight, bucket factor (bucket volume) and unit weight shall be recorded on the fresh concrete report. Show all batch weights for yield calculations. Slump and air content tests shall be taken a minimum of one test per 20 C.Y. and at least once per day.
   c. All field and laboratory testing shall be performed by technicians certified by the American Concrete Institute (ACI) for the type of testing performed.
   d. Initial cure of all cylinders shall be in a temperature controlled cure box or temperature controlled water tank with a hi-low thermometer. Hi-low temperature readings shall be recorded on the fresh concrete report.

5. Asphalt Mix Design

   a. For each type of asphalt mix, submit job mix formula (JMF) prepared by an ODOT pre-qualified laboratory from tests performed on the aggregates proposed for use.
   b. Sample and test for gradation and bitumen content as per ODOT 441.
   c. Asphalt compaction, thickness, and temperature tests shall be performed during asphalt placement per ODOT Item 448.

1.3 LABORATORY REPORTS

A. Reports of laboratory and field tests will be distributed to the Engineer, Owner, and Suppliers within 24 hours of completion.

END OF SECTION 013326.01

SECTION 013543 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 UNNECESSARY NOISE, DUST AND ODORS

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

1.2 SEWAGE, SURFACE AND FLOOD FLOWS

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

1.3 WORK IN FREEZING WEATHER

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

1.4 POLLUTION CONTROL

A. It shall be the responsibility of the Contractor to prevent or limit pollution of air and water resulting from his operations.

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

C. The Contractor shall perform work required to prevent dust attributable to his operations from entering the atmosphere. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with water and/or calcium chloride dust palliative as needed.

D. Any material removed from sanitary or storm sewers shall be disposed in accordance with all applicable regulations.

END OF SECTION 013543

SECTION 014126 - GENERAL REGULATIONS AND PERMITS

PART 1 - GENERAL

1.1 REGISTRATION

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

1.2 PERMITS

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

1.3 ARCHAEOLOGICAL DISCOVERIES

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

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

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

END OF SECTION 014126

SECTION 014223 - INDUSTRY STANDARDS

PART 1 - GENERAL

1.1 ABBREVIATIONS

A. Abbreviations, as used, designate the following:

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

1.2 REFERENCE TO OTHER SPECIFICATIONS

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

1.3 CODES AND STANDARDS

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

END OF SECTION 014223

SECTION 014323 – QUALIFICATIONS OF TRADESMEN

PART 1 - GENERAL

1.1 CHARACTER OF WORKMEN AND EQUIPMENT

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

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

END OF SECTION 014323

SECTION 015526 - TEMPORARY TRAFFIC CONTROL DEVICES

PART 1 - GENERAL

1.1 BARRICADES, SIGNS AND LIGHTS

A. The Contractor shall employ watchmen on the work when and as necessary. The Contractor shall erect and maintain such strong and suitable barriers and such lights as will effectively prevent the occurrence of any accident to health, limb or property. Lights shall be maintained between the hours of one-half (1/2) hour after sunset and one-half (1/2) hour before sunrise.

B. No manhole, trench, excavation will be left open awaiting connection or removal at a later date by the Contractor's forces or others but shall be temporarily backfilled and resurfaced if applicable with a temporary pavement passable to traffic at no additional cost to the Owner.

C. In addition to other safety requirements, a minimum of four (4) foot high fence will be incorporated around any shaft or manhole or other excavation left open at the end of a day's work.

1.2 MAINTENANCE OF TRAFFIC

A. The Contractor is required to provide maintenance of traffic in conformance with the Ohio Manual of Uniform Traffic Control Devices and Item 614 of the current Construction and Material Specifications of the Ohio Department of Transportation.

B. This work shall include providing suitable and satisfactorily trained and properly attired flagmen for use at any location where existing roadway is narrowed to a width of less than 2 full lanes (18 feet).

C. The Contractor is also responsible for maintaining local access to all residences and businesses along the route of the construction and to provide whatever temporary materials are necessary to provide a safe, adequate drive surface.

D. At all boring locations, Contractor shall provide suitable flashers, barricades, and traffic control devices as may be deemed necessary by the Engineer or the responsible authority in the case of the Department of Transportation, Turnpike Commission, or affected railroad. This may extend to maintain facilities on a 24-hour basis until such time as the areas are completely backfilled.

END OF SECTION 015526

SECTION 015713 - TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnishing all labor, materials, tools, equipment and services for the temporary soil erosion and sediment control work as indicated.

B. Coordinating the temporary pollution and erosion control with work of all other trades.

C. Reducing to the greatest extent practicable the area and duration of exposure of readily erodible soils.

D. Protecting the soils by use of temporary vegetation or mulch or by accelerating the establishment of permanent vegetation.

E. Mechanically retarding the rate of runoff from the construction site and control disposal of runoff.

F. Trapping all sediment resulting from construction in temporary or permanent debris basins.

G. Using temporary measures to keep erosion under control if construction is suspended for any appreciable length of time.

H. Providing protection against chemical, fuel, or lubricant spills, and sewage pollutants.

I. Protecting project and existing structures from surface water damage due to utility line excavations.

J. Controling soil erosion and sedimentation by use of silt fences, dikes, ditches, slope protection, sediment pits, basins, dams, slope drains, coarse aggregate, mulches, sod, grasses, filter fabrics, and other erosion control devices or methods.

1.2 SUBMITTALS

A. Product Data
   1. Filter fabric

B. Shop Drawings
   1. All submittals shall conform completely to the requirements of the Contract Documents.

C. Samples

D. Quality Control Submittals
   1. Design Data
   2. Test Reports
   3. Certificates
      a. Seed
      b. Fertilizer
      c. Limestone
   4. Manufacturers Instructions

E. Contract Closeout Submittals
   1. Project Record Documents

1.3 QUALITY ASSURANCE

A. Qualifications

B Regulatory Requirements

C. Certifications

D. Field Samples

E. Mock-ups

F. Pre-Installation Conference

1.4 DELIVERY, STORAGE, AND HANDLING

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

B. Acceptance at Site

C. Storage and Protection

1.5 PROJECT CONDITIONS

A. Environmental Requirements
   a. Refer to Subsurface Investigation Report (Appendix)

B. Existing Conditions

C. Field Measurements

1.6 SEQUENCING AND SCHEDULING

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

PART 2 - PRODUCTS

2.1 SEED

A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.

B. All areas of temporary seeding shall be seeded with grass as shown in the following table:

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

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

* After November 1, use mulch only

2.2 ORGANIC MULCH

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

	Rates		
Mulch	Per Acre	Per 1000 ft^2	Notes
Straw (temporary only)	2 tons	90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Wood Chips (permanent or temporary)	400 $yds.^3$	9 - 10 $yds.^3$	Apply approx. 3" deep. Treat with 12 lbs. of nitrogen per ton. Do not use on firm turf areas. Apply with mulch blower, chip handler, or by hand.
Bark Chips or Shredded Bark (temporary mulch only)	70 $yds.^3$	1½ - 2 $yds.^3$	Do not use in fine turf areas. Apply about ½" thick. Apply with a mulch blower or by hand.

2.3 FERTILIZER

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

2.4 LIMESTONE

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

2.5 WATER

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

2.6 DITCH CHECKS

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

2.7 INLET FILTERS

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

2.8 SLOPE DRAINS

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

2.9 FILTER FABRIC

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

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

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

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

2.10 BURLAP

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

2.11 FILTER SUPPORTS AND REINFORCING

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

B. Stakes for filter barriers shall be 1" x 2" wood (preferred) or equivalent metal with a minimum length of 3 feet.

C. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The Contractor shall limit the surface area of erodible earth material exposed by clearing and grubbing; the surface area of erodible earth material exposed by excavation; borrow; and fill operations; and provide immediate permanent or

temporary control measures to prevent contamination of adjacent streams or other areas of water impoundment. Such work will involve the construction of temporary ditch checks, filters, benches, dikes, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods necessary to control erosion and sedimentation.

B. The Contractor shall incorporate all permanent erosion control features into the Work at the earliest practicable time. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. This will require the establishing of final grades as shown on the Drawings and application of agricultural limestone, commercial fertilizer, seeding and mulching or sodding . When directed by the Engineer, temporary fertilizer, seeding and mulching materials shall be used. In general, the Contractor shall temporarily seed all disturbed areas within seven (7) days if they are to remain dormant for more than forty- five (45) days. Permanent soil stabilization shall be applied to disturbed areas within seven (7) days after final grade is reached on any portion of the site.. Temporary control measures will be used

when and as directed by the Engineer to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion control measures will be required between successive construction stages.

D. The Engineer will limit the area of excavation, borrow and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Mulching, seeding, and other such permanent control measures shall be applied after completion of a vertical eight (8) feet of embankment or cut, unless otherwise directed by the Engineer. Should seasonal limitations or embankment make such coordination unrealistic, temporary erosion control measures shall be taken immediately.

E. The Engineer may increase or decrease the allowable amount of surface area or erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions. Factors such as soil erodibility, slope, cut or fill height, exposed area contributing to a watercourse and weather will be considered in this determination.

F. In the event of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State or local agencies, the more restrictive laws, rules or regulations shall apply.

G. Temporary seeding areas shall be fertilized at a rate of 12-15 pounds per 1000 square feet of 10-10-10 or 12-12-12 analysis or equal.

H. When directed by the Engineer, the seed bed shall be thoroughly watered to maintain adequate moisture in the upper four (4) inches of soil, necessary to promote proper root growth.

I. When directed by the Engineer, temporary seeded areas shall be mowed when grass exceeds four (4) inches in height.

J. Temporary erosion control features shall be acceptably maintained and shall subsequently be removed or replaced when directed by the Engineer.

K. Removed materials shall become the property of the Contractor and shall be disposed of off the site at the Contractor's expense.

3.2 PERFORMANCE

A. If, in the opinion of the Engineer and Owner, proper control of soil erosion and sedimentation is not being provided by the Contractor, the Owner may take all necessary steps to provide corrective measures and the cost of such services will be deducted from any money which may be due or become due the Contractor.

B. Control work performed for protection of construction areas outside the construction site, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites shall be considered as a subsidiary obligation of the Contractor, with all necessary control costs included in the contract price.

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

3.3 SILT FENCE

A. The height of a silt fence shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).

B. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum six (6) inches overlap and securely sealed.

C. Posts shall be spaced a maximum of ten (10) feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed six (6) feet.

D. A trench shall be excavated approximately four (4) inches wide and four (4) inches deep along the line of posts and upslope from the barrier.

E. When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one (1) inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two (2) inches and shall not extend more than 36 inches above the original ground surface.

F. The standard strength filter fabric shall be stapled or wired to the fence, and eight (8) inches of the fabric shall be extended into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

G. When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of Subparagraph F above applying.

H. The trench shall be backfilled and soil compacted over the filter fabric.

I. Silt fences shall be removed when they have served their purpose, but not before the upslope area has been permanently stabilized.

J. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

K. Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.

L. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

M. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

3.4 TEMPORARY MULCHING

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

B. Mulch Anchoring
   1. Straw mulch shall be anchored immediately after spreading to prevent windblow. One of the following methods of anchoring straw shall be used:
      a. Mulch anchoring tool
         1) This is a tractor-drawn implement (mulch crimper, serrated straight disk or dull farm disk) designed to punch mulch approximately two(2) inches into the soil surface. This method provides maximum erosion control with straw. It is limited to use on slopes no steeper than 3:1, where equipment can operate safely. Machinery shall be operated on the contour.
      b. Liquid mulch binders
         1) Application of liquid mulch binders and tackifiers should be heaviest at edges of areas and at crests of ridges and banks, to prevent windblow. The remainder of the area should have binder applied uniformly. Binders may be applied after mulch is spread; however, it is recommended to be sprayed into the mulch as it is being blown onto the soil. Applying straw and binder together is the most effective method.

2) The following type of binder may be used:

a.) Asphalt - any type of asphalt thin enough to be blown from spray equipment is satisfactory. Recommended for use are rapid curing (RC-80, RC-250, RC-800), medium curing (MC-250, MC-800) and emulsified asphalt (SS-1, MS-2, RS-1 and RS-2). Apply asphalt at 4 gal./1000 ft.^{2}, 600 gal./acre. Do not use heavier applications as it may cause the straw to "perch" over rills.

b.) Wood Fiber - wood fiber hydroseeder slurries may be used to tack straw mulch.

c. Mulch nettings

1) Lightweight plastic, cotton or paper nets may be stapled over the mulch according to manufacturer's recommendations.

C. Chemical Mulches

1. Chemical mulches may be used alone only in the following situations:
   a. Where no other mulching material is available.
   b. In conjunction with temporary seeding during the times when mulch is not required for that practice.
2. Chemical mulches may be used to bind other mulches or with wood fiber in a hydroseeded slurry at any time. Manufacturer's recommendations for application of chemical mulches shall be followed.

D. Nets and Mats

1. Nets may be used alone on level areas, on slopes no steeper than 3:1, and in waterways.
2. When mulching is done in late fall or during June, July and August, or where soil is highly erodible, net should only be used in conjunction with an organic mulch such as straw.
3. When net and organic mulch are used together, the net should be installed over the mulch except when the mulch is wood fiber. Wood fiber may be sprayed on top of the installed net.
4. Excelsior blankets are considered protective mulches and may be used alone on erodible soils and during all times of the year.
5. Other products designed to control erosion shall conform to manufacturer's specification and should be applied in accordance with manufacturer's instructions provided those instruction are at least as stringent as this specification.
6. Staples will be made of plain iron wire, No. 8 gauge or heavier, and will be six (6) inches or more in length.
7. Prior to installation:
   a. Shape and grade as required the waterway, channel, slope or other area to be protected.
   b. Remove all rocks, clods or debris larger than two (2) inches in diameter that will prevent contact between the net and the soil surface.
   c. When open-weave nets are used, lime, fertilizer and seed may be applied either before or after laying the net. When excelsior matting is used, they must be applied before the mat is laid.

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

3.5 TEMPORARY SEEDING

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

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

C. Seeding
1. Apply the seed uniformly with a cyclone seeder, drill, cultipacker seeder or hydroseeder (slurry may include seed and fertilizer) preferably on a firm, moist seedbed. Seed wheat or rye no deeper than one (1) inch. Seed ryegrass no deeper than one-fourth (¼) inch.
2. When feasible, except where a cultipacker type seeder is used, the seedbed should be firmed following seeding operations with a cultipacker, roller or light drag. On sloping land, seeding operations should be on the contour wherever possible.

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

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

END OF SECTION 015713

SECTION 016600 - PRODUCT HANDLING AND PROTECTION

PART 1 - GENERAL

1.1 DELIVERY AND STORAGE OF MATERIALS

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

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

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

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

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

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

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

END OF SECTION 016600

SECTION 017800 - FINAL COMPLIANCE AND SUBMITTALS

PART 1 - GENERAL

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

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

B. Contractor's Certification of Completion.

C. Contractor's Affidavit of Prevailing Wage.

D. Consent of Surety Company for Final Payment.

E. Affidavit of Final Acceptance Date and Correction Period.

F. Before the OWNER will approve and accept the work and release the retainer, the CONTRACTOR will furnish the OWNER a written report indicating the resolution of any and all property damage claims filed with the CONTRACTOR by any party during the construction period. The information to be supplied shall include, but not be limited to, name of claimant, date filed with CONTRACTOR, name of insurance company and/or adjuster handling claim, how claim was resolved and if claim was not resolved for the full amount, a statement indicating the reason for such action.

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

END OF SECTION 017800

SECTION 017821 - CLEANING AND PROTECTION

PART 1 - GENERAL

1.1 GENERAL

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

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

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

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

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

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

END OF SECTION 017821

SECTION 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 BUILDINGS

A. The building and components shall function properly and in accordance with the plans, specifications and industry standards.

B. The following components are included, but not necessarily limited to, the following:

1. Roofing
2. Doors
3. Windows
4. Painting Systems
5. Floor Coverings
6. Equipment
    a. Architectural
    b. Mechanical
    c. Electrical

1.3 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. Rotating Equipment
4. Aeration Equipment
5. Flotation Equipment
6. Blowers
7. Telemetry
8. HVAC
9. Electrical

1.4 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 018000

SECTION 024100 - 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. It is the intent of this section that the Contractor shall furnish all of the equipment, labor, and materials necessary to demolish various concrete structures and to remove, disconnect and/or transport some miscellaneous equipment from the project site; together with all associated appurtenances as noted on the Contract Drawings, listed in the specifications herein, or as directed by the Engineer.

1.3 JOB CONDITION

A. The Contractor shall exercise all necessary precaution to protect adjacent properties and roadways from falling debris, material, and sections during the demolition process. All necessary barricades to protect pedestrians and vehicular traffic will be installed.

1.4 SUBMITTALS

A. The Contractor shall submit to the Engineer prior to the start of any proposed demolition, a written description of the method proposed to abandon, dismantle, or remove any of the structures or equipment located at the site. Under no circumstances will blasting or the use of explosives be allowed. All sewage within the tanks will be removed before demolition by maintaining pumping through the existing pump station, or diverting it to the new pumping station facility.

1.5 SCHEDULE

A. Demolition shall be scheduled and performed in strict conformance with these specifications and in a manner which will insure no interruption of sewage pumping operations beyond that provided for and approved by the Owner and the Ohio EPA. The date and the time of commencing the separate items of demolition work shall be submitted to the Engineer for review, and no demolition work shall commence until the Engineer's approval of date and time for the specific operation is in the hands of the Contractor.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXCAVATION, DEMOLITION & REMOVAL

A. The Contractor shall be responsible for the excavation, demolition, removal, and transportation from the site, to the satisfaction of the Engineer, including but not limited to the following:

1. Existing Pump Station (S.R. 125):

a. Existing pumps shall be preserved and given to Owner.
b. Pump equipment and miscellaneous items.
c. Drain and abandon all sanitary piping as shown on drawings.
d. Disconnect and remove cable from the electrical panel to all equipment with the exception of the lighting.

2. Copeland Lift Station
a. Existing manhole no. 3 shall be preserved and given to Owner.

3.2 OWNERSHIP & DISPOSAL OF MATERIALS

A. All salvaged material shall become the property of the Contractor with the exception of the items chosen by the Owner to remain.
1. Existing Pumps on S. R. 125 Lift Station
2. Existing Electrical Panels on S.R. 125 Lift Station
3. Existing Manhole No. 3 at the Copeland Lift Station.

B. All materials, whether they may be salvageable or not, shall be promptly removed from the construction site as demolition progresses. Material not sold for scrap value shall be transported to an approved landfill site for proper disposal.

END OF SECTION 024100

SECTION 024119 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

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 removal of pavement, piping, and equipment necessary to clear space for new construction and/or to rehabilitate existing construction.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

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

1.4 PROTECTION

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

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PAVEMENTS, SIDEWALKS, CURBING, SIMILAR STRUCTURES

A. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat and free from chipped or damaged edges.

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

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

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

3.2 EXCAVATION OF RIGID PAVEMENT

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

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

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

3.3 CATCH BASINS, INLETS AND SIMILAR STRUCTURES

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

B. Abandoned sewers shall be sealed and made watertight with approved masonry bulkheads.

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

3.4 FENCE

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

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

C. The Contractor will be required to replace, at no cost to the Owner, material lost or damaged by negligence or by the use of improper methods.

3.5 EQUIPMENT REMOVAL

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

3.6 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 offsite.

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

3.7 BACKFILLING

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

END OF SECTION 024119

SECTION 026500 - UNDERGROUND STORAGE TANKS REMOVAL / ABANDONMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Bid Documents, General and Supplementary Conditions and other Contract Documents apply to work of this section.

1.2 SUMMARY

A. This section includes provisions for the following items:

1. Preparation to Underground Storage Tanks (USTs) Prior to Removal
2. Purging of USTs to Remove Flammable Vapors
3. Testing of USTs for Flammable Vapors and Oxygen Concentration
4. Removal of the USTs from the Excavation Site
5. Proper Abandonment and Disposal of the USTs

B. It is the intent of this contract that the final removal be complete in all aspects and the Contractor shall be responsible for minor details and any necessary special construction/excavation not specifically included in these specifications.

1.3 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials and appurtenances necessary to perform the tasks outlined in these specifications. The Contractor is also responsible for arranging for a certified inspector to be on-site. This section provides provisions for the following items:

1. Preparation of the USTs prior to removal consists of the following:

a. Observing the special precautions in regards to worker exposure to petroleum hydrocarbon liquids, vapors, or wastes; toxicity considerations of petroleum substances including, but not limited to, benzene and tetraethyl lead (if applicable).
b. Drainage of product piping into the USTs, careful to avoid spillage, and capping/removing of product piping.
c. Removal of residues and liquids from the USTs.
d. Excavation of site directly above the top of the USTs.
e. Removal of the fill pipe, gauge pipe, vapor recovery truck connection, submersible pumps, and other tank fixtures.
f. Capping of all non-product lines, except the vent, and plugging all other tank openings.

2. Purging of the USTs of all flammable vapors consists of the following:

   CAUTION! Purging of the USTs provides a "temporary" vapor-freeing of the tank atmosphere. However, it should be noted that this process is indeed "temporary" and that a combustible gas indicator (CGI) shall be present and in operation at all times during the UST's removal.

   CAUTION! The work area shall be free from sources of ignition such as smoking materials and non-explosion-proof electrical and internal combustion equipment. Prevent the discharge of static electricity and the accumulation of flammable vapors at ground level.

   CAUTION! Certain methods of purging the USTs, if chosen, not only displace the flammable vapors inside of the USTs, but also devoid them of oxygen.

   a. Vent all vapors from the tank at a minimum of twelve (12) feet above grade and three (3) feet above any adjacent roof lines.
   b. USTs may be vented by any of the following means so long as they meet local and state regulations: purging with an inert gas such as Nitrogen (N_2) or Carbon Dioxide (CO_2) through the tank fill opposite the tank vent under low pressure to avoid the generation of static electricity and not exceeding five (5) pounds per square inch (psi), solid CO_2 (dry ice) at 1.5 pounds per 100 gallons of tank capacity may be added to the tank to displace flammable vapors, or tank vapors may be exhausted by either the use of an educator-type air mover or a diffused air blower.

3. Testing of USTs for Flammable Vapors and Oxygen Concentration consist of the following:

   a. The tank atmosphere and points surrounding the excavation area shall be regularly tested for flammable or combustible vapor concentrations until the USTs are removed from both the excavation and the site. The excavation site shall be regularly tested to ensure safe oxygen levels.
   b. Readings of 10 percent or less of the lower flammable limit must be obtained before the UST is considered safe for removal from the ground.

4. Removal of the USTs from the Excavation Site consists of the following:

   a. After it has been determined that the USTs have been freed of flammable vapors, excavation around the tanks may proceed.
   b. Remove the USTs from the excavation and place them on a level surface, placing blocks of wood to prevent movement of the tank.
   c. Open the USTs and clean internally. Place all bottom sludge into properly labeled 55-gallon drums.
   d. Load the USTs on a truck trailer and secure them for transportation properly so that the tank vents are at the uppermost point on the USTs.
   e. The USTs shall be transported in accordance with all applicable local, state, and federal regulations.

5. Proper Abandonment and Disposal of UST's
    a. Removal of residues and liquids from the USTs.
    b. Removal of the fill pipe, gauge pipe, vapor recovery truck connection, submersible pumps, and other tank fixtures.
    c. Capping of all non-product lines, except the vent, and plugging all other tank openings.
    d. Drill a core hole opening at the bottom of the USTs to allow for drainage.
    e. Fill the USTs with No. 57 stone, cap and backfill USTs

B. Related Specifications: The following specifications contain requirements that relate to this section.

1. Abandoned Treatment Units. Septic tanks that are no longer in use shall be completely pumped. The bottom of the tanks shall be cracked so the tank will not water, and the tank shall be filled with sand or soil. If the tank is removed from the ground, the excavation shall be filled with soil.

1.4 QUALITY ASSURANCE

A. In addition to the requirements of these specifications, comply and obtain any necessary permits within the regulations of the Ohio State Fire Marshal's Bureau of Underground Storage Tank Regulations (BUSTR), the Occupational Safety and Health Administration (OSHA), the Ohio Environmental Protection Agency (OEPA), and the Willoughby Fire Department regarding the proper removal procedures.

1.5 SUBMITTALS

A. Contractor Qualifications: The Contractor shall submit documentation of current Ohio UST removal certification.

B. Previous Experience: The Contractor shall provide documentation of at least five (5) completed projects of comparable scope and complexity which are acceptable to the Owner's Agent.

C. Product Data: The following product data must be submitted for approval prior to the Preparation of the USTs prior to removal as indicated in section 1.3 (A) (1) of these specifications.

1. Calibration records or certification of the Contractor's CGI and/or Oxygen Concentration detector(s).

1.6 JOB CONDITIONS

A. Utilities: Determine the location of all underground utilities at least 72 hours prior to excavation. Submit requests to have above ground utility cables protected or relocated at least seven (7) days prior to the start of work.

B. Work Area: All work activities shall be limited to the areas specified on the site plans in order to minimize interference with normal operations on the premises.

C. Site Access: Contractor shall provide access to the site Owner and Owner's Agent for inspection of all construction/excavation activities.

1.7 CONTRACTOR'S/ENGINEER'S USE OF THE PREMISES

A. General Conditions: In general, during the entire period of the scope of work, the Contractor shall have exclusive use of the premises for construction/excavation activities. Special conditions related to the Contractor's use of the premises are listed below:

1. Keep all excavation, stockpiling, backfilling and site restoration activities confined to the allowable work area specified on the site plans provided.
2. Keep existing driveways and entrances serving the premises clear and available to the Owner, his/her employees and representatives at all times, as well as for the Contractor's access. Do not use these areas for parking or storage of materials.
3. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials to a specific site. No storage sheds are to be constructed or installed for temporary use in any location of the project area during project implementation.
4. Lock automotive type vehicles, automobiles, trucks and other mechanized or motorized equipment, when parked or unattended, to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place or accessible to unauthorized persons.
5. Smoking or open fires are not permitted within 100 feet of the excavation or stockpile areas.
6. The Contractor shall provide adequate barriers or barricades to restrict objects, equipment or personnel from entering any excavation on-site. These barriers or barricades should consist of high-visibility materials and shall be erected during all periods of inactivity.

1.8 PROJECT COORDINATION

A. Administrative Requirements: This section specifies administrative and supervisory requirements necessary for project coordination. In general, the Contractor shall assign a Project Coordinator to serve as a liaison between the Contractor and the Owner's Agent. In addition, the Contractor shall coordinate progress meetings and keep daily logs of those meetings and any accidents which may occur.

B. Accident Reports: The Contractor shall prepare and submit reports of significant accidents occurring at the site or anywhere else while work is in progress. These reports should record and document data and actions and comply with OSHA and industry standards. For the purposes of this section, a significant accident is defined to include events where personal injury is sustained which requires more than first

aid (as defined by OSHA) or involves more than one-half day of lost time from work, or where property damage in excess of $100.00 is sustained, or where the event posed a significant threat of personal injury or property damaged.

1.9 AUTHORITY TO STOP WORK

A. The Owner's Agent, should the Owner determine hazardous or dangerous conditions exist, has the authority to stop the Contractor's work at any time it is determined that conditions are not within the required specifications and/or governmental regulations. Work shall not continue until conditions have been corrected and steps have been taken to the satisfaction of the Owner's Agent and a written notice has been given to the Contractor to start work again. Standby time required to resolve any specification-related items or regulatory agency violations shall be at the Contractor's expense.

PART 2 – PROJECT DESCRIPTION

2.1 MATERIALS AND EXCAVATION

A. Spill Prevention Equipment:

1. Spill prevention equipment shall prevent a release of product to the environment when removing the fill pipe, gauge pipe, vapor recovery truck connection, submersible pumps, and other tank fixtures.
2. Spill prevention equipment shall prevent a release of product to the environment when removing the USTs from the excavation site.
3. Spill prevention materials shall consist of drip pans beneath any disconnection of piping, absorbent material specifically for oil and other petroleum products, shovels and at least one (1) 55-gallon polydrum for any contaminated soil as a direct result of a release due to excavation.
    a. If a contamination is evident at the excavation site that is not a direct result of a release due to excavation, refer to section 1.3 (A) (4) (d) of these specifications.

B. Excavation Equipment:

1. All necessary equipment for the entire scope of work described shall be supplied by the Contractor as previously stated in section 1.3 (A) of these specifications.

PART 3 – EXECUTION

3.1 ORDER OF WORK

A. In coordination with tank removal on the premises, the excavation of the USTs will include the following tasks:

1. Conducting preliminary site visits, contracting utility companies, and attending a pre-construction meeting.

2. Taking the USTs and systems in conjunction with the USTs off-line, preparation of the USTs for removal, purging and testing of tank atmospheres of flammable vapors, removal of the USTs from the excavation site, and proper storage and disposal of the USTs (if applicable).
3. Site survey of the excavation site for signs of contamination.

3.2 SITE RESTORATION

A. Any disturbed areas surrounding the site shall be restored, as closely as possible, to the same or better condition existing prior to the start of work and shall include the following:

1. Replacement of excavation fill and the addition of clean fill to return the site to the level of the surrounding grade, sodding, seeding, mulching, etc.
2. All disturbed concrete slabs or aprons shall be replaced in accordance with the Owner's Agent or the Owner.

END OF SECTION 026500

SECTION 030000 - CONCRETE WORK

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 013319 – Field Testing Requirements

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including form work, reinforcing, mix design, placement procedures and finishes.

1. Extent of concrete work is shown on drawings.
2. Concrete paving and walks are specified in Division 2.
3. Precast concrete is specified in other Division-3 sections.
4. Mechanical finishes and concrete floor toppings are specified in other Division-3 sections.

1.3 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Engineer.

B. Shop Drawings; Reinforcement: Submit original shop drawings prepared for fabrication, bending, and placement of concrete reinforcement. Comply with ACI Detailing Manual showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. Shop Drawings; Form work: Submit shop drawings prepared by a registered Professional Engineer for fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items which affect exposed concrete visually.

1. Engineer's review is for general architectural applications and features only. Design of form work for structural stability and efficiency is Contractor's responsibility.

D. Samples: Submit samples of materials as requested by Engineer, including names, sources, and descriptions.

E. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design tests.

1. The proposed mix design submittal(s) shall follow the procedures of Chapter 5, Sections 5.2 to 5.3 of ACI-318.
2. Reference should be made to ACI-211.5R "Guide for Submittal of Concrete Proportions" for the required submittal information. Sample forms for presenting the necessary information can be found in the addendum at the end of this section. Example Form B should follow a completed Example A in the submittal when laboratory trial batches are used to document a water-cementious materials ratio curve.
3. Additional data summarizing the past performance records should be an integral part of the submittal if the submittal is based on past performance with the proposed materials and proportions.

F. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, latest revisions, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings."
2. ACI 318 "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
4. ACI 347 "Guide to Form work for Concrete."
5. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

B. Materials and installed work may require testing and retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

C. Engage a testing agency acceptable to Engineer to perform initial material evaluation and certification tests for mix designs and to design concrete mixes.

D. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of project, after Engineer's acceptance of visual qualities.
1. Demolish mockup and remove from site when directed by Engineer.

E. Pre-installation Conference: Conduct conference at project site to comply with requirements of Division 1 Section "Project Meetings" and the following:

1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine

procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials, inspection, testing and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:

a. Contractor's Superintendent
b. Agency responsible for concrete design mixes.
c. Agency responsible for field quality control.
d. Ready-mix concrete producer.
e. Concrete Subcontractor
f. Primary admixture manufactures.

1.5 PROJECT CONDITIONS

A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two (2) edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration to match Engineer's control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Forms for Cylindrical Columns and Supports: Metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.

E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

F. Form Ties: Factory-fabricated, adjustable-length, snap off metal or glass fiber-reinforced plastic form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to the exposed surface.

1. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.
2. All form ties shall have a factor of safety of two (2) to determine the recommended safe working load.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Galvanized Reinforcing Bars: ASTM A 767, Class II (2.0 oz. zinc psf) hot-dip galvanized, after fabrication and bending.

C. Epoxy-Coated Reinforcing Bars: ASTM A 775.

1. Repair of damaged epoxy-coating - When required, damaged epoxy-coating shall be repaired with patching material conforming to ASTM A 775. Repair shall be done in accordance with the patching material manufacturer's recommendations.

D. Steel Wire: ASTM A 82, plain, cold-drawn steel.

E. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. (Flat sheets only)

F. Welded Deformed Steel Wire Fabric: ASTM A 497.

G. Epoxy - Coated Welded Wire Fabric: ASTM A884, Class A.

H. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I, II or I/II and ASTM C595M, Type IP, unless otherwise specified. (See Table I, Concrete Requirements).

1. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Class F.

C. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

1. Limit use of fly ash to not exceed 25% of cement content by weight.
2. Limit use of granulated blast-furnace slag to not exceed 30% of cement content by weight.

D. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete, with nominal maximum aggregate size of 1 inch.

1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
2. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Engineer.
3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).

E. Lightweight Aggregates: ASTM C 330.

Maximum nominal aggregate size of 1 inch.

F. Water: Drinkable and complying with ASTM C94.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Air-Mix"; Euclid Chemical Co.
b. "Sika Aer"; Sika Corp.
c. "MB-VR or MB-AE"; Master Builders.

H. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "WRDA"; W.R. Grace.
b. "Eucon WR-75"; Euclid Chemical Co.
c. "Pozzolith Normal"; Master Builders.

I. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Sikament 300"; Sika Chemical Corp.
b. "Eucon 37"; Euclid Chemical Co.
c. "Rheobuild or Polyheed"; Master Builders.

J. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Accelguard 80"; Euclid Chemical Co.
b. "Pozzutec 20"; Master Builders.
c. "Daraset"; W.R. Grace & Co.

K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Pozzolith"; Master Builders.
b. "Eucon Retarder 75"; Euclid Chemical Co.
c. "Plastiment"; Sika Chemical Co.

L. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Catexol 1000CL; Axim Concrete Technologies.
b. MCI 2000 or MCI 2005; Cortec Corporation.
c. DCI or DCI-S; W.R. Grace & Co., Construction Products Div.
d. Rheocrete 222+; Master Builders, Inc.
e. FerroGard-901; Sika Corporation.

M. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

N. Fiber Reinforcement:

1. Synthetic fiber reinforcing shall be added to the concrete for the areas so indicated in the drawings. Only fibers designed and manufactured specifically for use in concrete shall be acceptable as secondary reinforcement, complying with ASTM C1116, not less than 3/4 inch long.
2. The fibers may be added at the batch plant. The incorporation of said fibers shall be documented on the delivery ticket from the ready mix producer. Fibers shall be added to the concrete in strict accordance with manufacturer's printed instructions. The minimum dosage rate shall be 1.5 lbs/cubic yard.
3. Nylon fibers containing 100% virgin nylon monofilaments shall be utilized to impart a "non-hairy" surface to the finished concrete.
4. Products: Subject to compliance with requirements, provide the following fibrous reinforcement or approved equal:

    a. Nycon Fiber; Nycon, Inc.
    b. Nylo-Mono; Forta Corp.
    c. Fibrasol N; Axim Concrete Technologies

2.4 RELATED MATERIALS

A. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Waterstops: Provide waterstops at construction joints and other joints as indicated and specified in Section 030000.02.

C. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

D. Vapor Retarder: Provide vapor retarder cover, ASTM E1745 Class C, over prepared base material where indicated below slabs on grade. Use only materials which are resistant to deterioration when tested in accordance with ASTM E 154, as follows:

1. Polyethylene sheet not less than 10 mils thick.
2. Water resistant barrier paper consisting of heavy Kraft papers laminated together with glass fiber reinforcement and over-coated with black polyethylene on each side.

    a. Product: Subject to compliance with requirements, provide Moistop Ultra 10 by Fortifiber Corporation, Stego Wrap 10-mil by Stego Industries or equal.

E. Non-Shrink Grout: CRD-C 621 and ASTM C-1107, factory pre-mixed grout.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Non-metallic

1) "Set Grout"; Master Builders.
2) "Euco-NS"; Euclid Chemical Co.
3) "Five Star Grout"; U.S. Grout Corp.

F. Non-slip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rust-proof, and non-glazing, and is unaffected by freezing, moisture, and cleaning materials.

G. Colored Wear-Resistant Finish: Packaged, dry, combination of materials, consisting of Portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground, non-fading mineral oxides, interground with cement. Color as selected by Engineer, unless otherwise indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Colorcron"; Master Builders.
b. "Surflex"; Euclid Chemical Co.
c. "Lithochrome"; L.M. Scofield Co.

H. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

I. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

J. Liquid Membrane-Forming Curing Compound: Liquid type membrane- forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg./sq. m. when applied at 200 sq ft./gal.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Masterkure"; Master Builders.
b. "Ecocure"; Euclid Chemical Co.
c. "Horn Clear Seal"; A.C. Horn, Inc.

K. Underlayment Compound: Freeflowing, self-leveling, pumpable cementitious base compound for applications from 1 inch thick to feathered edges.

1. Products: Subject to compliance with requirements, provide one of the following:
a. "Flo-Top"; Euclid Chemical Co.
b. "Underlayment 110," Master Builders, Inc.
c. "Thoro Underlayment Self-Leveling"; Thoro System Products.

L. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Polyvinyl Acetate (Interior Only):

1) "Euco Weld"; Euclid Chemical Co.
2) "Weldcrete"; Larsen Products Corp.
3) "Everweld"; L&M Construction Chemicals, Inc.

b. Acrylic or Styrene Butadiene:

1) "Day-Chem AD Bond"; Dayton Superior Corp.
2) "Everbond"; L & M Construction Chemicals.
3) "SBR Latex"; Euclid Chemical Co.

M. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Epoxtite Binder 2390"; A.C. Horn, Inc.
b. "Sikadur 32 Hi-Mod"; Sika Chemical Corp.
c. "Euco Epoxy 452 or 620"; Euclid Chemical Co.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301 and ACI 211. If the trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Engineer.

1. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Engineer and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.

C. Design mixes to provide normal weight concrete with the following properties, as indicated in Table I.:

TABLE 1

CONCRETE REQUIREMENTS

Concrete Class	Cement Type	Min. 28-Day Compressive Strength PSI	*Max. Water-Cement Ratio	Min. Cement Content Sacks	Slump Min.	Inch Max.	Entrained Air %
A	I	4000	0.45	6	-	-	6±1
B	I	2000	0.74	4-1/2	2	6	5±1-1/2
C	I	4000	0.50	6.38	1	4	6±2
D	II or IP	4000	0.45	6	-	-	6±1

*Maximum Water - Cementitious Materials Ratio

1. All reinforced concrete shall be Class A, except as otherwise specified or shown on the drawings.
2. Concrete used for mud mats, fill and channeling in manholes and chambers shall be Class B unless otherwise noted on the drawings.
3. Class C concrete conforming to ODOT 499 (Class C) shall be used for all concrete pavement, curbing, driveways, and sidewalks, unless noted otherwise on the drawings.
4. Class B concrete may be used for encasing pipelines, fill, and pipe bedding.
5. Class B concrete shall be used as concrete fill in concrete tanks for shaping or sloping bottoms.

    a. The following steps shall be taken for installation of the Class B concrete:

        1) Scrub concrete slabs and/or walls with a stiff wire brush and streams of clean water as a minimum, to remove laitenance.
        2) Apply a bonding agent in accordance with the manufacturer's surface preparation and application recommendations.
        3) The Class B concrete shall then be placed and screeded to bring the surface to final grade.

6. Class D concrete shall be used for sewerage treatment plants and sewerage pump stations, as noted on the drawings.

D. Lightweight Concrete: Lightweight aggregate and concrete shall conform to ASTM C 330. Proportion mix to produce concrete with a minimum compressive strength of 3000 psi at 28 days and a calculated equilibrium unit weight of 110 pcf plus or minus 3 pcf as determined by ASTM C 567. Concrete slump at the point of placement shall be the minimum necessary for efficient mixing, placing, and finishing. Maximum slump shall be 6 inches for pumped concrete and 5 inches elsewhere. Air entrain concrete exposed to weather according to ACI 301 requirements.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

F. Admixtures:

1. Use high range water-reducing admixture (super plasticizer) in Classes A and D concrete unless noted otherwise.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
3. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content within limits shown in Table I.
4. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
5. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as shown in Table I:

    a. Concrete containing HRWR admixture (super-plasticizer): Not more than 8" after addition of HRWR to site-verified 2"-3" slump concrete.

2.6 CONCRETE MIXING

A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.

1. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

    a. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

A. Design, erect, support, brace, and maintain form work to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct form work so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain form work construction tolerances complying with ACI 347.

B. Design form work to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

E. Provide temporary openings where interior area of form work is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete form work to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6" and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by form work, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

F. Epoxy - Coated Reinforcing Steel:

1. Epoxy-coated reinforcing bars supported from form work shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable materials. Wire bar supports shall be coated with dielectric material for a minimum distance of 2 inches from the point of contact with the epoxy-coated reinforcing bars. Reinforcing bars used as support bars shall be epoxy-coated.
   In walls having epoxy-coated reinforcing bars, spreader bars where specified by the Engineer, shall be epoxy-coated. Proprietary combination bar clips and spreaders used in walls with epoxy-coated reinforcing bars shall be made of corrosion-resistant material.
2. Epoxy-coated reinforcing bars - Equipment for handling epoxy-coated bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pick-up points to minimize bar-to-bar abrasion from sags in the bundles. Coated bars or

bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. Fading of the color of the coating shall not be cause for rejection of epoxy-coated reinforcing bars. Coating damage due to handling, shipment and placing need not be repaired in cases where the damaged area is 0.1 square inches or smaller. Damaged areas larger than 0.1 square inches shall be repaired in accordance with the epoxy material manufacturer's recommendations. The maximum amount of damage including repaired and unrepaired areas shall not exceed 2 percent of the surface area in each linear foot of each bar.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.

1. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

B. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

C. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Section 030000.02 of these specifications.

D. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4 of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting premolded plastic strips into fresh concrete until top surface of strip is flush with slab surface.
2. Follow the directions of Insert Manufacturer for finishing the slab and joints.

E. If joint pattern not shown, provide joints not exceeding 15' in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

1. Joint sealant material is specified in Section 030000.02 of these specifications.

3.6 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto. Electrical conduit shall not be embedded in concrete.

B. Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units to support screed strips using strike-off templates or compacting type screeds.

3.7 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, from-coating compound before placing reinforcement.

C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel form work is not acceptable.

3.8 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete form work installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement operations.

E. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.

    a. The concrete shall be maintained within this temperature range for not less than seven (7) days.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials or against cold reinforcing steel.
3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

F. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineers.

3.9 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to- view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed; provide smooth rubbed finish to smooth form finish. Refer to "Concrete Surface Repairs."

C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment.

1. Scarify or roughen entire surface by grinding or similar effective means.
2. Combined one part Portland cement to 1-1/2 parts fine sand by volume and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.
3. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
4. Repeat the above process if necessary to fill voids or bug holes and obtain a consistent match to adjacent surfaces, subject to acceptance of the Engineer.

D. Grout Cleaned Finish: Provide grout cleaned finish on scheduled concrete surfaces which have received smooth form finish treatment.

1. Scarify or roughen entire surface by grinding or similar effective means.
2. Apply Thoroseal plaster mix coating by Thoro System Products or approved equivalent with an approximate thickness of 1/8-inch to ¼-inch.
3. Follow the manufacturer's recommendations and guidelines regarding surface preparation, application methods and curing.
4. Repeat the above process if necessary to fill voids or bug holes and obtain a consistent match to adjacent surfaces, subject to acceptance of the Engineer.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

1. After placing slabs, plane surface to tolerances for floor flatness F(F) 15 and floor levelness F(L) 13, measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both, Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F(F) 18 F(L) 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to

tolerances of F(F), 20 and F(L) 17, measured according to ASTM E1155. Grind smooth surface defects which would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

E. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

F. Non-slip Aggregate Finish: Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and elsewhere as indicated.

1. After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
2. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose non-slip aggregate.

G. Colored Wear-Resistant Finish: Provide colored wear-resistant finish to monolithic slab surface indicated.

1. Apply dry shake materials for colored wear-resistant finish at rate of not less than 100 lbs. per 100 sq. ft., unless greater amount is recommended by material manufacturer.
2. Immediately following first floating operation, uniformly distribute approximately 2/3 of required weight of dry shake material over concrete surface, and embed by means of power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications, and embed by power floating.
3. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by dry shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.11 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete from rapid moisture loss before and during finishing operations.
1. The evaporation graph, Figure 1, of ACI 308 - Curing Concrete, shall be used to determine the evaporation rate during concrete placement. If the rate of evaporation equals or exceeds 0.2 lbs/sq.ft./hr., steps shall be taken to prevent excessive evaporation from the surface.

2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

    a. Initial curing may be any of the methods listed herein that maintain a satisfactory moisture content and temperature.

3. Begin final curing procedures, if they differ from initial curing, immediately following initial curing and before concrete has dried. Continue curing for at least seven (7) days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of all structural concrete as herein specified.

1. Provide moisture curing by following methods.

    a. Keep concrete surface continuously wet by covering with water.
    b. Continuous water-fog spray.
    c. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows:

    a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

C. Provide curing and sealing compound to pavement, walks, and curbs only, as follows:

1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours) and after surface water sheen has disappeared. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

D. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

E. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing methods.

1. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.12 SHORES AND SUPPORTS

A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.

B. Extend shoring from ground to roof for structures four (4) stories or less, unless otherwise permitted.

C. Extend shoring at least three (3) floors under floor or roof being placed for structures over four (4) stories. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.

D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.

1. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.13 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for five (5) days after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members. Lab cured cylinders will not be considered.

C. Form facing material may be removed five (5) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.14 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new form work.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

3.15 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

1. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled. Cure concrete as herein specified.

E. Reinforced Masonry: Provide concrete grout conforming to ASTM C476 for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.16 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.

1. Saw-cut out honeycomb, rock pockets, voids over 1/4" in any dimension, down to solid concrete but, in no case to a depth of less than 1." Make edges of cuts slightly undercut to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with Portland Cement patching mortar, or precast cement cone plugs secured in place with bonding agent. When other materials are used, apply them in accordance with manufacturer's recommendations.

1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
2. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
3. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
4. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Engineer.
6. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
8. Perform structural repairs with prior approval of Engineer or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.
9. Repair methods not specified above may be used, subject to acceptance of Engineer.
10. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of specified underlayment material.

3.17 THROUGH SECTION CONCRETE CRACK REPAIRS

A. Sealing through wall or slab cracks.

1. Seal cracks for a water-tight or structurally bonded repair with epoxy or chemical grouting procedures.

a. The Contractor shall make proper repairs with epoxy injection or chemical injection with a moisture reactive hydrophilic polyurethane foam grout, as directed by the Engineer.

3.18 MUD MATS

A. Where called for on the plans or as directed by the Engineer, the Contractor shall construct concrete mud mats immediately after cleaning the excavation bottom, to preserve the bearing surface condition. Concrete for mud mats shall be not less than 3 in. thick. Bottom of excavation shall be free of water, mud and loose material prior to mud mat placement. See Section 310000.

1. Mud mat concrete shall be cast against the side walls of all excavations to completely seal the bottom.

ADDENDUM
EXAMPLE FORM A

CONCRETE SUPPLIER:_____

PROJECT:_____ CONTRACTOR:_____

MIXTURE ID:_____ SPECIFIED f'c:_____PSI

MATERIAL MIXTURE PROPORTIONS lbs-mass/cu.yd. (pcy)

1.0 Cement Type_____ Source:_____

Sp. Gr._____ _____pcy _____cu. ft.

1.1 Other Cementitious Materials:_____ Class:_____ Source:_____

Sp. Gr._____ _____pcy _____cu. ft.

2.0 Aggregate (No. 1) Type:_____ Size:_____ Source:_____

SSD Sp. Gr._____ _____pcy _____ cu. ft.

Dry Rodded Unit Wt.:_____pcf

Alternate (No. 1) Lightweight Aggregate Type:_____ Size:_____Source:_____

Sp. Gr. Factor _____ over dry pcy _____ cu. ft.

Loose Unit Wt._____pcf Estimated Wet _____pcf

2.1 Aggregate (No. 2) Type:_____ Size:_____ Source:_____

SSD Sp. Gr._____ _____pcy _____cu. ft.

Dry Rodded Unit Wt.: _____pcf (If Fine Sized - FM _____)

2.2 Aggregate (Nos. 3, 4, n) Type:_____ Size:_____ Source:_____

SSD Sp. Gr._____ _____pcy _____cu. ft.

Dry Rodded Unit Wt.: _____pcf

3.0 Water: _____gal. _____pcy _____cu. ft.

EXAMPLE FORM A (CONTINUED)

4.0 Admixtures expressed as fluid ounces/cubic yard, and estimated range

Source:_____ Name:_____ Type_____ _____oz

Source:_____ Name:_____ Type_____ _____oz

Source:_____ Name:_____ Type_____ _____oz

Total Admixture Liquid Vol. _____ cu. ft.

(*) Note: Show volume in 4.0 if not included in cubic feet of air or water.

5.0 Other Materials - fibers, color pigment or other additions

Sp. Gr._____ _____pcy _____cu. ft.

Total Mixture Mass and Volume: _____pcy _____cu. ft.

Fresh Concrete Properties

Slump _____ +/-_____ in.

Unit Weight _____ pcf

Air Content _____+/-_____%

If Trail Batch Data -

Identify Batch No. _____

Batch Date _____

Concrete Temp._____°F

Comp. Strength-Average _____°F

Coarse & Fine Aggregate Gradation

Percent Passing

Sieve Size	Aggregate No. 1	2	3	4	Combined
2 in.	____	____	____	____	_____
1-1/2 in.	____	____	____	____	_____
1 in.	____	____	____	____	_____
3/4 in.	____	____	____	____	_____
1/2 in.	____	____	____	____	_____
3/8 in.	____	____	____	____	_____
No. 4	____	____	____	____	_____
No. 8	____	____	____	____	_____
No. 16	____	____	____	____	_____
No. 30	____	____	____	____	_____

7 day avg. _____psi	No. 50	____ ____ ____ ____ _____
28 day avg. _____psi	No. 100	____ ____ ____ ____ _____
	No. 200	____ ____ ____ ____ _____

Comments:_____

_____

Signature: _____ Date:_____

Title: _____

Organization: _____

EXAMPLE FORM B

CONCRETE SUPPLIER:_____

MATERIAL	TRAIL BATCH NUMBER - proportions per cubic yard			
	1	2	3	4
1.0 Cement Source: _____				
Type ____	_____lb	_____lb	_____lb	_____lb
1.1 Other Cementitious Material Sources:_____				
Type ____	_____lb	_____lb	_____lb	_____lb
2.0 Aggregate No. 1 Size_____ Source:_____				
SSD ____	_____lb	_____lb	_____lb	_____lb
Alternate No. 1 Lightweight Aggregates Type _____ Source: _____				
Sp. Gr. Factor _____				
Oven Dry	_____lb	_____lb	_____lb	_____lb
Wet	_____lb	_____lb	_____lb	_____lb
2.1 Aggregate No. 2 Size_____ Source:_____				
SSD ____	_____lb	_____lb	_____lb	_____lb
2.2 Aggregate Nos. 3, 4, n) Size_____Source:_____				
SSD ____	_____lb	_____lb	_____lb	_____lb
3.0 Water	_____lb	_____lb	_____lb	_____lb
4.0 Admixtures Source: _____				
_____ Type _____	_____oz	_____oz	_____oz	_____oz
_____ Type _____	_____oz	_____oz	_____oz	_____oz
_____ Type _____	_____oz	_____oz	_____oz	_____oz

5.0 Other Materials

_____ Type _____ _____lb _____lb _____lb _____lb

_____

Total Mass: _____lb _____lb _____lb _____lb

Total Mass/cy: _____pcy _____pcy _____pcy _____pcy

Relative Cubic Yard Volume:
_____cy _____cy _____cy _____cy

Water-Cementitious Material Ratio:

Fresh Concrete Properties

	TRAIL BATCH NUMBER			
	## -1	## -2	## -3	## -4
Slump-inches	_____	_____	_____	_____
Air-Content %	_____	_____	_____	_____
Unit Wt. pcf	_____	_____	_____	_____
Concrete Temp. °F	_____	_____	_____	_____
Compressive Strength Results (ASTM C192, C39) or Other Specified Test Requirements				
7 days	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
Average (7 day)	_____	_____	_____	_____

28 days	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
Average (28 day)	_____	_____	_____	_____
Water-Cementitious Material Ratio:				
	_____	_____	_____	_____

Signature: _____Date:_____

Title:_____

Organization: _____

END OF SECTION 030000

SECTION 034000.02 - PRECAST CONCRETE MANHOLES

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. Under this section, the Contractor shall furnish and construct precast concrete manholes, including drops and manhole stacks of types and at locations shown on the Drawings and/or scheduled.

B. This section includes additional excavation to widen and deepen sewer trenches for manhole construction, furnishing and installing concrete of classes called for, brick, Portland cement mortar, reinforcing steel, precast concrete pipe, integral base sections, bottom riser sections, transition sections, riser sections, eccentric cones, flat slab tops and adjusting rings, flexible manhole connections, pipe for drop connections, plugging lifting holes, pointing joints, forming channels through manhole bottoms, making watertight connections to new and existing sewers, and other work incidental to manhole construction.

1.3 QUALITY ASSURANCE

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

1.4 DEFINITIONS

A. The various types of manholes are as shown on the Drawings or in the Standard Details.

1.5 SUBMITTALS

A. Manufacturer's Shop Drawings and Certificates

1. Precast Concrete Manhole Sections and Specials
2. Flexible Joints

B. Supplier's Certificates

1. Reinforced Concrete Pipe Manhole Sections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Precast Concrete Pipe Manhole Sections

1. Precast concrete pipe manhole sections, transition sections, eccentric cones, flat slab tops, and adjusting rings shall conform to ASTM Specification C 478. Reinforcing in transition sections shall be equal to that specified for wall sections of the larger diameter.
2. Joints shall be O-ring type conforming to ASTM Specification C 443.
3. The standard length of riser sections shall be 48 in. Lengths of 32 in. or 16 in. shall be used to meet required dimensions and as specified.
4. Openings for connecting pipes in riser sections, bottom riser sections, and integral base sections, and for access in flat slabs shall be pre-formed or cored by the manufacturer. Cut-out openings shall be made immediately after the pipe is removed from the casting form. All cored openings for sewer pipe connections shall have flexible joints.
5. Specified manhole steps shall be factory installed to provide a continuous ladder of 16 in. c/c rung spacing. Steps shall be placed in the forms and cast in pipe wall or placed immediately after the pipe is removed from casting and carefully mortared in place with nonshrink mortar to insure a watertight joint. If the outer surface of the pipe wall is pierced, the patch shall be completely covered with a bituminous sealer.
6. Where pressure tight manhole frames and covers are called for, threaded inserts shall be cast in eccentric cones or flat slab tops and holes formed or cored in adjusting rings to match bolt size and spacing specified for manhole casting.

B. Manhole frames, covers, and steps utilized shall comply with their respective specification.

C. Mortar

1. Mortar used for the structures herein specified shall conform to Specifications for Mortar for Unit Masonry, ASTM Designation C 270 Type S, containing no masonry cement. The mortar shall be composed of one part Portland cement to two parts sand by volume.
2. Materials for nonshrinking grout shall conform to CRD-C "Corps of Engineers Specifications for Non- Shrink Grout". Approved products are "Sauereisen F-100 Grout" by Sauereisen Cements Co.; "Five Star Grout" by U.S. Grout Corporation; "Masterflow 713" by Master Builders; "Euco N-S" by Euclid Chemical Company.

D. All cast-in-place concrete used for forming channels in manhole bottoms shall be Class B as specified in the Section 030000.

E. Reinforcing steel used in cast-in-place concrete shall meet the requirements of Section 030000.

F. Flexible joints for precast manhole pipe openings herein specified shall conform to ASTM designation C 923, "A-Lok" Type as manufactured by A-Lok Products; or an approved equivalent.

G. The pipe and size for manhole drops shall conform to the Standard Details and its respective specification contained herein.

H. Brick used for catch basin and manhole construction shall conform to Specifications for Sewer and Manhole Brick (made from clay or shale), ASTM Designation C 32, and shall be Grade "MS" unless otherwise specified.

PART 3 - EXECUTION

3.1 LOCATION AND CONSTRUCTION

A. Location and type of manhole installed shall be as shown on the Drawings or directed.

B. Construction shall be in conformance with details shown on the Drawings and as specified under this section.

3.2 EXCAVATION

A. Excavation for manhole construction shall be prepared as directed in the applicable paragraphs of Section 310000 Earthwork.

3.3 INSTALLATION OF INTEGRAL BASE SECTIONS

A. Class B concrete shall be poured so as to provide a minimum of 4-in. thick pad under the entire area of the manhole base. Place the manhole on the pad before the concrete is completely set so that final leveling adjustment can be made.

B. 6" Granular backfill bedding can be used in lieu of Class B concrete.

3.4 CHANNELING MANHOLE BOTTOMS

A. The bottoms of all manholes shall be channeled to conduct flow in the planned direction. Channels shall be the true shape of the lower half of the sewer pipe and shall match inverts of connecting pipe at the manhole wall.

B. In integral base sections (only) channels may be constructed using brick and Portland cement mortar. Mortar shall be 3/4-in. thick minimum between bricks and between bricks and concrete and 1-in. thick minimum on all exposed surfaces.

3.5 PRECAST CONCRETE RISER SECTIONS

A. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the flat slab top.

B. Pipe section joints shall be pointed and lifting holes filled with nonshrinking mortar.

3.6 SPECIAL PROVISIONS

A. The intent of this section is to identify requirements only associated with improvements, or rehabilitation of existing sewerage manholes.

B. The installation of bottom riser sections shall be as follows:

1. The base shall be of Class A concrete as specified in Section 030000 9 in. thick minimum placed on undisturbed earth.
2. The cut-out riser section shall be blocked in place above the pipe and the concrete base poured in place. Concrete shall be extended above the lower rim of the riser wall as required to provide a watertight seal around the entire circumference of the riser section.
3. On straight runs the Contractor may carry the sewer pipe through the manhole and break out the top half after the fill concrete has set. In all cases the sewer pipe shall extend through the manhole wall to the inside face.

C. All manholes for sanitary sewers shall have an application of Thoro-Seal or other approved coating (any color but gray).

END OF SECTION 034000.02

SECTION 034000.08 - PRECAST CONCRETE VAULTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Furnish and install precast concrete vaults at the locations shown on the plans.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SIZE, DIMENSIONS

A. Vault dimensions shall conform nominally to those shown on the plans.

2.2 MATERIALS

A. The materials used in the manufacture of the vaults shall conform to the following requirements:

1. Cement: Portland Cement, Type II, conforming to ASTM C150 or ASTM C175.
2. Concrete Aggregate: ASTM C33. The maximum size of aggregate shall not be more than one inch (1").
3. Reinforcing Steel: ASTM A615, Grade 60.
4. Gaskets: All joints shall be sealed against water leakage in or out by an acid-resistant and base-resistant flexible joint sealer material.
5. Wall pipes: Cast iron, AWWA C110.

2.3 QUALITY CONTROL

A. Precast concrete containing hairline cracks which are visible but not measurable by ordinary means may be accepted. Cracks of width measurable by ordinary means (0.01 inch wide and over) shall cause rejection. The Engineer shall make the final decision on whether the cracks are acceptable or not, and if the cracks are detrimental to the member structurally.

B. Surfaces shall be devoid of any honeycomb, evidence of spalling, holes, or voids. Such imperfections may be patched, except those reaching into reinforcing.

C. Precast concrete units which do not conform to the specified requirements, including strength, dimensional tolerances, and finishes, shall be replaced with precast concrete units that meet the requirements of this section. The Contractor shall also be responsible for the expense of corrections to any other work affected by or resulting from corrections to the precast concrete work. All corrections shall be made promptly and at no additional expense to the Owner.

2.4 CONSTRUCTION

A. The vault shall be constructed of properly reinforced 5,000 psi, 28-day compression strength precast concrete. All reinforced concrete shall be of such thickness and properly reinforced to support the full earth loads and hydrostatic forces that will be imposed on it. Minimum wall and bottom slab thickness shall be six inches (6"). The vault shall be prefabricated in as few sections as possible for ease in shipment and handling. Design and construction of precast units shall conform to ASTM C913.

B. Individual vault sections shall be joined one to another with a horizontal tongue and groove joint. Each joint shall be sealed with a 4" x 1/2" neoprene gasket. All joints shall be watertight. Non-compression joints with grout sealing compounds will not be acceptable. The neoprene gasket shall be installed and compressed to fit the contour of the receiving "groove" of each casting within the system before the adjoining "tongue" section is set into position.

C. Wall pipes, sleeves, manhole covers, etc. of the indicated sizes and locations shall be cast into the structure at the time of manufacture.

2.5 SUGGESTED MANUFACTURER

A. The precast concrete vaults shall be a product of Mack Vault, Valley City, Ohio; Norweco, Norwalk, Ohio; Scioto Valley Precast, Chillicothe, OH or approval equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units on six-inch (6") minimum thickness gravel bedding.

B. Backfill with approved granular material compacted in six-inch (6") lifts.

C. Fill unit with clean water prior to backfilling.

END OF SECTION 034000.08

SECTION 083113 - ALUMINUM ACCESS DOORS

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 the furnishing and installation of all aluminum access doors and frames as shown on the Drawings necessary to complete the work of this Contract. Access doors shall include frames, hinges, handles, coatings, hardware and all appurtenances necessary for a complete installation.

1.3 QUALITY ASSURANCE

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

1.4 WARRANTY

A. Manufacturer shall guarantee against defects in material or workmanship for a period of five years under normal use, operation and service.

1.5 SUBMITTALS

A. Manufacturer's catalog data showing:

1. Dimensions, spacing, and construction of doors and frames.
2. Materials of construction.

B. Detail shop drawings showing:

1. Dimensions of each access door and frame.
2. Location and identification mark.

PART 2 - PRODUCTS

2.1 FLOOR DOORS

A. Floor access doors shall be Type "K" or Type "KD" as manufactured by the Bilco Company; or equal.

B. The access frame shall be 1/4 in. extruded aluminum with built in neoprene cushion and strap anchors bolted to the exterior.

C. The access door shall be 1/4 in. aluminum diamond plate reinforced with aluminum stiffeners as required. Cast steel hinges shall be bolted to the underside and pivot on torsion bars that counterbalance the door for easy operation. The door shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release the cover for closing. Doors shall be built to withstand a live load of 150 pounds per square foot, and equipped with a snap lock and removable handle.

D. A mil finish with bituminous coating is to be applied to the exterior of the frame by the manufacturer. Hardware shall be cadmium plated.

E. Access door and frame for floor doors shall be of the types and sizes specified.

2.2 INTERIOR/EXTERIOR DOORS

A. Interior/exterior doors shall be Type "J" or Type "JD" as manufactured by the Bilco Company; or equal.

B. The access frame shall be 1/4 in. aluminum with an anchor flange around the perimeter.

C. The access door shall be 1/4 in. aluminum diamond pattern plate to withstand a live load of 300 pounds per square foot. The door shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators for easy operation, and an automatic hold-open arm with release handle. A snap lock with removable handle shall be provided. A 1-1/2 in. drainage coupling shall be located in the front right corner of the access frame.

D. Hardware shall be cadmium plated and factory finish shall be a mil finish with bituminous coating applied to the exterior of the frame.

E. Access door and frame for interior/exterior doors shall be of the types and sizes specified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.

END OF SECTION 083113

SECTION 260500 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 REFERENCE

A. All work included under this division is subject to the Bidding Requirements, General Conditions, Supplementary Conditions and contract General Requirements. The Contractor is directed to refer thereto as an integral part of his contract performance.

B. These general provisions are in addition to other requirements as specified in Division 16, and are not intended to replace them.

C. This specification includes provision of all equipment, materials, labor, tools, test equipment, and appliances necessary to perform all operations incident to the completion of a fully operational electrical system as called for in these specifications or shown on the drawings.

D. Electrical equipment furnished by other trades and specified in or shown on the contract documents shall be installed and connected by the Electrical Contractor, unless otherwise noted.

E. Coordination of work schedules and assignment of responsibility for provision of equipment and/or services between trades and/or sub-contractors is the express responsibility of the General or Prime Contractor, subject to the requirements of the project specifications and the other contract documents.

1.2 QUALITY STANDARDS/WARRANTIES

A. Provide work which conforms to the accepted practices and standards of the trade. Further definition of the quality required is given by reference to various codes, laws, regulations, and standards.

B. All applicable laws and codes having jurisdiction over this project are deemed included in their entirety as part of these specifications. Any other codes, laws, regulations, or standards cited herein are also deemed to be included in their entirety unless otherwise limited by the reference thereto.

C. All electrical installations shall conform to the requirements and standards of the National Electrical Code (NFPA 70-84), and the National Electric Safety Code (ANSI C2-84). Other requirements or specifications shall not be deemed to take precedence for any reason unless such requirements and/or specifications are clearly superior to the referenced Electrical Code(s) requirements.

D. Work shall be deemed unacceptable when found, in the opinion of the Contracting Officer, to be defective or contrary to the plans, specifications, codes specified, or accepted standards of good workmanship.

1. The Contractor shall promptly correct all work found to be unacceptable, whether observed before or after substantial completion and whether or not fabricated, installed, or complete.
2. The Contractor shall bear all costs incurred as a result of correcting such unacceptable work.

E. The Contractor shall be liable for all defects, repairs, and replacements due to faulty workmanship or premature failure for a period of one year after final payment is approved by the Contracting Officer. Where warranties are furnished by equipment manufacturers for greater periods than one year, such warranties shall be obtained by the Contractor and transferred/provided to the government as part of the required submittals.

1.3 CONTRACT DRAWINGS

A. The drawings accompanying these specifications are schematic and indicate the general locations and extent of the work required. The contract drawings shall be followed as closely as actual facility construction and existing structures will permit.

B. Any deviations from the drawings deemed necessary by the Contractor must be approved by the Contracting Officer prior to accomplishment.

C. In the event of conflict between the drawings, specifications, or applicable codes/regulations, the Contractor shall immediately call such to the attention of the Contracting Officer, and the Contracting Officer shall determine which interruption shall take precedence.

D. Exact locations of equipment and auxiliaries shall be coordinated with other contractors/trades and field verified.

E. Maintain at the job site one (1) copy of all Drawings, Specifications, Addenda, Approved Shop Drawings, Change Orders and other modifications. These documents shall be kept in good order and marked as required to record all changes made during construction. These documents shall be available to the Contracting Officer or his designated representatives during all phases of construction, and at completion, shall be checked for completeness and delivered to the Contracting Officer. An extra or additional set of documents will be furnished by the Contracting Officer for this purpose upon request.

1.4 SITE EXAMINATION

A. The Contractor is expected to visit the proposed project work site; existing conditions, structures, services, or operating schedules may affect the manner or sequence of performance of the work. Verify and reconcile the work required by contract documents with site conditions prior to bid.

B. Once the contract is awarded, no allowance will be made for lack of knowledge of existing site or project conditions.

1.5 GENERAL REQUIREMENTS

A. ELECTRICAL WORK on energized circuits will not be permitted. Where and when it is necessary to operate adjacent to electrically energized components, the Contractor shall ensure that personnel are qualified for such work and shall provide adequate and necessary materials for equipment and personnel protection.

B. APPLICABLE VOLTAGES for Newark Air Force Station are as follows:

1. Outside Substation primary voltage is 69KV nominal, and the secondary voltage is 4160Y/2400V nominal.
2. Distribution substations are 4.16KV to either 480Y/277V or 208Y/120V.
3. All substations are Delta primary and Grounded Wye secondary.
4. Other sub-distribution transformers or working voltages to be encountered during project work will be specified in the contract special requirements.

C. SWITCHING OPERATIONS to facilitate project work will be performed by government personnel. Prior coordination is required for all such power interruption, at least four (4) weeks in advance unless otherwise specified. Major interruptions will be scheduled to take place during other than normal Newark AFS working hours, either for open second or third shift times if applicable, or for Saturday, Sunday, or Federal holidays.

D. WORK ACCOMPLISHMENT: The schedule and sequence of work performance shall be arranged, prior to actual start of performance, to minimize the number and extent of power interruptions/shutdowns, and to minimize vulnerability of station facilities to any damage. The Contractor shall carry all new work installation to a near completion as possible prior to actual interruption of services. Switching operations will not be accomplished as scheduled if preparation work has not been completed.

E. GROUNDING AND BONDING: All exposed non-current carrying metal parts of electrical systems, metallic raceway systems, and neutral conductors of wye wiring systems shall be solidly grounded. Grounding and bonding shall be in accordance with Article 250 of the National Electrical Code, and shall essentially be an extension/continuation of the existing grounding and bonding system.

1. All raceways shall include a green grounding conductor of proper size for the service, in accordance with Table 250-95 of the National Electrical Code, except that the minimum conductor size shall be #12 AWG. Grounding electrode conductors shall be sized as shown on the Contract Drawings, and at minimum, shall be in accordance with Table 250-94 of the National Electrical Code.
2. Grounding conductors shall be connected to the enclosures, at each pull or junction box through which they pass, by means of a ground lug or solidly bolted connection. Boxes, conduit, etc., shall not be used as part of the grounding conductor system.
3. The Contractor shall, in the presence of the Project Engineer, test all system neutrals to prove that they are free of grounds except at their source.
4. Enclosures which do not require a ground bar shall have all ground conductors connected together and a pigtail the size of the largest conductor bonded to the enclosure with a single connector used for no other purpose.

5. At each receptacle box the ground conductor shall connect to the ground pigtails to the receptacle, the box ground, and to the outgoing ground conductor to the next device if not at end of run. Contract between the device yoke and the box is not acceptable as a ground bond.
6. Motor terminal boxes, lighting fixture enclosures, and the like shall be grounded by use of manufacturer supplied ground lug or pigtail, the use of grounding clips fastened to bare metal, or by drilled/tapped hole for a ground screw.
7. Conduit systems shall be electrically continuous except at the interface point between isolated (ground) systems. Locknuts shall be made to cut through enameled of painted surfaces on enclosures. Where enclosures and other non-current carrying metal parts of the system are isolated from the conduit system, or where reducing washers or knockouts are used, bonding bushings or jumpers shall be required.

F. IDENTIFICATION

1. Each major component of equipment shall be legibly and permanently marked with the manufacturer's name, catalog number, model, style, or type on a plate securely and conspicuously attached to the item of equipment.
2. Nameplates for electrical equipment shall conform to applicable NEMA standards. In addition, the Contractor shall provide engraved, laminated (black-white-black) plastic nameplates, fastened to each item of distribution equipment with drive screws, metal screws, or rivets. These plates shall identify the equipment as specified in the drawings or special requirements section of this specification. If not otherwise specified, the nameplates shall include as minimum the following in l/4 inch letters:

EXAMPLES

Item Number: (such as)	PB400 (or)	MAIN DISC. SW.
Voltage:	208V	480V
Power Source:	Fm: A9T555	Fm: A9-4
Service Area:	To: Rm 42F66	To: A9T555PB400 or 401

3. Where new work affects or interfaces with existing electrical services, care shall be taken to ensure that the existing phase rotation of load equipment is not changed.
4. Conductors shall be color coded according to the following:

   a. Wire in sizes l0AWG and smaller to be furnished in colors specified. Number 8 thru 2AWG may be furnished in black and white; number lAWG and larger may be furnished all black.
   b. Color code all conductors by taping and identifying at all visible locations such as terminations, junction, or pull box. The following code shall be used:

	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Blue	Orange
Phase C	Red	Yellow
Neutral	White	Gray
Ground	Green	Green

   c. Emergency services: Same as normal, except that an additional l/2 inch red tape is to be added, l/2 inch above the code tape.

d. Fire alarm or control wiring shall be coded as specified in the applicable section(s) of these specifications.

5. Panels, load centers, substations, or other multiple-point distribution equipment shall have schedules prepared to list all applicable services on each circuit. Schedules shall be affixed to each such device, and a duplicate copy delivered to the Contract Inspector or Project Engineer for inclusion/update of station records. Where the system is installed exactly as shown on the contract drawings and such drawings include a specified schedule which has been followed exactly, the duplicate copy schedule may be omitted. Applicable blank schedules will be provided to the Contractor by the Station Electrical Engineer for this purpose upon request.

G. SPLICES shall be made in accessible locations only. No splices will be permitted in wet, underground, or normally inaccessible locations.

1. All taps, terminations, or splices made on Number 8 or larger wire shall be made using pressure type mechanical connectors such as "micropress" or "hydropress" connectors, and shall be insulated with preformed sleeve insulation suitable for the application or insulated with electrical tape to 150% of the insulating value of the conductor insulation.
2. Splices or connections made on Number 10 or smaller wire may be made using insulated mechanically crimped or screwed type connectors.

H. UTILITIES

1. The Contractor shall locate existing utilities prior to start of construction. Minor relocations may be made to permit new work installation without further coordination if included in the base bid for the work. Any other change requires the prior approval of the Contracting Officer.
2. Coordinate any utility service interruptions/shutdowns prior to accomplishment. See Paragraph l.05 C, Switching Operations, above.
3. All concealed locations of utility services shall be shown on the record (AS BUILT) drawings.

I. DEMOLITION AND REMOVALS: Each Contractor shall be responsible for the removal of construction waste and demolition materials generated in the performance of this work. Disposal of waste and debris shall be in accord with all pertinent Federal, State and Local regulations covering health, safety, and environmental protection.

1. Waste and debris shall be placed in approved Contractor owned or furnished containers to prevent the spread and accumulation of dust and dirt. Such waste shall be removed from the premises as often as necessary, but not less than once at the end of each work day.
2. Disposal of equipment removed as part of the job performance shall be in accord with these specifications.
3. All equipment, raceway, and wiring systems designated for removal shall be removed in their entirety, back to source. Where portions of raceways are concealed in structure which is to remain, such as floors or walls, the protruding sections shall be cut-off flush or below the surface, the surface(s) patched as required and refinished to contract specifications.

4. In all cases, where the system(s) are to be disconnected and not reused or modified, all conductors, fixtures, and devices shall be removed completely. Where parts are to be reworked, existing facilities may be reused for through connections or modified as required by the contract specifications.

J. INSPECTIONS

1. Before any electrical work is covered, the Contractor shall request an inspection of that portion of the work at that time.
2. Final inspection shall be requested by the Contractor when he is satisfied that all work is completed and in proper operating order. This inspection shall be requested of the Contracting Officer in writing at least seven (7) days in advance. If more than one (l) re-inspection is required after this final inspection, the Contractor shall bear all added costs.

K. SUBMITTALS

1. Data submitted shall consist of the items listed on the attached form entitled "Submittal Items Required." Shop drawings required for electrical equipment shall be submitted to the Contracting Officer for approval before any work is started; drawings or layouts shall include enough information to properly identify the subject and it's location in the project.
2. Where possible, all submittals pertaining to one project, except manuals or system test reports, should be forwarded in a single package for approval.
3. Materials and equipment installed as part of this project shall meet all requirements of the contract documents, and no materials or equipment shall be ordered before the submittals are reviewed and approved by the Contracting Officer.
4. Submit complete copies of the catalog data or shop drawings for each manufactured item of equipment and all components to be used in the work. Include description, catalog number, rating, dimensional data, wiring diagrams, etc., as required by the contract documents.
5. When submitted for review, all shop drawings shall bear the Contractor's signed certification that he has reviewed, checked, and approved the shop drawings, that necessary coordination has been accomplished, and that he has verified field measurements and other contract criteria.
6. Unless otherwise stated by note on the submittal form, three (3) copies of each submittal item marked is required. (Exceptions to this requirement are samples and/or color selection "fan strips", which may be supplied as a single piece or item.)

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         16       TRANSFORMER, 150 KVA                    X X          X   X X
         16       600A BUS DUCT                    :X:X:X: : : : : : : :X:
         16       VACU-BREAK SWITCHES                     X X
         l6       400A DUCT & SWITCH MODIFICATIONS          X X X              X
         l6       CONDUIT AND FITTINGS                  :X: : : : : : : : : : :
         16       WIRE/CABLE                       X              X
         l6       DISCONNECT SWITCHES                    X
         16       FUSES                          :X: : : : : : : : : : :
         16       SPLICE CONNECTORS/METHODS               X X
         16       LIGHTING FIXTURES                      X
         16       CIRCUIT BREAKERS FOR PB311             X X
         16       RECORD MANUALS, PER SECTION 260500, PAR 5.2 : : : : : : : : :X: : :
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L. RECORD AND INFORMATION MANUALS

1. REFERENCE

a) Draft manuals shall be submitted to the Contracting Officer for review and approval at least 7 days prior to the final inspection date.

b) Following approval, the Contractor shall submit the completed and approved manuals to the Contracting Officer. Three complete copies are required.

2. MANUALS

a) Manuals shall be supplied in three hole, screw bound, hard cover binders. Material contained shall be typewritten or printed and shall be fully legible, with each section divided by labeled tabs.

b) The following information, together with any other pertinent data, shall be included:

1) Each manual shall be labeled on the front cover with Project name, Contract number, Contractor's name, and date completed.

2) Description of system(s) provided as part of the project.

3) Manufacturer's names, Model numbers, and Serial numbers of the system components.
4) Maintenance instructions, including routine and emergency service information and the name and location of the nearest factory service representative.
5) Operating instructions, start-up and shut-down procedures.
6) Parts lists, replaceable parts, and sources of supply.
7) Manufacturer's literature describing each item of equipment.
8) One approved copy of each Shop Drawing submitted.
9) Wiring diagrams and schematics.
10) Written Warranties. See paragraph l.02E, Quality Standards/Warranties.
11) Test Reports.

PART 2 - PRODUCTS

2.1 DESIGN BASE MANUFACTURERS

A. The drawings and specifications are based on the requirements and layout of the equipment used as the design base. Design coordination of specified equipment has been made for specific models and manufacturers as listed where applicable. Where several manufacturers are listed, the first listed is the design base manufacturer unless noted otherwise.

B. Where equipment or material submittals are made for other than the design base item, new layouts must accompany the submittals if the new or substituted item differs in dimensions or service requirements.

C. Where other than the design base equipment or material is provided by the Contractor, he assumes the responsibility for all costs and coordination of modifications required for other trades as well as his own. Where changes to other trades work is required, this Contractor must include all such costs in his bid.

PART 3 - EXECUTION

3.1 SUPPORTS AND CUTTING

A. The Contractor shall do all cutting/fitting required for the installation of his work and for securing equipment and materials to be installed as part of this project. All necessary supports shall be provided by the Contractor, including support from existing structural members.

B. No unspecified cutting or modification of structural members shall be done without the prior approval of the Contracting Officer.

C. All cutting and patching shall be accomplished promptly, and repair shall be done as required to present a completed job which matches the original finish.

D. Patching shall be done by qualified tradesmen in the respective crafts required; all patching of siding, wallboard, masonry, etc., shall match the existing or completed new work.

3.2 WELDS AND EXOTHERMIC CONNECTIONS

A. Welds and exothermic connections are required in the course of the work and shall be done by qualified personnel. All such completed connections shall be cleaned and repainted to match existing finish.

3.3 PAINTING AND RELATED WORK

A. Any painting specified in sections of Division 16 is the direct responsibility of the Electrical Contractor. It shall be done by qualified tradesmen skilled in the craft.

B. Each Contractor is responsible for repair/repainting of finished areas disturbed by his own work.

C. Factory finished equipment which is rusted or damaged shall be repaired, cleaned, primed with zinc chromate, and refinished to the original color and finish.

D. New support steel shall be rust-free, cleaned, primed, and painted.

3.4 TESTING

A. The contract documents or orders of authority having jurisdiction may require portions of the work to be tested, inspected, or approved. Such services shall be performed by approved agencies, and costs of testing, inspecting, or approval shall be borne by the Contractor.

B. The Contractor Officer shall be notified at least 48 hours in advance of all scheduled tests, and such tests shall be accomplished in the Contracting Officer's presence. Performance of tests without the Contracting Officer present or without proper notification may result in the requirement for the Contractor to perform the test again, at his own expense.

END OF SECTION 260500

SECTION 260504 - BASIC ELECTRICAL MATERIALS AND METHODS

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. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Common electrical installation requirements.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping, where required.

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Coordinate sleeve selection and application with selection and application of firestopping.

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

G. Cut sleeves to length for mounting with a 2-inch extension beyond surfaces of walls.

H. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

I. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with manufacturer's directions for application of firestopping materials.

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.5 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 260504

SECTION 310000 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

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

B. The Work 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 trenches and other excavation 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 trench walls, 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 for backfill at the location where the excavation is made, to other parts of the Work where filling is required, and disposal of all types of surplus material off the site.

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.
F. The work shall include but is not limited to Backfill for slabs or backfill for under the roadway.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013319 – Field Testing Requirements

B. Section 015713 - Temporary Erosion Control

C. Section 030000 - Concrete Work

D. 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 and Submittals.

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. Underpinning *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.
6. 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. Mock-ups

F. 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.

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

1.8 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 013543, Environmental Protection.

1.9 SEQUENCING AND SCHEDULING

A. Refer to 013319 for testing laboratory service scheduling.

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 and shall make acceptable provision for their protection, support and maintenance in operation. The Engineer shall be provided advance notification when and where excavation for test pits will take place. The Contractor shall provide the Engineer a record of field locations of all listed utilities, structures or facilities a minimum of five (5) days prior to initiating construction of the project. Locations and elevations are to be provided by a Surveyor registered in the State of Ohio.

PART 2 - PRODUCTS

2.1 GRANULAR PIPE EMBEDMENT

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

2.2 ONSITE BACKFILL

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

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

C. Unsuitable Backfill Material

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

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

2.3 SPECIAL BACKFILL MATERIAL (ODOT Item 304)

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

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

2.4 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 l 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.

2.5 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.

2.6 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

2.7 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 TRENCH EXCAVATION

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

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

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

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

3.7 EXCAVATION OF UNSUITABLE MATERIALS

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

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

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

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

3.8 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

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

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

3.9 BACKFILL

A. Pipelines, Sewers and Conduits

1. All pipe shall have bedding extending the width of the trench with depth in conformance with the Drawings. The bedding material shall be thoroughly compacted by tamping until no further densification is possible.
2. Pipe cover material shall be used for filling above the pipe bedding along the sides of the pipe and to a height of twelve (12) inches over the top of the pipe. The pipe cover material shall be brought up evenly on both sides of the pipe to eliminate the possibility of lateral displacement of the pipe and shall be thoroughly compacted by tamping until no further densification is possible. Care shall be taken to spade the aggregate under the pipe haunch below the spring line.
3. All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless otherwise directed by the Engineer.
4. After the pipe cover has been placed and compacted around the pipe as specified above, the remainder of the trench may be backfilled by machine. The backfill material shall be deposited in eight (8) inch horizontal layers, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfilling material from a bucket be allowed to fall directly on a pipe and in all cases the bucket must be lowered so that the shock of the falling earth will not cause damage.

B. Structures

1. Backfilling shall not commence before concrete has attained specified strength. Do not use equipment for backfilling and compaction operations against structures that will overload the structure.
2. Backfilling around and over structures shall be carefully placed and tamped with tools of suitable weight to a point one (1) foot above the top of same. Additional backfill may be required to protect the structure from damage from heavy equipment. Backfill shall be placed in uniform layers not exceeding eight (8) inches in depth. Each layer shall be placed, then carefully and uniformly compacted to the specified density so as to eliminate the possibility of displacement of the structure.

3. After the backfill has been placed and compacted around the structure to the height specified above, the remainder may be backfilled by machine. The backfill material shall be deposited in eight (8) inch horizontal layers, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfilling material from a bucket be allowed to fall directly on a structure, and in all cases the bucket must be lowered so that the shock of the falling earth will not cause damage.

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

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

3.10 LOW STRENGTH MORTAR BACKFILL

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

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

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

D. For low strength mortar backfill placed against existing structures of unknown strength, backfill material shall be brought up uniformly in maximum 12 inch lifts and allowed to cure for a minimum of 24 hours or until it can carry a person's weight without leaving imprints before the next lift is placed.

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

3.11 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.

3.12 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.

D. Full Width New Pavement Construction
1. After the surface of the subgrade has been shaped to approximate cross section grade, and before any pavement, base or subbase material is placed thereon, the subgrade shall be compacted. When the rolling is completed, all surface irregularities shall be corrected and the surface of the subgrade shall be shaped as necessary to conform to the grade and cross section shown on the Drawings within the tolerance set forth in this Section and shall be so maintained until the overlying course is in place.

3.13 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.

3.14 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.

3.15 COMPACTION REQUIREMENTS

A. The bottom of excavations upon which concrete foundations or structures are to be placed shall be compacted so as to obtain 100% of maximum dry density per ASTM D-698 in the top twelve (12) inches.

B. The top twelve (12) inches of stripped original subgrade and final subgrade shall be compacted to not less than 100% of maximum dry density per ASTM D-698.

1. Subgrade under new, proposed, or future pavement shall be compacted 18 inches beyond the edge of pavement, paved shoulders or paved medians.

C. 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.

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

E. 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.

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

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

H. 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

I. 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.

3.16 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 inch.

C. Grading inside Building Lines
   1. Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

END OF SECTION 310000

SECTION 312323.33 - LOW STRENGTH MORTAR BACKFILL MATERIAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

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

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement

1. ODOT 701.01 or ODOT 701.04.

B. Fly Ash

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

C. Fine Aggregate

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

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

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

2.2 MORTAR MIX PROPORTIONING

A. The initial trial mixture shall be as follows:

Quantity of Dry Materials per Cubic Yard

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

* saturated-surface dry

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

PART 3 - EXECUTION

3.1 TRIAL BATCH

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

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

B. Fluidity of the mortar mixture shall be measured by the Corps. of Engineers' Flow Cone Method according to CRD-C611. Prior to filling the flow cone with mortar, the mixture shall be passed through a 1/4-inch screen. Time of efflux shall be approximately 12 seconds.

C. Prior to the first placement, the Contractor shall make one or more trial batches of mortar of the size to be hauled to job site and shall cast one or more test samples equivalent to the approximate dimensions of the trench to be backfilled (either in a form or trench). Amount of bleeding, settlement rate and time required to support pavement replacement shall be determined from these full-size tests. The Contractor shall furnish the required materials and samples.

3.2 MIXING EQUIPMENT

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

3.3 PLACING MORTAR

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

END OF SECTION 312323.33

SECTION 320113.62 - ASPHALT SURFACE TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This work shall consist of furnishing all labor, equipment, and material, and in performing all operations necessary for the rejuvenation and in-depth sealing of asphaltic concrete surface course by spray application of petroleum oil and resins emulsified with water, complete, in accordance with the specifications, the applicable drawings or at locations specified by the Engineer.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. The asphalt rejuvenating agent shall be composed of a petroleum resin oil base uniformly emulsified with water. The Contractor shall submit a certified statement from asphalt rejuvenating manufacturer showing that the asphalt rejuvenating emulsion conforms to the following physical and chemical requirements.

Designation	Test Method	Requirements
Viscosity, S.F. at 77 F., sec.	ASTM D244	15-40
Residue, % Min. (1)	ASTM D244 (Mod.)	60-65
Miscibility Test (2)	ASTM D244 (Mod.)	No Coagulation
Sieve Test, % Max. (3)	ASTM D244 (Mod.)	0.10
Particle Charge Test	ASTM D244	Positive
Tests on Residue from	ASTM D244 (Mod.) ASTM D445	 100-200

Viscosity cs, 140F		
Asphaltenes, % Max.	ASTM D2006-65-T	0.75
Maltenes Dist. Ratio	ASTM D2006-65-T	0.3-0.5

$$\frac{PC + A_1 (4)}{S + A_2}$$

1. ASTM D244 Modified Evaporation Test for percent of residue is made by heating 50 gram sample to 300 F. foaming ceases, then cool immediately and calculate results.
2. Test procedure identical with ASTM D244 except that .02 Normal Calcium chloride solution shall be used in place of distilled water.
3. Test procedure identical with ASTM D244 except that distilled water shall be used in place of 2% sodium oleate solution.
4. In the Maltenes Distribution Ratio Test by ASTM Method D2006-65-T;
   PC - Polar Compounds; A - First Acidaffins; A - Second Acidaffins
   S - Saturates

B. The materials shall have a record of at least five years of satisfactory service as an asphalt rejuvenating agent and in-depth sealer; such satisfactory service being based on the capability of the material to increase the ductility and penetration value of the asphalt binder in the pavement surface and to seal the pavement in-depth to the intrusion of air and water.

C. The Contractor shall furnish the manufacturer's certification that the material proposed for use is in compliance with the specification requirements and include copies of supporting tests and previous use documentation.

2.2 MANUFACTURER

A. The product Reclamite, or approved equal, is acceptable for these requirements.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. The temperature of the emulsion at the time of application shall be as recommended by the manufacturer.

B. Contents in tank cars or storage tanks shall be circulated at least ten minutes before withdrawing the material for application. When loading the distributor, the asphalt rejuvenating agent concentrate shall be loaded first and then the required amount of water shall be added. The water shall be introduced into the distributor with enough force to cause agitation and thorough mixing of the two materials. To prevent foaming, the discharge end of the water hose or pipe shall be kept below the surface of the material in the distributor which shall be used as a spreader. Cleanliness of the spreading equipment shall be subject to the approval and satisfaction of the Engineer.

C. The distributor for spreading the emulsion shall be self-propelled, and shall have pneumatic tires. The distributor shall be designed and equipped to distribute the emulsion uniformly on variable widths or surface at readily determined and controlled rates from 0.05 to 0.5 gallons per square yard of surface, and with an allowable variation from any specified rate not to exceed 5 percent. Distributor equipment shall include full circulation spray bars, pump, tachometer, volume measuring device and a hand hose attachment suitable for application of the emulsion manually to cover areas or patches inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the emulsion within the tank.

D. A check of distributor rate and uniformity of distribution shall be made when directed by the Engineer.

E. The emulsion shall be applied only when the existing surface to be treated is thoroughly dry and when the weather is clear and is not threatening to rain. The emulsion shall not be applied when the atmospheric temperature is below 40°F.

F. The asphalt rejuvenating agent shall be applied by distributor at the temperature recommended by the manufacturer and at the pressure required for the proper distribution. The emulsion shall be so applied that uniform distribution is obtained at all points of the areas to be treated. Distribution shall be commenced with a running start to insure full rate of spread over the entire area to be treated. Areas inadvertently missed shall receive additional treatment as may be required by hand sprayer application.

G. Application of asphalt rejuvenating agent shall be on one-half width of the pavement at a time.

H. When the second half of the surface is sealed, the distributor nozzle nearest the center of the road shall overlap the previous application by at least one-half the width of the nozzle spray. In any event the center line construction joints of the pavement shall be treated in both application passes of the distributor truck.

I. A light coating of dry, gritty sand shall be applied to the surface in sufficient amounts to protect the traveling public.

J. The Contractor shall schedule his operations and carry out the work in a manner to cause the least disturbance and/or interference with the normal flow of traffic over the areas to be treated. Treated portions of the bituminous surfaces shall be kept closed and free from traffic until penetration, in the opinion of the Engineer, has become complete, and the area is suitable for traffic. All necessary traffic control to assure the proper application of this material shall be included under this item.

K. Before spreading, the asphalt rejuvenating agent shall be blended with water at the rate of two (2) parts rejuvenating agent to one (l) part water, by volume or as specified by the manufacturer. The combined mixture of asphalt rejuvenating agent and water shall be spread at the rate of 0.05 to 0.08 gallons per square yard, or as approved by the Engineer

L. Grades or super elevations of surface that may cause excessive runoff, in the opinion of the Engineer shall have the required amounts applied in two (2) or more applications as directed.

M. The rejuvenating agent shall be applied by an experienced applicator of such material. The applicator shall have a minimum of three (3) years' experience in applying the product proposed for use. He shall submit a list of the last five (5) projects on which he applied said rejuvenator.

3.2 MEASUREMENT

A. The quantity to be paid for under this item shall be the actual number of square yards of rejuvenating agent applied. The number of square yards shall be determined from the Engineer's measurements.

3.3 PAYMENT

A. The quantity measured as above provided shall be paid for at the contract unit price bid as called for in the Proposal, which price shall constitute full compensation for surface preparation, furnish and applying rejuvenating agent, traffic control, sand cover and for all labor, tools, equipment and incidentals necessary to complete this item.

END OF SECTION 320113.62

SECTION 321000 - PAVEMENT REPLACEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish all of the equipment, labor and materials necessary to install, replace, and/or restore existing pavement structures together with their respective appurtenances as shown on the plans and as specified herein. This work shall include all of the subgrade preparation, subbase, base, intermediate pavement course(s), and finish pavement courses together with curbing, guttering, tack and/or prime coating, sealing and other pertinent work as necessary to meet the conditions of this contract.

1.3 QUALITY ASSURANCE

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

1.4 REPAIR OR REPLACEMENT WORK

A. For the repair and/or replacement of all existing pavement structures and their respective appurtenances that are removed and destroyed or otherwise damaged by the Contractor in the course of his performance of the work required under this contract, the Contractor shall furnish all equipment, labor, and materials as necessary to properly restore to a condition equal to that at his entry, and to the satisfaction of the Engineer, the Ohio Department of Transportation, the County Engineer, City Engineer, all cinder, slag, gravel, water-bound macadam, bituminous macadam, asphalt and brick or concrete driveways, curbs, sidewalks and roadways in strict accordance with the drawings and as specified herein.

B. In general, this item will include concrete, steel reinforcement, brick, stone, slag, cinders, gravel, asphalt and other bituminous materials and curbs, gutters, driveway culverts, road and curb drains and the demolition, excavation and removal of existing driveways, sidewalks and roadways.

1.5 REFERENCE TO OTHER PARTS

A. Other sections of these specifications shall apply, as and where applicable to this section and such sections will be the same as though they were included in this section.

B. For all old work where pavement is being repaired and/or replaced as a result of damages occurring thereto during the course of the work of this contract, all clearing and grubbing, removal and storage of topsoil, excavation and/or placing of compacted fill and granular backfill, shall be done as required under other parts of these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Generally, for all repair and replacement work, all new materials shall match the existing and adjoining work in both composition and quality unless otherwise ordered, specified herein, and/or shown on the drawings. In any stone driveway or roadway, the material used for stone fill shall conform to the existing material.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. All pavement work shall be done in strict accordance with the specifications of the governmental body concerned and the latest ODOT specifications as applicable or at the direction of the Engineer.

B. All pavements disturbed by the Contractor's operations shall be re-laid to the thickness of the adjoining pavement and, in all cases, the restoring of pavements, shall apply both to foundation courses and to the wearing surface.

C. Should cracks or settlements appear in adjoining pavements, the paving shall be removed to the extent necessary to secure firm and undisturbed bearing and shall be replaced in a satisfactory manner.

D. No permanent pavement shall be installed, repaired, and/or restored unless, or until, in the opinion of the Engineer, the condition of the backfill is such as to properly support the pavement.

E. Where new or replacement concrete pavement or base is placed adjacent to existing concrete pavement or base, contraction joints shall be provided in the new or replacement pavement so as to form a continuous joint with that in the existing pavement.

3.2 ROADWAY SUBGRADE

A. The entire area to be occupied by the roadways and parking areas shall be cleared, topsoil removed and stored, and the excavation or compacted fill made as required and brought to the proper cross-sections. Pipe trenches and other excavations shall be backfilled as required, and thoroughly compacted within the limits of the roadways or parking areas.

B. After the surface of the subgrade has been properly shaped and before any stone or slag is placed, the entire subgrade shall be thoroughly rolled and compacted to a depth of 12 inches under this section. Rolling shall be done with an approved type of self-propelled roller, weighing not less than ten (10) tons. All hollows and depressions which develop during the rolling shall be filled with acceptable materials, and the subgrade rerolled. The process of filling and rolling shall be repeated until no depressions develop, and the entire subgrade has been brought to a uniform condition of stability.

C. All places which, in the opinion of the Engineer cannot be properly rolled, shall be tamped with handheld mechanically or pneumatically powered tampers.

D. In making the compacted fill and in doing the final subgrade rolling, the Contractor shall see that the material to be compacted and/or rolled has the proper moisture content to secure maximum compaction. When, in the opinion of the Engineer, the material is too wet, the compacting shall be delayed until the material has dried sufficiently. When, in the opinion of the Engineer, the material is too dry, the material shall be sprinkled with water in an amount to secure the proper moisture content.

END OF SECTION 321000

SECTION 321216 - ASPHALT CONCRETE PAVING AND MATERIALS

SECTION 1 - MATERIALS

1.1 The asphalt concrete mixture and installation thereof shall meet Ohio Department of Transportation (ODOT) Specifications except as modified in these specifications.

1.2 In the ODOT Specifications substitute "Engineer" for "Department" (except as stated below in reference to ODOT 403 for Department VA testing and acceptance).

1.3 No steel slag shall be used as coarse or fine aggregate for any asphalt concrete.

1.4 All asphalt cement utilized on this project shall meet AASHTO Provisional Standard MP1 or any superseding AASHTO specification for performance graded asphalt cement binder in conformance with PG 64-22.

1.5 The following exceptions shall be made for the Asphalt Concrete or for the Asphalt Concrete Surface Course:

A. The coarse aggregate material shall be only limestone
B. No Recycled Asphalt Product (R.A.P.) will be permitted

1.6 Except where designated otherwise in the plans or specifications all asphalt concrete mixes shall be designed for medium traffic volumes. Where light or heavy traffic pavements are designated in the plan, the contractor shall use an asphalt concrete mix designed for such traffic conditions.

1.7 Acceptance of the mixture will be based upon the certification that the mixture was produced according to the approved JMF within the production control and composition tolerances of the specifications. The Contractor shall hire and pay for an independent testing lab approved by the Engineer to perform all sampling, testing, monitoring, analysis and certification required by the Laboratory, Monitoring Team or Department in ODOT 403 and 441. All work by the independent laboratory shall be performed by personnel with ODOT Level II Bituminous Concrete certification.

1.8 ODOT 401.20 - "Asphalt Binder Price Adjustment" shall not apply to this contract.

1.9 Monument box and valve box risers shall be East Jordan Iron Works No. 8626, No. 8631, or approved equal. The Contractor shall follow the manufacturer's recommended installation procedure. New manhole frames and grate or frame and cover shall be EJIW 1710.

1.10 Brick used for manhole, catch basin, or inlet basin castings adjusted to grade under ODOT 611.10 Method D.1. shall be red shale or clay sewer brick meeting the requirements of ASTM C32 sewer brick, grade SM.

1.11 Risers used for manhole castings adjusted to grade under ODOT 611.10 Method D.2. shall be manufactured by Manhole Systems, Model MS-101TB, or approved equal.

1.12 All inlets and manholes shall be adjusted to grade after installation of the intermediate course(s), if any and prior to installation of the surface course.

1.13 All materials delivered to this project must have been weighed on a platform scale with electronic imprinter to show gross, tare, and net weights. No payment will be made for materials which are not correctly weighed as necessary. Material weight shall not exceed the current legal allowable limit.

1.14 Unless specified elsewhere in the specifications, material for berms shall be limestone only. Recycled concrete and asphalt concrete will not be permitted.

SECTION 2 - PAVING EQUIPMENT

2.1 All spreading equipment shall be self-propelled. The Contractor shall identify the make and model of the paving machine that will be used for the intermediate and surface courses for approval prior to the pre-construction meeting.

2.2 All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. The Contractor shall be prepared to furnish proof of certification that all equipment to be used on the project has been calibrated within the past six (6) months.

SECTION 3 - GENERAL - PAVING

3.1 All paving shall be done on a single-lane basis.

3.2 If traffic loop detectors are encountered and broken, the Contractor is to repair as per local specifications. The cost for this work will be paid under the loop detector replacement bid item, if any; at negotiated unit prices; or by time and materials as directed by the Engineer.

3.3 Tack Coat, Item 407, shall be applied at the rate of from 0.05 to 0.15 gallons per square yard as appropriate for the surface conditions with sand cover if required.

3.4 Asphalt driveway aprons shall be matched to new pavement with 24" transition sections or as shown on the drawings or required by the Engineer. The Contractor shall install apron wedge as required in the detailed drawings.

3.5 Unless otherwise shown on the drawings, jointing of new to existing pavement shall be by milled butt joints six (6) feet in width (or as shown on the plans) from edge of pavement to edge of pavement. Depth of this milled area shall equal the total of subsequent intermediate course and surface course as specified.

3.6 One (1) copy of each hauled/weighed material truck load ticket (plant ticket) for materials incorporated in this project shall be provided to the project representative daily. All bulk materials delivered to this project must have been weighed on a platform scale with electronic imprinter to show gross, tar and net weights. No payment will be made for materials which are not correctly weighed as necessary. Material weight shall not exceed the current legal allowable limit. If a partial load is used, the Contractor's foreman and the project representative shall confer and come to an agreement as to what portion of the product was used. The percent of material of this load, as reported by the project representative, is what shall be recorded as utilized.

3.7 For variable depth courses where tonnage tickets are used for determining quantities for payment, the conversion to cubic yards shall be number of tons verified and approved by the Engineer divided by 2.00 regardless of the actual density of the mix.

3.8 Positive drainage is to exist subsequent to the completion of the surface course. The Contractor shall take any necessary measures to assure positive drainage of the surface course. It shall be the responsibility of the Contractor to repair any low/puddled areas at his own cost by milling out the affected areas to a minimum depth equal to the nominal depth of the course being repaired and replacing with the specified asphalt concrete to grades that will correct the drainage problem.

3.9 Surface tolerances for all completed surface courses shall be as noted in ODOT 401.19. This tolerance shall apply regardless of whether or not an intermediate course is installed.

3.10 At the direction of the Engineer, periodic weight checks of asphalt concrete in loaded trucks shall be made by the Contractor and verified by the Engineer.

3.11 All quality control testing data performed on material incorporated into this project shall be forwarded to the Engineer for review as soon as it is available.

3.12 Quantity verification (but not necessarily payment quantity) for all asphalt concrete incorporated into the work shall be by weight tickets as produced by the plant or supplier or other means approved by the Engineer. Tack coat shall be verified by a ticket filled out and signed by the Contractor's tack truck driver based on weights taken or observations of level indicators. All verification tickets are required to be submitted to the Engineer on the day the material is incorporated into the work; however, the Engineer may, at his sole discretion, accept verification tickets for any items up to seven (7) calendar days subsequent to the work being performed. **After that date additional verification tickets for material will not be accepted for consideration of payment.**

3.13 No work is to be performed without the presence of the Engineer or his designated Project Representative. Forty-eight (48) hour advance notice of work shall be given to the Engineer and Owner by the Contractor.

3.14 All edges of surface courses abutting curbs or other appurtenances shall be sealed with hot AC-20.

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

END OF SECTION 321216

SECTION 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.

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 their 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.

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

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

1.4 PROJECT CONDITIONS

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

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

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

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

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 1/2" 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% $\pm$ 3.0%
- Organic content	99.2% $\pm$ 0.8% O.D. Basis
- pH	4.8 $\pm$ 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 1/2” 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 (min. of 12”), 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 329223 – SODDING

PART 1 - GENERAL

1.1 SUMMARY

Installation of sodded areas shall be to the extent shown on Drawings and shall include supplying of all sod, topsoil, soil conditioning materials, watering, and the incorporation of these materials into the work as specified. The Contractor shall place topsoil at the depths specified in those areas requiring sod. Topsoil shall be furnished by the Contractor.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Provide copies of soils tests for both new topsoil (provided) and onsite topsoil to the Owner's Representative for review and approval.

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, to the Owner's Representative.

3. Provide the name of the sod producer, the location of the sod field, the date the sod was cut, and the thickness the sod was cut, to the Owner's Representative for review and approval.

4. Provide soil amendments information based on soils test requirements, to the Owner' Representative.

1.1 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 his 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. Copies of the soils test shall be provided to the Owner's Representative prior to the placing of the topsoil, for review and approval.

C. Sod: All sod shall meet O.D.O.T. specifications for percentage of weeds.

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

1.4 PROJECT CONDITIONS

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

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

C. Soil Stabilization: The Contractor shall provide permanent or temporary soil stabilization to denuded areas within fifteen (15) days after final grade is reached on any portion of the site. Any such area which will not be regraded for longer than fifteen (15) days shall also be stabilized. Soil stabilization includes any measures which protect the soil from the erosive forces of raindrop impact and flowing water. Applications include 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. Work shall be performed only during periods when weather conditions will result in reliable viability of the sod.

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 SOD

A. Front Yard or Tree Lawn: Sod shall be a well-rooted Kentucky Blue grass blend of a minimum of four (4) varieties grown on a mineral soil and obtained from a commercial sod nursery. Sod shall be free of all noxious weeds such as wild mustard, thistles, quack grass, etc. and be reasonably free from dandelions and crabgrass.

B. Erosion Control: Sod shall be a well-rooted tall fescue grass blend of a minimum of three (3) varieties grown on a mineral soil and obtained from a commercial sod nursery. Sod shall be free of all noxious weed such as wild mustard, thistles, quack grass, etc. and be reasonably free from dandelions and crabgrass.

C. Sod shall have been recently mowed to a height of not more than 2 inches and shall be cut in strips not less than 3 feet long or more than 6 feet long and shall be cut in a uniform width of not over 18 inches.

D. Sod shall be delivered to the job within 24 hours after being cut and shall be installed within 36 hours after being cut.

E. During wet weather the sod shall be allowed to dry sufficiently to prevent tearing during handling and placing and during dry weather have been watered before lifting to insure its vitality and to prevent dropping off of soil during handling.

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 sod 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 sod. If necessary, supply and install topsoil in areas where there is no topsoil left after vegetation has been removed.
2. Allow for sod thickness in areas to be sodded.
3. 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 PLACING OF SOD

A. Do not plant dormant sod or place if ground is frozen or extremely wet.

B. Lightly water the soil immediately prior to laying the sod.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlay. Stagger strips to offset joints in adjacent courses. Ensure that sod is not stretched. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass. Anchor sod on slopes with wood pegs to prevent slippage.

D. Water sod thoroughly with a fine spray during installation. Immediately after planting irrigate thoroughly so that the new sod pad and soil immediately below the sod are wet but not overly saturated.

E. Upon completion of each area, the entire area shall be rolled and the surface of the sod shall coincide with the finished grade.

3.3 RECONDITIONING EXISTING LAWNS

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

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

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

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

E. 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.

F. All work shall be the same as for new sod areas.

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

3.4 ESTABLISHMENT

A. 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 sodded 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. Resodding
   a. Resodding shall be with sod as herein specified. Depressions exceeding 2" shall be filled and resodded. Sod that fails to thrive during the maintenance period shall be removed and replaced with new sod. Seeding over previously sodded areas is not acceptable.

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.

3.5 INSPECTION AND ACCEPTANCE

A. When sodding 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. Acceptance shall be based upon achieving a vigorous uniformly stand of sod. Unaccepted areas shall be maintained by the Contractor until acceptable.

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

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

END OF SECTION 329223

SECTION 329300.23 - TREES, SHRUBS, AND GROUND COVER

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 this Section.

1.2 DESCRIPTION OF WORK

A. Installation of trees, shrubs, and ground covers shall be to the extent shown on Contract Drawings and shall include supplying all plant material indicated on the plans, plant mix, soil conditioning materials, mulching materials, guying and staking, watering and the incorporation of these materials into the work as specified.

1.3 QUALITY ASSURANCE

A. Landscaping shall be done by a single firm specializing in landscape work.

B. Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.

C. All plant material shall conform to ANSI Z60.1 "American Standard for Nursery Stock"; and State of Ohio, Department of Transportation, "Construction and Material Specifications", current edition.

D. All plant material shall be labeled with a securely attached waterproof tag indicating species and size.

E. All tree trunks shall be wrapped prior to leaving the nursery to protect the trunk from injury during transport. Wrapping shall stay on until planting is completed and removed after the tree is planted.

F. All plant material shall be provided with protective covering (tarping) during transport to reduce desiccation.

G. The Contractor shall have soils tests done at his expense by a State approved soils testing laboratory to determine amendments to the existing soils. Copies of the soils tests shall be provided to the Owner’s Representative prior to planting the plant materials for review and approval.

1. Soils tests shall determine percent organic matter, pH, buffer pH, available phosphorus, exchangeable potassium, calcium, magnesium, Cation Exchange Capacity (CEC), and percent base saturation with recommendations for nitrogen, phosphate, potash, magnesium and lime based on plant type and use.

H. Plants may be subject to inspection and approval by the Owner's Representative at the place of growth or holding yard for conformity to specification requirements as to quality, size and variety. Notify Owner's Representative prior to transport of plant material to the site.

I. The Contractor shall hire an arborist certified by the International Society of Arboriculture (ISA). The arborist shall be on site full time during tree planting operations to ensure that correct planting procedures are followed.

1.4 JOB CONDITIONS

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

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

C. All plants shall be guaranteed for the entire maintenance period covered by the Maintenance Bond.

1.5 PRE-BID SUBSTITUTIONS

A. Every reasonable effort shall be made to find the material specified by the architect. The landscape contractor is responsible for qualifying his/her proposal to document any plant suitability or availability problems. The landscape contractor may offer substitutions to the landscape architect for his/her consideration. The landscape contractor will notify the landscape architect if there are known diseases or insect resistant species that can be substituted for a selected pest-prone plant.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. All plant material shall be of the quantity, size, genus, species, and variety shown, and conforming to ANSI Z60.1, "American Standard for Nursery Stock". Provide healthy, vigorous stock, nursery grown, free of disease, insects, eggs, larvae, and defects such as sun-scald, injuries, abrasion or disfigurement.

B. All plant material shall be of typical proportion and form for the species.

B. Provide freshly dug trees and shrubs.

C. Provide ground cover plants and other plant materials as specified on the drawings.

2.2 OTHER PRODUCTS

A. Mulch shall be double shredded hardwood, free of deleterious materials.

B. Soil amendments shall conform to the soils tests.

C. Organic matter shall consist of composted leaves, composted sludge, or other approved material. Peat moss is not an acceptable material.

D. Filter fabric, i.e., soil separator shall be a non-woven, heat-bonded geotextile fabric made of 100% polypropylene, with a weight of 3.5 oz. to 4.02 oz. per square yard a minimum grab strength of 100 lbs. and a water flow rate of 100 gpm/ft.

E. Structural soil.

1. A uniformly blended mixture of 20-70% Crushed Stone, 20-25% Loam topsoil and 10-15% organic material mixed to proportions that meet CBR #50.
   a. Crushed Stone shall be AASHTO M43 #57 (limestone aggregate).

2. Submit sample of Structural Soil for testing. The air void/porosity of the soil compacted to 100% maximum density per ASTM D698 shall be 25% to 30%. Submit California Bearing Ratio test results for each sample compacted to peak standard density. The soaked CBR shall equal or exceed a value of 50.

F. Inorganic soil additives shall be Perlite (coarse texture), Vermiculite or approved equal.

G. A water retaining, soil conditioning polymer (polyacrylamide) such as “Soil Moist”, by JRM Chemical or approved equal.

PART 3 - EXECUTION

3.1 PLANTING PREPARATION

A. All planting shall be done during the proper planting season for each species. Planting shall not be done under extreme wet, cold or dry conditions. Planting adjacent to heavily treated streets shall only be done in the spring.

B. All fall planted B&B trees shall have a minimum diameter root ball increased in size to that of the minimum diameter required for the next larger caliper size.

C. Deliver trees and shrubs after preparation for planting has been completed, and plant immediately. If planting is delayed more than 6 hours after delivery, set plant material in shade, protect from weather and mechanical damage and keep roots moist by covering with mulch, burlap, or other acceptable means of retaining moisture. No plants shall be stored more than 2 weeks unless with approval of Owner’s Representative. Do not remove container grown stock from containers until planting time.

D. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Owner's Representative's approval prior to start of planting. Make adjustments as directed by the Owner's Representative.

E. Planting beds shall be installed after lawn areas have been brought to finish grade and fine graded, but not seeded.

3.2 TREE PLANTING

A. Excavate pits with flared sides and with bottom of pit at the same depth as the rootball. An auger shall not be used to dig planting pits.

B. For balled and burlapped plants and container plants, pits shall be two and one-half times greater in diameter than the ball and the same depth as the ball.

C. Dispose of any unsuitable subsoil. Plant mix shall consist of existing soil which is free of debris, sticks, rubbish and stones greater than 1", and twenty percent (20%) organic matter by volume. Add amendments as per the soils test requirements.

D. For balled and burlapped material, set tree ball on bottom of pit, centered, and so the flare of the trunk sits at the same grade as it was in the nursery, when settled. Peel back burlap, cut first two rings of wire. When set, place additional plant mix around base and sides of ball, and work each layer to settle plant mix and eliminate voids and air pockets. Water after placing final layer of plant mix.

E. For container plants, remove plant from container and loosen rootball. Make 4 – 5 cuts 3/4 the length of the rootball with a sharp knife. Spread out root mass and place on bottom of pit, centered, so the flare of the trunk sits at the same grade as it was in the nursery when settled. When set, place additional plant mix around base and sides of ball and work to settle plant mix and eliminate voids and air pockets. Water thoroughly.

F. Form a 3" high dish of backfill around the planting area to allow for mulching, as per detail.

G. Provide mulch to a uniform depth of 2". Do not touch mulch to trunk of plant.

H. Guy and stake trees immediately after planting, as indicated on the drawings. Remove wrapping around tree trunks.

3.3 PLANTING BEDS

A. Loosen subgrade of planting bed areas to a minimum depth of 12" using a culti-mulcher or similar equipment. Remove stones greater than 1" in any dimension, remove sticks, rubbish, and any other extraneous matter. Planting soil mixture shall be the same as plant mix in the tree planting section. Remove all stones greater than 1" in any dimension in plant mix. Remove sticks, rubbish and any other extraneous matter. Soil amendments apply here as well.

B. Spread planting soil mixture to a depth of 12" to meet line, grades, and elevations shown after light rolling and settlement. Place approximately 1/2 the total amount of planting soil required. Thoroughly mix into loosened subgrade to create a transition layer, then place remainder of plant soil.

C. Set container grown stock as specified for balled and burlapped stock, except remove container and loosen root system. Plants, when settled, must be set at the same elevation as when in the container.

D. Set bare root stock on cushion of planting soil mixture. Spread out roots without tangling or turning up to surface. Cut injured roots clean; do not break roots. Carefully work backfill around roots by hand, and puddle with water until plant mix layers are completely saturated. Plumb before backfilling and maintain plumb while working plant mix around roots and placing layers of soil mixture above roots. Plants, when settled, must be set at the same elevation as they were in the nursery.

E. Form a 3” saucer of backfill around the planting area, as per detail. Mulch planted areas to a uniform depth of 2" and finish level with adjacent grades. Do not touch mulch to trunk of plant.

F. Space ground cover plants as indicated on the planting plan. Dig holes large enough for spreading of roots, and backfill with planting soil mixture. Eliminate air pockets. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils. Mulch areas between plants to a uniform depth of 2".

G. Newly planted trees and shrubs shall be pruned in accordance with supplier’s recommendations. All pruning must be done by experienced personnel.

3.4 CONTAINED PLANTER BEDS

A. Drainage

1. Install drainage material and structures in all planting areas as per plan. Areas to be planted must be clean of extraneous material and debris. Insure that planter drains are operable and free of debris. The landscape architect may review the installation of the drainage systems prior to placing any backfill mixes.
2. Install filter fabric above drainage material. Make sure filter fabric does not slip during the backfill installation.

B. Planting soil mixture shall consist of 2 parts topsoil, 1-part organic matter and 1-part inorganic soil additive.

C. Soil Placement

1. Place soil in 12” layers and lightly tamp to eliminate air pockets and minimize settling. Care should be taken in placing soil so as to not compact and restrict drainage. Due to anticipated settling, soil fill may exceed final grade.
2. Prior to planting, the landscape contractor shall regrade and repair any areas which settle or are uneven.

D. Planting Operations: Sections for plant materials and planting execution shall apply. Set plants 2” below top of the planter wall to allow for mulching.

E. Bracing Operations: See drawings for bracing techniques. In some cases, galvanized steel eye bolts can be imbedded into the sides of the planter to allow the connection of guy wires.

3.5 STREETSCAPE TREE PLANTING

A. Do not proceed with the installation of the Structural Soil material until all walls, curb footings and utility work in the area have been installed. For site elements dependent on Structural Soil for foundation support, postpone installation until immediately after the installation of Structural Soil.

B. Install subsurface drain lines as shown on the drawings prior to installation of Structural Soil.

C. Excavate and compact the proposed sub-grade to depths, slopes and widths as shown on the drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted sub-grades of adjacent pavement or structures.

D. Confirm that the sub-grade is at the proper elevation and compacted as required. Sub-grade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the drawings.

E. Clear the excavation of all construction debris, trash, rubble and any foreign material.

F. Protect adjacent walls, walks and utilities from damage or staining by the soil. Use 1/2” plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.

G. All Structural Soil mixing shall be performed at the Contractor’s yard and not at the project site to assure proper quality control.

H. Install Structural Soil in 6-inch lifts and compact each lift to maximum density per ASTM D698 and to required CBR value.

I. Bring Structural Soils to finished grades as shown on the drawings. Immediately protect the Structural Soil material from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution of the mix with plastic or plywood as directed by the Engineer.

J. Planting Operations: Sections for plant materials and planting execution shall apply.

K. Bracing Operations: See drawings for bracing techniques.

3.6 LANDSCAPE WATERING

A. The Contractor shall furnish water for watering plants on a weekly basis in absence of 1-1/2" rainfall. All plant material shall be thoroughly watered throughout the period of establishment.

B. Saturate the root zone and mulched area of each plant without causing run-off. During the period from May 15 to September 15, the Contractor shall install one Tree Gator or approved equal drip irrigation bag with each tree planted. Use upright for deciduous trees and flat for evergreen trees. After completion of planting trees, the Contractor shall remove tape from drip irrigation bags and fill with water. Shrubs and trees too small to accept drip irrigation bags shall be watered by other means approved by the Owner.

C. The Contractor shall water plant material at least once a week through-out the period of establishment, unless there has been adequate rainfall. An average of 1-1/2" rainfall per week shall be considered adequate to suspend watering, at the Owner's Representative's direction.

D. The Contractor shall conduct an inspection of the trunk surrounded by and the area beneath each TreeGator irrigation bag on a bi-weekly basis. If any evidence of pests or disease is noticed, the Owner's Representative shall be notified in writing.

3.7 PERIOD OF ESTABLISHMENT

A. Before final inspection, all plants shall be in place and under the care of the Contractor for a period of establishment. This period shall begin immediately upon completion of the planting operations and shall continue until October 1st. In no case shall it be less than one growing season, June 1 to October 1.

B. During this period of establishment, follow all horticultural practices that will ensure the vigor and growth of the transplanted material. This includes watering, remulching, restaking, guying and cultivating. Weeding shall be performed either manually or by chemical control. If there is evidence of deer damage, then a deer inhibitor shall be applied.

C. On or about September 14 the Owner's Representative will inspect the planting and supply the Contractor with a list of missing and dead plants and those that have died back beyond normal pruning lines. Replant as required in accordance with the specifications of the original material. However, plants replaced and planted in the Fall, that die before or during the Spring planting season, shall be replaced immediately.

D. The Contractor is responsible for removing all stakes and guy wires from all plants approximately one year after final acceptance of the planting. The Owner's Representative shall be notified prior to removal.

END OF SECTION 329300.23

SECTION 330130 - MISCELLANEOUS TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 MAINTENANCE OF SANITARY FLOWS

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

END OF SECTION 330130

SECTION 330130.11 - SEWER TELEVISION INSPECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. The Contractor shall clean the sewer and trap all debris downstream for removal off-site. The Contractor may not flush the debris downstream in the sewer system.

B. After cleaning, the manhole sections shall be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time. Final acceptance of the sewer will be given only after the DVD(s) are reviewed and approved by the Engineer.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EQUIPMENT

A. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative.

B. The DVD with audio shall be shall provide the highest quality picture and sound that is capable of being played back on conventional equipment **without special software**.

3.2 PROCEDURE

A. Prior to televising, the sewer shall be charged with water until it begins to discharge at the downstream end so any depressions and low points that may be in the sewer will be filled.

B. The camera will be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

C. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two (2) manholes of the section being inspected to insure good communications between members of the crew.

D. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Engineer.

E. The following information shall be provided on the DVD:

1. The beginning of each DVD shall contain: project name, contract number, Contractor's name, firm doing filming, date of televising, manhole numbers or sections televised, direction of flow, location, distance between manholes, and distance to wyes, and total tape counter number for the end of the DVD. The DVD counter shall be set at zero at the beginning of the DVD.
2. The beginning of each section of pipe shall have a narrative describing; street locations, the manhole numbers and stationing at the beginning and end of this section, which direction the camera is traveling, the condition of the beginning manhole, size and material of pipe, and plan length of this section of pipe. Manhole numbers (from-to) shall be continuously displayed along with footage.
3. During televising of each pipe section, there shall be a brief report as to findings, such as service connections, defects in pipe, water infiltration, dips in the line, debris, mud, etc. The footage of the finding from the beginning manhole shall also be called out.
4. The end of each section of pipe shall have a narrative describing; the as-built length of this pipe section center-to-center of manholes, the length of the pipe between joints, the overall condition of the pipe, the manhole number and stationing at the end of the section, and the condition of this manhole.

F. The DVD shall be accompanied by a video log report. The format of the report shall be approved by the Engineer. The report shall contain a table of contents and a separate report page for each section of pipe between manholes or structures, or between a manhole and the end of a run of pipe.

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

END OF SECTION 330130.11

SECTION 330507.13 – 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.

1.2 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 greater than 2,000 LF of Gravity Flow Sewers.
2. The installation of at least 2,000 LF of 12-inch diameter or greater pipe.
3. 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 MATERIALS

A. High Density Polyethylene Pipe: Pipe and fittings shall meet the requirements of ASTM C906. Pipe used for directional drilling shall be a minimum thickness equivalent to DR 9 HDPE pipe. Joints shall be butt fusion welded.

2.3 EQUIPMENT

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

B. The directional drilling machine shall consist of a hydraulically powered system to rotate, push, and pull hollow drill pipe into the ground at variable angles down to 8 degrees above horizontal, while delivering a pressurized fluid mixture to a guidable drilling and piping installation. The machine shall be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. The rig shall have a system to monitor the maximum pull-back pressure during the pull-back operation. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

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

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

2.4 GUIDANCE SYSTEM

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

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

2.5 DRILLING FLUID SYSTEM

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

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

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

2.6 OTHER EQUIPMENT

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

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

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

2.7 PROOF-OF-DESIGN TESTS

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

2.8 TRACER WIRE

A. All piping shall be installed with a continuous, insulated solid number 10 gauge UF (underground feeder per National Electrical Code Article 339) copper wire for location of non-metallic pipe with an electronic pipe tracer.

B. The wire color shall match the pipe stripe as specified in T02622 and taped along all non-metallic pipes.

C. Splices, if required, shall be with Buchanan connectors or approved equivalent.

D. Upon completion, the Contractor shall demonstrate to the Engineer or his representative that the wire is continuous and unbroken through the entire pipe run by providing full signal conductivity when energized. If the wire is broken, the Contractor shall repair it at no additional cost.

PART 3 - EXECUTION

3.1 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 pipe in a secured entry and assembly pit. The pipe sections are assembled individually and then progressively pulled into the bore path a distance equivalent to a single pipe section. This assembly-pull process is repeated for each pipe length until the entire line is pulled through the bore path to the exit point.

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

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

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

3.4 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.

3.8 CONTINGENCY AND RESOURCE PROTECTION PLAN

A. On-Site Monitoring

1. During drilling operations, visual inspection along the bore path of the alignment shall take place at all times.

2. The Contractor shall supply the following information to the monitoring team throughout the duration of the HDD operation at specific time intervals (e.g. upon completion of each drill rod):
   a. Position of the drilling head relative to the drilling point of entry;
   b. Estimated total volume of drilling fluid that has been pumped during the drilling operation;
   c. Comparison of the current total volume of drilling fluid used and the estimated current total volume of returns;
   d. Equipment breakdowns and repairs;
   e. Any abnormal drilling fluid pressure at the time of occurrence; and
   f. Any change of drilling fluid contents (e.g. new bentonite mixture or introduction of LCMs.

B. Field Response Plan

1. During the drilling process, the operator shall adjust the thickness of the bentonite mixture to match the substrate conditions and ensure continuous flow. Subsequently, the operator shall closely monitor drilling pressures and penetration rates so use of fluid pressure shall be optimal to penetrate the formation.

2. A complete and sudden loss of returns serves as a signal to both the operator and the monitor that something more significant may be occurring and to watch closely for a possible surface release. This plan uses the loss of returns or pressure, the use of a tracing dye and visual indications, to trigger response and mitigation actions.

3. In the event of a sudden loss of approximately 75 percent of expected returns, or in the event that a surface release of drilling fluid or dye are detected, the Contractor shall immediately cease operations to determine what actions need to be taken. In areas containing sensitive resources, agency notifications shall be made and the decision to resume operations shall be determined in consultation with the appropriate agencies' representatives.

4. All equipment required to contain and clean up a frac-out release shall either be available at the work site or readily available at an off-site location within 10 minutes of the bore site. Required equipment will be made available by manual transport; unless vehicle transportation is required due to magnitude of equipment and access is available. This equipment includes the following:

    a. Heavy weight plastic clean gravel filled sand bags (at least 20 bags);
    b. Geotek filter bags 10-by-12 foot size or equivalent (at least 3 bags per segment):
    c. Several hard plastic (5-gallon) buckets;
    d. One wide heavy-duty push broom;
    e. Three flat bladed shovels;
    f. Silt fence (appropriate coverage up to 40 foot perimeter);
    g. Certified weed-free hay bales (appropriate coverage up to 40 foot perimeter);
    h. Two bundles of absorbent pads to use with plastic sheeting for placement beneath motorized equipment while in operation in the vicinity of a riparian/stream zone;
    i. Straw logs (wattles or fiber rolls) (at least two 10-foot rolls);
    j. Portage pumps;
    k. A minimum of 100 feet of hose; and
    l. Vacuum truck (800 and 3,000 gallon).

5. General responses to frac-out releases related commitments are as follows:

    a. Directional boring would stop immediately;
    b. The bore stem would be pulled back to relieve pressure on frac-out;
    c. The Owner and Owners' site representative would be notified to ensure adequate response actions are taken and notifications are made;
    d. Terrestrial releases would be cleaned up using on-site equipment;
    e. A dike/berm may be constructed around the frac-out (terrestrial only) to entrap released drilling fluid;
    f. Response equipment stored off-site in readily accessible locations (e.g. portable pumps and full equipped 800 or 3,000 gallon vacuum trucks) would be mobilized to recover larger releases of drilling fluid;
    g. Access to the frac-out release area would be via existing roads and temporary work easements. Additional access needed to perform clean-up activities would be coordinated with and require approval of all regulating entities.

C. Proper Notification and Documentation

1. If frac-out occurs or any degree of dye were detected within the water column of a stream, the Contractor shall immediately notify the appropriate permitting agencies, and additional follow-up response actions would be developed in coordination with agency representatives.
2. Documentation of environmental compliance shall include written reports of observations, documentation of events and follow-up, and project tracking.

D. Training of Personnel

1. Prior to the commencement of construction, the Contractor shall conduct an on-site training session for members of his monitoring team, Owners' personnel and Owners' site representative. The training session shall cover the following topics:

    a. Details of the information found within the Contractor's safety, traffic control and environmental protection and contingency plans;
    b. Specific permitting conditions and requirements;
    c. Requirement to retain copies of all appropriate permits on the site during all operations;
    d. Sensitive resources located at or near the site;
    e. Requirement to monitoring during all operations;
    f. Proper lines of communication;
    g. Proper lines of authority and responsibility;
    h. Information the Contractor shall provide to the monitoring personnel and Owners' site representative;
    i. Contact names and phone numbers of the appropriate individuals and agencies; and
    j. Types of events that the Contractor is required to report and to whom.

2. The Contractor shall provide an overview of the drilling operation in their work plan. The training session shall ensure that Contractor personnel recognize the authority of the on-site monitors to stop drilling.

END OF SECTION 330507.13

SECTION 330531.06 – PVC PIPE (AWWA C900)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish all the materials for and shall properly place at the locations shown on the drawings or as directed, all PVC pipe of the sizes specified, shown or required for the proper completion of the work included under this contract.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. All PVC pipe used, as covered under this section, shall conform to AWWA C900, with end being designated for one of the type joints as specified herein.

B. The outside diameter of the pipe shall be identical to that of ductile iron pipe for similar diameters, requiring no special adaptors to allow the use of cast or ductile iron fittings where necessary.

C. The minimum class for PVC pipe under this Item shall be DR 18.

D. Materials of construction, including joints and gaskets, shall be suitable for exposure to raw sewage, and shall also be UV stabilized with either 2% carbon black or titanium dioxide.

2.2 JOINTS

A. Mechanical Joints and Push-on Joints including their respective appurtenances shall conform to ANSI A21.11 (AWWA C111).

B. Flanged Joints shall conform to AWWA C110 or ANSI A21.10. Flanged joints shall not be installed underground except within structures as indicated on plans or directed by the Engineer.

C. Appurtenances used to make flanged joints shall include: 1/16 in. thick red rubber gaskets, bolts having American Standard Heavy Unfinished Hexagonal Head and Nut dimensions in conformance with ANSI B18.1, and material for bolts and nuts shall conform to ASTM A 575 or A 576.

D. Ball and socket joints (river crossing) shall be restrained, boltless and capable of deflecting up to 15 degrees and shall be installed in accordance with the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All trenches, when pipe laying is in progress, shall be kept dry and all pipes and specials shall be laid accurately to the required lines and grades and shall be uniformly supported along their entire lengths. The bottom of the excavation shall be properly trimmed, with holes at each joint to receive the bell and to permit the properly cementing the joints.

B. Pipe shall be fully entered and shall abut against adjacent pipe and in such a manner that there will be no unevenness along the inverts.

C. When pipes enter or pass through concrete walls, manholes, sewers or other structures, holes shall be provided and the pipes properly cemented in place so as to form a watertight joint.

END OF SECTION 330531.06

SECTION 330531.17 – PVC PIPE (ASTM D2241)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish all the materials for and shall properly place at the locations shown on the drawings or as directed, all PVC pipe of the sizes specified, shown or required for the proper completion of the work included under this contract.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. All PVC pipe used, as covered under this section, shall conform to ASTM D2241, with end being designated for one of the type joints as specified herein.

B. The minimum class for PVC pipe under this item shall be SDR 35.

2.2 JOINTS

A. Pipe joints shall be Push-on Joints. Joints, including their respective appurtenances, shall conform to ASTM D3139.

B. All fittings shall be Mechanical Joint C153 DIP. All Mechanical Joints shall be restrained with mechanical devices except for tees in the main no closer than 40 feet from the end of a run. Pipe stubs or nipples 30 inches or less (i.e. between Hydrant Tees and Watch Valves or between Watch Valves and Hydrants) shall be Cast Iron or Ductile Iron with restraining anchor glands.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All trenches, when pipe laying is in progress, shall be kept dry and all pipes and specials shall be laid accurately to the required lines and grades and shall be uniformly supported along their entire lengths. The bottom of the excavation shall be properly trimmed, with holes at each joint to receive the bell and to permit the properly cementing the joints.

B. Pipe shall be fully entered and shall abut against adjacent pipe and in such a manner that there will be no unevenness along the inverts.

C. When pipes enter or pass through concrete walls, manholes, sewers or other structures, holes shall be provided and the pipes properly cemented in place so as to form a watertight joint.

END OF SECTION 330531.17

SECTION 330533.23 - 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 Ductile Iron Pipe Size (DIPS) high-density polyethylene pipe intended for the transportation of potable water.

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

1.2 RELATED DOCUMENTS

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

1.3 QUALITY ASSURANCE

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

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

C. Material References:

Reference		Title
1.	AWWA C906	Polyethylene (PE) pressure Pipe & Fittings 4-inch through 63-inch for water dist.
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	Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
5.	ASTM D1505	Density of Plastics
6.	ASTM D2837	Hydrostatic Design Basis
7.	NSF Std. #14	Plastic Piping Components &Y Related Materials

8.	ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
9.	ASTM F905	Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
10.	ASTM F 1055	Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and application instructions. 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 materials furnished for this project.

PART 2 - PRODUCT

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: PLEXCO Division of Chevron Chemical Company, DRISCOPIPE as manufactured by Phillips Products Co., Inc. SCLAIRPIPE as manufactured by Dupont of Canada, 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 outside diameter shall be measured using a suitable periphery tape to ensure conformance with ASTM F714 or ASTM D3035, whichever is applicable.
      c. Pipe wall thickness shall be measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance with ASTM F714 or ASSTM D3035, whichever is applicable.

d. Pipe length shall be measured.
e. Pipe marking shall be examined and checked for accuracy.
f. Pipe ends shall be checked to ensure they are cut square and clean.
g. 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 MATERIALS FOR PIPE SIZES 4-INCH DIAMETER AND LARGER

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 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.

B. High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C906.

C. 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.

D. Dimensions and workmanship shall be as specified by ASTM F714. 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.

E. HDPE pipe and accessories shall be 250 psi at 73.4°F meeting the requirements of Dimension Ratio (DR) 9 as MINIMUM STRENGTH. Pipe sizes 4-inch in diameter and larger shall be Ductile Iron Pipe Size (DIPS). Pipe sizes smaller than 4-inch in diameter shall be Iron Pipe Size (IPS).

F. HDPE pipe used for waterlines shall be black with exterior blue striping.

G. 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. Electrofusion Fittings shall be made of HDPE material with a minimum material designation code of PE 3608 and with a minimum Cell Classification as noted in 3.2.A. Electrofusion Fittings shall comply with ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting. Markings shall be according to ASTM F 1055.

E. Service connections shall be electrofusion saddles with a brass or stainless steel threaded outlet. The size of the outlet shall be as shown on the plans.

F. All transition from HDPE pipe to PVC 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 back-up ring assembly shall be used for pipe type transitions. Back up rings shall be stainless steel.
   1. A harness restraint or concrete anchor is required at all mechanical couplings to prevent pullout.
   2. No solid sleeves shall be allowed between such material transitions.
   3. Fittings and transitions shall be as manufactured by Phillips Driscopipe, Inc., 1000 Series Pressure Pipe, Chevron Chemical Company Plexco/Spiralite pipe, or equal.
   4. 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., ASTM F714 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. BLUE – Potable Water

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. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

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. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F 2620 or TR-41 or the fitting manufacturer’s recommendations and PPI TR-41. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on this project.

E. 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. HDPE shall be installed by Directional Bore Method.

C. 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.

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

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

F. 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.

G. 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.

H. 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.

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

J. 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.

K. 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.

L. 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.

M. 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.

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

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

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

3.3 RECORD KEEPING AND RECORD DRAWINGS

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

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

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

3.4 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.

3.5 PIPE TESTING

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

END OF SECTION 330533.23

SECTION 331216.02 - PLUG VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the furnishing and installation of an eccentric plug valve and all pertinent accessories, complete and in place, ready for service as shown in the Drawings and described in this section.

B. Each valve unit shall be furnished complete with valve gears, handwheel actuator, supports, brackets, gaskets, bolts, nuts, and any other appurtenances necessary for the completion of this work.

C. All work performed under this section shall be in accordance with all approved trade practices and manufacturer's recommendations.

1.3 GENERAL

A. All valves and appurtenances shall be of standard make approved by the Engineer and shall have the name, monogram, or initials of the manufacturer cast thereon. They shall be built and equipped for the type of operation shown on the Drawings, specified herein, or as directed by the Engineer.

B. Unless otherwise specified, valves with screw stems shall open by turning counter-clockwise, the direction being indicated by an arrow cast where easily visible to the operator.

C. The valve shall be provided with flanges compatible with pipe in which they are installed.

D. Unless otherwise specified, a stuffing box packed with O-ring seals shall be used to seal the stem of the valve. The seal system used shall be replaceable without removing bonnet or rotating element. Gaskets shall be of rubber composition.

E. Bolts and nuts shall be bronze, cadmium plated, or stainless steel, unless otherwise shown or specified.

1.4 QUALITY ASSURANCE

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

1.5 JOB CONDITIONS

A. All valves shall be protected at all times from rust or damage, both before and after erection, until the completion of the Contract.

1.6 SUBMITTALS

A. Shop drawings showing the principal dimensions, general construction of, and materials used in, all parts of the valves and operating mechanism.

B. Manufacturer's illustrated catalog data and parts schedule in sufficient detail to serve as a guide in assembly and disassembly of the valve and in ordering repair parts.

C. Manufacturer's certification of compliance with all applicable provisions of AWWA Standards and with the supplementary specifications included herein.

D. A certified report of shop operation and leakage tests.

PART 2 - PRODUCTS

2.1 PLUG VALVES

A. Unless otherwise shown on the Drawings plug valves shall be the non-lubricated, eccentric type valve providing dead-tight shutoff to the full valve rating of 175 psig differential; with flow in either direction.

B. Port area of valves shall be not less than 80% of the nominal pipe area.

C. The valve body bonnet and rotating element shall be semi-steel. The bonnet shall be held in position with bolts, and designed with either a recessed tongue and groove or two dowel pin connection to the valve body to insure proper alignment of the body and bonnet bushings.

D. Valve bearing system shall be corrosion-resistant bushings of the permanently lubricated type provided in the body and the bonnet to support the rotating element trunnions. These bearings should be stainless steel suitable for sewage service. Tape, sprayed, or roll-on bushings or sleeves are not an acceptable substitute in this bearing system.

E. The valve body seat contacting the rotating element shall be either a welded in overlay of not less than 90% pure nickel; or corrosion resistant non-metallic fusion bonded Nylon 11, in compliance with AWWA C507, AWWA C550, and AWWA C509. The seating surface of the rotating element shall be Buna-N rubber (nitrile rubber), or other material recommended by the manufacturer for the liquid handled.

F. Valves and actuators shall have seals on all shafts and gaskets on covers to prevent leakage of liquid out of or the entry of dirt or liquid into the valve. Valves shall be designed so they can be re-packed under pressure without bonnet removal.

G. Packing shall be one of the following:

1. Multiple V-ring compression type with a definite packing gland, or
2. Permanent non-adjustable triple lobe Buna-N shaft seal of "O" ring type with integral cartridges through 24 in. sizes conforming to AWWA C504 and AWWA C507.

H. The plug valve shall be equipped with an enclosed gear operator.

I. Valves shall be DeZurik series 100; or Dresser series 800.

2.2 OPERATORS

A. Manual Operation

1. The valve shall be equipped with a handwheel and other appurtenances as required for manual operation.
2. Operation shall be designed so that the effort required to operate the handwheel shall not exceed 25 lbs. applied at the extremity of the wheel or lever. The handwheel on the valve shall not be less than 6 inches in diameter.

B. Gears for valve operation shall be sized for the working pressure and installed in such a manner that the stuffing box will be accessible for packing.

2.3 SHOP PAINTING

A. The plug valve shall be cleaned and painted as follows:

1. 1st coat - 66 - 1211 Epoxoline Primer
(4.0 - 6.0 dry film - mils.)
2. 2nd coat - 66 - Color Hi-Build Epoxoline
(4.0 - 6.0 dry film - mils.)
3. Finished coat to match color of existing piping and valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The valve shall be carefully installed in its respective position free from distortion and stress. Connecting joints shall conform to applicable requirements of the specifications.

3.2 TESTING

A. All valves shall be tested in place by the Contractor as far as practicable under conditions for the pipelines in which they are placed, and defects revealed in valves or connections under test shall be corrected at the expense of the Contractor to the satisfaction of the Engineer.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintaining instructions, and a complete parts and recommended spare parts list. The O&M Manuals shall be in compliance with the General Requirements of these specifications.

END OF SECTION 331216.02

SECTION 331217.02 – AIR RELEASE VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the furnishing and installation of an air release valve and all pertinent accessories, complete and in place, ready for service as shown in the Drawings and described in this section.

B. All work performed under this section shall be in accordance with all approved trade practices and manufacturer's recommendations.

1.3 GENERAL

A. All valves and appurtenances shall be of standard make approved by the Engineer and shall have the name, monogram, or initials of the manufacturer cast thereon. They shall be built and equipped for the type of operation shown on the Drawings, specified herein, or as directed by the Engineer.

1.4 QUALITY ASSURANCE

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

1.5 JOB CONDITIONS

A. All valves shall be protected at all times from rust or damage, both before and after erection, until the completion of the Contract.

1.6 SUBMITTALS

A. Shop drawings showing the principal dimensions, general construction of, and materials used in, all parts of the valves and operating mechanism.

B. Manufacturer's illustrated catalog data and parts schedule in sufficient detail to serve as a guide in assembly and disassembly of the valve and in ordering repair parts.

C. Manufacturer's certification of compliance with all applicable provisions of AWWA Standards and with the supplementary specifications included herein.

D. A certified report of shop operation and leakage tests.

PART 2 - PRODUCTS

2.1 AIR RELEASE VALVES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Crispin-Multiplex Manufacturing Co.
   2. GA Industries, Inc.
   3. Val-Matic Valve & Manufacturing Corp.
   4. Flo-Matic

B. Description: Hydromechanical device to automatically release accumulated air.
   1. Standard: AWWA C512.
   2. Pressure Rating: 150 psi minimum
   3. Body Material: Cast iron
   4. Valve: Stainless Steel Ball Valve
   5. Trim Material: Stainless steel

2.2 AIR/VACUUM VALVES:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Crispin-Multiplex Manufacturing Co.
   2. GA Industries, Inc.
   3. Val-Matic Valve & Manufacturing Corp.
   4. Flo-Matic

B. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.
   1. Standard: AWWA C512.
   2. Pressure Rating: 150 psi
   3. Body Material: Cast iron
   4. Trim Material: Stainless steel

2.3 COMBINATION AIR VALVES:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Crispin-Multiplex Manufacturing Co.
   2. GA Industries, Inc.
   3. Val-Matic Valve & Manufacturing Corp.
   4. Flo-Matic

B. Description: Float-operated, hydromechanical device to automatically release accumulated air or to admit air.
   1. Standard: AWWA C512.

2. Pressure Rating: 150 psi
3. Body Material: Cast iron
4. Trim Material: Stainless steel

2.4 PROTECTIVE COATINGS

A. All iron parts of valve assemblies shall be painted before leaving the shop.

B. All exterior and internal waterway ferrous surfaces of each valve, except finished or bearing surfaces shall be shop painted with a liquid or powder epoxy coating of approximately 10 mils dry film thickness conforming to AWWA C-550.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The valve shall be carefully installed in its respective position free from distortion and stress. Connecting joints shall conform to applicable requirements of the specifications.

3.2 TESTING

A. All valves shall be tested in place by the Contractor as far as practicable under conditions for the pipelines in which they are placed, and defects revealed in valves or connections under test shall be corrected at the expense of the Contractor to the satisfaction of the Engineer.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintaining instructions, and a complete parts and recommended spare parts list. The O&M Manuals shall be in compliance with the General Requirements of these specifications.

END OF SECTION 331217.02

SECTION 333100 - SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

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

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

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013319 – Field Testing Requirements

B. Section 310000 - Earthwork

C. Section 015713 - Temporary Erosion Control

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

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

B. Special backfill material specified in Section 310000 - Earthwork

1.4 SUBMITTALS

A. Product Data
   1. PVC pipe, each type specified
   2. Reinforced concrete pipe
   3. Vitrified clay pipe
   4. Ductile iron pipe
   5. Manhole castings
   6. Precast concrete manholes
   7. Manhole steps

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

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

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

1.5 REFERENCES

A. ASTM A-48 Standard Specification for Gray Iron Castings

B. ASTM C-76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C. ASTM C-150 Standard Specification for Portland Cement

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

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

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

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

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

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

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

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

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

M. ANSI/AWWA C111/A21.11 American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

N. ANSI/AWWA C151/A21.51 American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids

O. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution

1.6 QUALITY ASSURANCE

A. Qualifications

B Regulatory Requirements

C. Certifications

D. Field Samples

E. Pre-Installation Conference

1.7 PROJECT CONDITIONS

A. Environmental Requirements

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

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

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

1.9 SEQUENCING AND SCHEDULING

A. Perform no pipe work in fill areas until embankment or fill has been completed to at least two (2) feet above proposed top of pipe and fill has been properly compacted.

PART 2 - PRODUCTS

2.1 PIPE

A. Polyvinyl Chloride Pipe (PVC) 4" - 15" Diameter

1. Except where noted for excessive depth, all polyvinyl chloride pipe in this size range shall conform to ASTM D-3034 (**SDR 35**), shall be integral bell and spigot type, with joints conforming to ASTM D-3212, minimum pipe stiffness of 46 psi, and elastomeric seals conforming to ASTM F-477.
2. All pipe and fittings shall be marked or stenciled in conformance with ASTM D-3034. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.
3. Acceptable manufacturers shall be current members of the Uni-Bell Plastic Pipe Association.
4. For pipe runs with a depth greater than 15-feet within the run, polyvinyl chloride pipe shall conform to ASTM D-3034 (**SDR 26**), shall be integral bell and spigot type, with joints conforming to ASTM D-3212, minimum pipe stiffness of 115 psi, and elastomeric seals conforming to ASTM F-477.
5. Pipe material shall be uniform SDR rating between manholes for the complete run. No change in materials shall occur between manholes.

B. Ductile Cast Iron Pipe

1. Ductile cast iron pipe shall be designed in accordance with ANSI/AWWA C150/A21.50 and manufactured in accordance with ANSI/AWWA C151/A21.51, and shall be Thickness Class 52. Pipe shall be coated with a bituminous material on the outside and shall be cement mortar lined in accordance with ANSI/AWWA C104/A21.4. Joints shall be mechanical or push-on in conformance with ANSI/AWWA C111/A21.11 incorporating rubber gaskets. Mechanical joints shall be used wherever joint restraint is required. Bolts for mechanical joints shall be made of either high strength cast iron containing a minimum of 0.50 percent copper or high strength low alloy steel conforming to ANSI/AWWA C111/A21.11.
2. All pipe shall be marked or stenciled in conformance with ANSI/AWWA C151/A21.51. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.
3. Acceptable manufacturers are:
   a. U.S. Pipe
   b. Tyler Pipe

C. PVC Pressure Rated Pipe

1. PVC pressure pipe shall be designed in accordance with AWWA C900 and shall be Thickness Class 18 (DR 26) The bell section shall be as hydrostatically strong as the pipe wall. Joints for PVC pressure pipe shall be push-on with elastomeric ring in conformance with ASTM F-477.

2. All pipe and fittings shall be marked or stenciled in conformance with AWWA C900. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.
3. Acceptable manufacturers shall be current members of the Uni-Bell Plastic Pipe Association.

2.2 PRECAST CONCRETE MANHOLES

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

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

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

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

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

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

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

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

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

2.3 MANHOLE STEPS

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

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

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

2.4 CASTINGS

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

2.5 MASONRY MORTAR

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

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

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

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

2.6 MANHOLE ENCAPSULATION MATERIALS

A. Manhole encapsulation material shall be irradiated and cross-linked polyethylene impermeable backing, coated with protective heat-activated adhesive. Material width shall be sufficient to extend 4-inches below the cone unit-grade ring joint and 4-inches above the grade ring-frame joint.

B. The manhole encapsulation material shall be as manufactured by Canusa, Division of Shaw Resources Inc., The Woodlands, TX or equal.

C. Primer shall be as recommended by the manufacturer.

2.7 PREFORMED BUTYL MASTIC SEALANT

A. Preformed butyl mastic sealant material shall be furnished in 1-inch wide strips conforming to the requirement of ASTM C-990.

B. The butyl mastic sealant shall be Bidco C-56 as manufactured by Bidco Sealants, Inc., Park Hills, MO or equal.

2.8 COUPLINGS

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

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

PART 3 - INSTALLATION

3.1 ALIGNMENT AND GRADE

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

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

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

3.2 PIPE INSTALLATION

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

B. PVC pipe shall be installed in full compliance with ASTM D-2321. Clay pipe shall be installed in full compliance with ASTM C-12. All concrete pipe shall be installed in conformity with recommended practices published by the American Concrete Pipe Association in the "Concrete Pipe Installation Manual."

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

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

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

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

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

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

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

3.3 JOINTING

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

B. Ductile cast iron push-on joints

1. The gasket seat and the gasket shall be thoroughly cleaned and should be wiped with a clean cloth and a thin film of lubricant applied to the inside surface of the gasket that will come in contact with the entering pipe. Use only the lubricant furnished with the pipe. In no case shall a mineral oil or petroleum base lubricant be used.
2. The plain end of the pipe to be jointed shall be thoroughly cleaned and started into the socket so that it is in contact with the gasket. In some cases it may be desirable to apply a thin film of lubricant to the outside of the plain end for about one (1) inch back from the end. The joint is then completed by exerting sufficient force on the entering pipe so that its plain end is moved past the gasket until it makes contact with the base of the socket. Any manufacturer approved method may be used to home the pipe.
3. When laying the pipe in concrete bedding, care shall be exercised to prevent the joint materials from coming in contact with the fresh concrete until after the joint has been completed.

3.4 PERMISSIBLE DEFLECTION AT JOINTS

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

3.5 MANHOLES

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

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

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

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

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

F. Inverts shall be formed to the equivalent of half-pipes in concrete and as follows:

1. Carry concrete out to the manhole wall with a slope of ½ in./ft. from the top of the half-pipe.

2. The bottoms of all manholes shall be channeled to conduct flow in the planned direction. Channels shall be the true shape of the lower half of the sewer pipe and shall match inverts of connecting pipe at the manhole wall.

3.6 DROP MANHOLES

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

3.7 BRANCH CONNECTIONS

A. In general, provision shall be made in the sewers for service connections by inserting a wye branch in the sewer at the location shown on the Drawings, where required or ordered, for each service connection with a branch size called for by the Drawings but never less than six (6) inch, for sewers ten (10) feet or less in depth. Where indicated on the plans, the Contractor shall construct a riser, as per detail, in such manner, that the top of the riser shall be not less than seven (7) feet below grade or at such elevation as to properly receive the required service connection, with full regard to elevation of service sewer and slope from building or structure to the sewer which shall not be less than one percent (1%).

B. The approximate location of service connections are shown on the Drawings based upon available information. The Owner may increase the number of connections or delete some connections as the sewer is being built.

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

3.8 MAINTAINING SEWAGE FLOW

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

3.9 REPLACING, MOVING AND REPAIRING OF EXISTING UTILITIES

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

3.10 CONNECTION TO EXISTING SEWER SYSTEM

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

3.11 CLEAN-UP

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

3.12 DEFECTS TO BE MADE GOOD

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

END OF SECTION 333100

SECTION 333213 – PREPACKAGED WASTEWATER PUMP STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 through 48 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. This section includes the furnishing and installation of factory built duplex raw wastewater pump station systems and wet wells as shown on the plan drawings and as described in this section.

B. All material, equipment, products, incidentals, and testing required and necessary to provide a complete and operational system. Install where noted on the drawings and as specified within these specifications.

C. Coordinate all work with this equipment and any other associated equipment, installed and specified under other sections of these specifications.

D. All work performed under this section shall be in accordance with all approved trade practices and Manufacturer's recommendations.

E. All work performed under this section shall be in accordance with all approved trade practices and Manufacturer's recommendations.

1.3 SUBMITTALS

A. The Contractor shall submit manufacturer’s technical data and application instruction in accordance with the General and Supplementary Conditions and Division 1 Specifications and any additional information listed herein.

B. Product Data: Submit Manufacturer's technical data and application instructions.

C. Shop drawings shall be presented to the Engineer for approval. Electronic submittal information is acceptable. All shop drawings shall clearly identify the specific equipment and material being supplied, the quantity being supplied, and all accessories, dimensions, descriptions, mounting and connection details, and any other information necessary to determine compliance with the plans and specifications. Shop drawings shall include plan and section layouts of the equipment, dimensions, clearances required, power requirements, and wiring diagrams.

D. Sizes shown on Contract Drawings are typical. Individual Manufacturer’s dimensions shall be as shown on the Contract Drawings. Any deviation from given dimensions may interfere with site characteristics. Manufacturer shall be responsible for providing Engineer with drawings showing proposed changes and/or equipment locations. Any

additional engineering costs associated with these changes will be the sole responsibility of the Manufacturer with no additional cost to the Owner.

E. Prior to or with the delivery of equipment, the Manufacturer shall provide copies of an operation and maintenance manual including storage, installation, startup, operating and maintenance instructions, and a complete parts list and recommended spare parts list. The O&M Manuals shall be in compliance with the General Requirements.

F. O&M Manuals: Provide three (3) bound paper copies and one (1) digital electronic copy of operating and maintenance manuals containing copies of the approved shop drawings, operating and greasing instructions, and parts list.

G. Operation Data: Provide description of system operation, adjusting and testing required.

H. Maintenance Data: Provide system maintenance requirements, servicing cycles, lubrication requirements, and local sources for spare parts.

1.4 RESPONSIBILITY AND COORDINATION

A. Under this Contract, the Contractor shall be responsible for the purchase, storage, and installation of all equipment required providing a complete operating facility. The Drawings and Specifications are intended to illustrate and define the equipment installation; however, the Contractor shall properly install, adjust, and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Specifications.

B. The mechanical portion of the pump station including pumps, valves, and controls, shall be provided as a package. The concrete wetwell is **not** required to be part of the package and may be supplied separately by the General Contractor.

1.5 WARRANTY

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
   1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
   2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
   1. Pump Performance Certifications

a. Solids Management System designed for management of sanitary wipes, plastic bags, feathers, hair, sludge, and all other types of stringy solids.
b. Solids Handling Capability
    1) All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.

D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Five (5) years demonstrated experience in providing packaged pump stations.

B. The pumps and pump station manufacturer must be ISO 9001:2008 certified, with scope of registration including design control and service after sales activities.

C. All equipment and materials shall be new and of the best quality.

D. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests, and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

E. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

F. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

G. Contractor Qualifications. Contractor shall have experience installing prepackaged wastewater pump stations on at least ten (10) projects.

PART 2 - PRODUCTS

2.1 PRE-PACKAGED PUMP STATIONS

A. Station Enclosure
   1. Contractor shall furnish and install factory built above ground valve vaults. The station enclosure shall contain and enclose all valves and associated controls and shall be constructed to enhance serviceability by incorporating the following design characteristics:
      a. Both sides of the enclosure shall open.
      b. Panels shall be sized and placed to permit routine maintenance operations through the openings of the enclosure. For these purposes, routine maintenance shall include frequently performed adjustments and inspections of the electrical components, controls and valves.
      c. The access panels shall be protected by a keyed lock.
      d. At least one enclosure side shall contain a screened vent or fan to maximize air flow for enclosure ventilations.
      e. Station enclosure, less base, must be removable or able to be disassembled following the removal of reusable hardware.

   2. Ventilation capacity shall be sufficient to change station air a minimum of once every two minutes. Ventilation shall be thermostatically controlled. Motor and control circuit shall be protected by a thermal magnetic air circuit breaker to provide overcurrent and overload protection. Exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

B. Station Base
   1. Station base shall be constructed of manufacturer's standard materials. The enclosure base shall be positioned at the wet well top. The wetwell top shall incorporate a duplex access lid, sized for the installation and removal of the specified pumps, and shall be of sufficient size to permit access to the wet well. Color used shall deemphasize the presence of dirt, grease, etc., and shall be provided with a nonskid surface.

   2. The station base shall incorporate the wet well access hatch, wet well vent and the cable transition plate.

3. The station base shall be furnished with elastomeric compression sealing devices for all piping penetrations to provide for a vapor tight transition between the wet well and lift station enclosure.

4. Station Heater
   a. Electric radiant heat shall be mounted in the enclosure for freeze protection. The heater shall be thermostatically controlled and shall energize automatically based on field adjustable set points. The electric heater control circuit shall incorporate a thermal-magnetic circuit breaker providing overcurrent and overload protection. Ungrounded heaters shall not be acceptable.

5. Insulation Package
   a. The pump station shall be fully insulated to an R value of 14.

6. Discharge Gauge Kit
   a. The pump station shall be equipped with a glycerin-filled pressure gauge to monitor discharge pressures. Gauge shall be a minimum of 4 inches in diameter and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Pressure gauge shall be graduated 0 to 140 feet water column minimum. Gauge kit shall be mounted and complete with all hoses and fittings and shall include a shutoff valve installed in each connection to discharge piping and a three-way valve to monitor either pump.

2.2 SUBMERSIBLE GRINDER PUMPS (South, South Main, Middle and North Lift Stations)

A. Pump Description
   1. Pumps shall be submersible grinder type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump shall be capable of reducing all components in normal domestic sewage including “foreign objects” such as sanitary napkins, wood, plastic, glass, wipes, rubber and disposable diapers to finely divided particles which will pass freely through the passages of the pump and discharge piping. The temperature limitation of the liquid being pumped is 160 °F (71°C) intermittent and shall be capable of running dry for extended periods of time.
   2. Materials and Construction Features
      a. Pump casing shall be ASTM A48 cast iron Class 30 components.
      b. The pumps shall have a seal leak detection sensor that signals an alarm in the control panel.
      c. Submersible pumps shall be rated to operate in a Class 1, Division 1, Groups C and D hazardous location.

B. Grinder
   1. 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 assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder shall be a one-piece stainless

steel, forged cutter wheel of the rotating type with inductively hardened cutter teeth (Rockwell 56-60) for abrasion resistance. A stationary quench hardened and ground shredding ring shall be provided. The shredding ring will have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.

2. 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 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.

C. Performance and Pump Schedule

1. In order to ensure proper operation in all conditions, pump(s) must operate without overheating in continuous operation, maximum head condition required by the system. Pump(s) must also be capable of operating at zero or negative heads without damage to the pump(s).
2. Pump Schedule: Refer to the plan drawings for a complete pump schedule.
3. The pump(s) shall be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valve be allowed to create a false apparent head.

D. Construction

1. The volute, seal plates and motor housing shall be constructed of high-quality ASTM A-48 class 30 cast iron. The pump(s) shall be painted with air dry enamel of 2 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. Discharge connection shall be a standard 1.25-inch NPT in the vertical position using a threaded bolt on discharge flange.
2. The pump impeller shall be of the recessed, vortex design.
3. The pump shall be a three-bearing design consisting of an upper ball bearing, an intermediate ball bearing restrained for the purpose of carrying the thrust loads, and an oil lubricated lower bronze sleeve bearing to carry radial loads and prevent shaft deflection imposed by the pump impeller and grinder operation. The oil lubricated sleeve bearing shall be located between two mechanical seals. Lip type seals are not acceptable. Designs reducing the number of bearings or substituting sleeve bearings for ball bearings will not be considered equal. Bearings shall have a 50,000-hour B-10 life.

E. Mechanical Seal

1. The pump shall utilize a tandem mechanical shaft seal arrangement and shall operate in an oil atmosphere. Each seal shall be double floating, self-aligning rotary shaft seals to prevent leakage between the motor and pump. The materials of construction shall be silicon carbide. The seal shall be commercially available and not a proprietary design of the manufacturer.

F. Moisture Detection

1. The seal chamber shall include a moisture-sensing probe with leads for connecting to a relay in the control panel. The relay will warn of an impending seal failure without the need of visual inspection of the pump.

2.3 SUBMERSIBLE (CHOPPER) PUMPS (Winchester Lift Station)

A. Pump Description
   1. The pump and motor assembly shall be designed for continuous submerged operation at the bottom of the wet well and to be easily removable from the top surface of the wetwell without any human entrance into the wetwell being required. The unit will be designed to connect with the wetwell discharge piping by sliding down two stainless steel rails mounted inside the wetwell. Pumps and motors furnished shall be complete with all necessary components to provide a functional and long-lasting dependable system.
   2. Pumps shall be an explosion proof, solids handling, chopper type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump shall be capable of solids handling to reduce solid sizes to pass solids in the waste stream greater than 3" in size. The temperature limitation of the liquid being pumped is 160 °F (71°C) intermittent and shall be capable of running dry for extended periods of time.
   3. Materials and Construction Features
      a. Pump casing shall be ASTM A48 cast iron Class 30 components.
      b. The pumps shall have a seal leak detection sensor that signals an alarm in the control panel.
      c. Submersible pumps shall be rated to operate in a Class 1, Division 1, Groups C and D hazardous location.

B. Chopper Mechanism
   1. The radial cutter, slicing blade and striker blade shall be made of 440C Stainless Steel. The slicing mechanism shall be designed to reduce solid size small enough to prevent clogging of the pump.
   2. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The chopper shall be constructed 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.

C. Performance and Pump Schedule
   1. To ensure proper operation in all conditions, pump(s) must operate without overheating in continuous operation, maximum head condition required by the system. Pump(s) must also be capable of operating at zero or negative heads without damage to the pump(s).
   2. Pump Schedule: Refer to the plan drawings for a complete pump schedule.
   3. The pump(s) shall be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valve be allowed to create a false apparent head.

D. Construction
   1. The volute, seal plates and motor housing shall be constructed of high-quality ASTM A-48 class 30 cast iron. The pump(s) shall be painted with air dry enamel of 2 mil minimum thickness. All exposed hardware shall be 300 series stainless steel.

2. The pump impeller shall be of the dual vane design to reduce clogging and constructed of ASTM A-48 Ductile Iron to protect from corrosion and breakage. Impeller shall be dynamically balanced to ISO G6.3 tolerances.
3. Shaft: The pump shaft shall be pickled, turned, ground and polished stainless steel 416 steel designed to carry maximum torque.
4. Shaft Keys: shall be constructed of #416 stainless steel.

E. Mechanical Seal
1. The pump shall utilize a tandem carbon / ceramic vs. silicon / carbide seals with oil filled seal chamber. The seal shall be commercially available and not a proprietary design of the manufacturer.

F. Power/Sensor Cord:
1. AWG rated submersible pump cable sized accordingly to the motor supplied and the National Electric Code, not allowing a voltage drop of more than 5% from the panel to the motor. The power cord shall include power and sensor wires and have a water-tight, quick disconnect, type 4X, water and gas tight design, plug-and-play cord end to simplify installation and maintenance operations.

G. Moisture Detection
1. The seal chamber shall include a moisture-sensing probe with leads for connecting to a relay in the control panel. The relay will warn of an impending seal failure without the need of visual inspection of the pump.

2.4 ELECTRIC MOTORS

A. Single Phase Motors
1. Single phase motors shall be of the capacitor start, capacitor run, NEMA L design and three phase motors shall be of the dual-voltage 240/480, NEMA B design. The motor shall be designed to be non-overloading throughout the entire pump curve. The motor shall be constructed with the open windings operating in a sealed housing, which contains clean dielectric oil for heat dissipation from the windings and for lubrication of the bearings, making it capable of operating in a totally, partially, or non-submerged condition for extended periods of time without damage due to heat being generated. Oil used must be able to be disposed of as non-hazardous waste. Air-filled motors shall not be acceptable.
2. Protection against excessive temperature shall be provided by heat sensor.
3. The pumps shall be equipped with a watertight strain relief cord grip with a grommet that protects the outer cord jacket. An epoxy filled cord jacket will provide anti-wicking moisture protection.

B. Three Phase Motors
1. The motor shall be three-phase, dry squirrel-cage induction type in design conforming to IEC / VDE / EN standards. The motor shall be adequately sized and rated for continuous operation to maximum a fluid temperature of 104 °F (40 °C).
2. The motor housing shall be both air filled and watertight. Motor protection shall be at minimum IP 68.
3. Allowable maximum submergence shall be not more than 25 m.

4. The motor shall be rated for supply voltage of 460 V and frequency of 60 Hz and accept voltage fluctuations as per range B of DIN EN 60 034-1 (Supply voltage +/- 10 % supply frequency -5% /+3 %).
5. The motor higher than 7.5 KW shall be designed for a maximum of 30 number of starts per hour. Starting of the motor shall be direct.
6. The motor stator shall be wound to have an overall motor rating of 180°C, Class H. The rotor bars and short circuit rings shall be made of cast aluminum. The motor and pump set complete shall be designed and manufactured by the same company.

2.5 AUTOMATIC DISCHARGE CONNECTION

A. Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design must insure an automatic and firm connection of the pump to the discharge piping when lowered into place.

B. A gray iron or fabricated steel base plate with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base plate shall be designed with an integral 90^0 elbow or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base plate shall be coated with an epoxy coating for corrosion resistance. The manufacturer shall provide all necessary drawings to insure proper installation and alignment of baseplate within the sump.

C. Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.

D. The contractor shall provide two lengths of 2", schedule 40 stainless steel guide rail pipe for each pump.

E. Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.

F. The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.

G. Lifting cable shall consist of a stainless-steel braided wire cable attached to the pump lifting bail. A crimped ball end shall be provided at the upper end of this cable for attaching to the wet well access frame.

H. All bolts, machine screws, nuts, washers, and lock washers for complete assembly of access cover, guide rails, and discharge elbow shall be stainless steel.

2.6 WET WELL ACCESS

A. The wet well access shall be fabricated from welded aluminum sections. A hinged aluminum door shall be provided for each pump. The hinged door shall be fabricated from 1/4" thick aluminum with non-skid diamond tread on upper surface. All hardware on access assembly shall be stainless steel with a flush upper surface without protrusions. For safety, the door shall have a 300 lbs./sq.ft. rating and be fitted with a recessed staple for padlock. Door shall be furnished with a flush aluminum drop handle and automatic hold open arm.

B. A fall protection safety grate shall be provided. An aluminum grate provided and installed allowing access to pump cables, lifting cables and guide rail brackets without removal. The grate is latchable in the open position, includes 316 SST hardware and is load rated consistent with the access cover.

2.7 VALVES AND PIPING

A. Piping components to include the following:
   1. Suction elbows (90-degree standard radius) supplied for each pump.
   2. Discharge check valves for each pump, with clean out ports.
      a. Lever & weight swing check valves with flanged connections, AWWA C508 with ductile iron ASTM A536 body and epoxy coated for wastewater service.
   3. Three-way discharge plug valves with manual lever operator as required.
   4. Common header piping.
   5. Automatic Air Release Valves (AARV), one (1) for each pump with stainless steel fittings.
      a. Air release / vacuum valve with a cast iron body, stainless steel trim and threaded 2” NPT connections with Buna-N seat, rated for 150 PSI and includes a backflush kit with drain hose to wet well.
   6. Isolation ball valves (1” SST) supplied for each AARV.
   7. Pump drain kits with valves for each pump.
   8. Drain hose supplied (10 ft.) with mating camlock fitting, one for each station.
   9. Gauge kit:
      a. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full-scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
      b. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless-steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.
   10. Discharge Bypass Piping

a. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps. The plug valve shall be non-lubricated, tapered type. Valve body shall be cast iron with flanged end connections drilled to 125-pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings and shall have a resilient facing bonded to the sealing surface.
b. The header pipe shall penetrate the station side wall and terminate with a male OPW type quick connect fitting.

11. Suction Bypass Piping
    a. The station shall incorporate piping to permit emergency access to the pump station wet well.
    b. The pipe shall penetrate the station side wall and terminate with a male OPW type quick connect fitting.

12. Alarm Light
    a. Station manufacturer will supply one 115-volt AC, LED alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rainwater from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.
13. Alarm Flasher
    a. The alarm light circuit shall be equipped with a repeat cycle timer causing the alarm light to flash. Flash rate shall be approximately 1 second. (1/2 second on and off).

2.8 ELECTRICAL CONTROL COMPONENTS

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

B. Panel Enclosure
1. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.
2. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.
3. A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

C. Control Panel UL Label Requirement

1. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

D. Station Enclosure Low Temperature Alarm:

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

E. Motor Branch Components

1. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

2. Circuit Breakers and Operating Mechanisms

   a. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
   b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

3. Motor Starters

   a. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

4. Overload Relays

    a. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.
    b. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

5. Three Phase Monitor

    a. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, voltage unbalance, high voltage, and low voltage. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

6. Transient Voltage Surge Suppressor

    a. The control panel shall be equipped with a modular surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected by heavy duty zinc-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a short circuit current rating of 200,000 Amps and a Maximum Discharge current rating [I_{max}] of 40,000 Amperes. Nominal discharge current [I_n] is 20,000 Amperes. Surge arrester according to UL 1449 3rd Edition, Type 2 component assembly.

7. Voltage Alert Indication

    a. The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.

8. Pump Start Delay
    a. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

9. Panel Heater
    a. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.

10. Fault/Status monitoring signals wired to terminal blocks and includes:
    a. High Water Alarm (Primary Level Control)
    b. Low Water Alarm (Primary Level Control)
    c. Pump Fault No. 1
    d. Pump Fault No. 2
    e. Pump Run No. 1
    f. Pump Run No. 2
    g. Low Station Enclosure Temperature
    h. Three Phase Voltage Monitor Fault
    i. Backup Float Switch Control System Activated
    j. Wet Well Level Sensed by Analog Signal
    k. Flow Meter Reading (analog) as applicable
    l. Low Temperature Fault (Remote Hot Box)

F. Control Circuit

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall permit manual start or stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.
3. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
4. Six-digit elapsed time meter shall be displayed on the operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable, and password protected.
5. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
6. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115-volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be

provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

7. Two spare 20 amp circuit breakers shall be supplied.
8. Pump Start Delay
   a. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.
9. Panel Heater
   a. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.
10. Wiring
    a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.
    b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
    c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

       1) Line and Load Circuits, AC or DC power.....Black
       2) AC Control Circuit Less Than Line Voltage.....Red
       3) DC Control Circuit.....Blue
       4) Interlock Control Circuit, from External Source.....Yellow
       5) Equipment Grounding Conductor.....Green
       6) Current Carrying Ground.....White
       7) Hot with Circuit Breaker Open.....Orange

11. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14-gauge minimum. Motor branch wiring shall be 10-gauge minimum.
12. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.
13. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.
14. Conduit
    a. Factory installed conduit shall conform to following requirements:

       1) All conduit and fittings to be UL listed.
       2) Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

3) Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
4) Conduit shall be sized according to the National Electric Code.

15. Grounding
    a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
    b. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

16. Equipment Marking
    a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

        1) Equipment serial number
        2) Control panel short circuit rating
        3) Supply voltage, phase and frequency
        4) Current rating of the minimum main conductor
        5) Electrical wiring diagram number
        6) Motor horsepower and full load current
        7) Motor overload heater element
        8) Motor circuit breaker trip current rating
        9) Name and location of equipment manufacturer

    b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
    c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.9 LIQUID LEVEL CONTROL

A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.

D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

E. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or “standby pump start level” so that all pumps are operating. These levels shall be adjustable as described below.

1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
2. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.
3. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.
    a. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
    b. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

c. Level adjustments shall be electronic comparator set-points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.
d. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.
e. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.

4. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.
5. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.
6. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.
7. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
8. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
9. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.
10. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.
11. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.
12. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.
13. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
14. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that

a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

15. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low-level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.
16. Integrinex Standard Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting.

F. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane style button integral to the Integrinex Standard level controller.

G. Level Control Systems

1. Air Bubbler System

a. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.
b. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.
c. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.
d. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

2. Radar Level Sensor

a. The transducer shall be FMCW radar type, emitting W-Band energy. The frequency change is proportional to distance and is converted into filling height.

Variations in the filling height are converted into a linear 4-20mAdc signal. Signal processing shall filter out false reflections and other background noises.

b. Range
   1) Up to 15 meters (49.21 feet)

c. Performance Requirements
   1) Accuracy: ±2 mm
   2) Process pressure: -14.5 to 43.5 psig
   3) Process temperature: -40 to +176 deg F
   4) Ambient temperature: -40 to +176 deg F
   5) Sinusoidal Vibrations resistance Class 4M8 according to IEC 60271-3-4
   6) Shock resistance 50 g, 2.3 ms; according to EN 60068-2-27
   7) Impact resistance IK07 according to IEC 62262

d. Characteristics
   1) Protection rating IP 66/68 (3 bar) NEMA 6P submersible
   2) Measuring cycle time ≤ 250 ms
   3) Boot strap time ≤ 10 s
   4) Step response time <3 s
   5) Beam angle 8 deg
   6) Output signal 4-20mA with HART
   7) 32-point linearization curve
   8) Integrated open channel flow algorithms
   9) Flumes – Parshall, Palmer-Bowlus, Venturi
   10) Weirs – Trapezoidal, Rectangular, V-Notch

e. Communications
   1) Encrypted Bluetooth communication with PIN and authentication process

f. Certifications
   1) CE approved
   2) FCC 15.256 approved
   3) CSA certified to Ordinary Location for use in Canada and USA
   4) CSA certified Intrinsically Safe to Class I, Division 1, Groups A, B, C, and D; Class II, Division 1 Groups E, F, and G; Class III for use in Canada and USA
   5) CSA certified Non-Incendive to Class I, Division 2, Groups A, B, C, and D; Class II, Division 2 Groups F and G for use in Canada and USA

g. Memory
   1) The radar shall include a counter for tracking the number of parameter changes to the sensor.
   2) The radar shall track the minimum and maximum distance measured, measurement reliability, measurement rate and electronics temperature.

h. Diagnosis
   1) The radar sensor shall include self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650.

2) Status messages categories shall be failure, function check, out of specification and maintenance requirement.
3) The radar sensor shall be able to perform a function test and produce a test report verifying that the sensor is functioning properly.

i. Mounting
1) The radar sensor shall have mounting options of a straining clamp or a mounting bracket.

j. Maintenance
1) No maintenance required in normal operation.

k. Manufacturer
1) VEGA Americas

2.10 BACKUP LIQUID LEVEL CONTROL

A. A backup level control system shall be provided to operate the pumps, in the event of a failure of the primary solid state level control system. This backup level control will allow for a redundant pump off switch to turn the pump motors off in the event of a primary level control failure.

B. The backup level control system shall start and stop pump motors in response to changes in wet well level. It shall be the mercury float switch type, incorporating intrinsically safe relays. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system.

C. The backup level control system shall start and stop the pumps in accordance to the wet well level. The pump start and stop float switches shall be set above and below the normal pump start and stop level settings utilized for the primary level control. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the “pump start level”. When the water is lowered to the “pump stop level”, the system shall stop the pump. These actions shall constitute one pumping cycle.

D. The backup level control system shall work in conjunction with an alternator relay to select first one pump, then the second pump, to run as “Lead” pump. Alternation will occur at the end of each pumping cycle.

E. Two (2) float switches shall be supplied for installation by the contractor. Each float shall contain a mercury switch sealed in a polypropylene housing, with 50 feet of power cord, and polypropylene mounting hardware. A stainless steel chain with weight shall be furnished to secure the switches in the wet well.

F. Two intrinsically safe relays shall be supplied in a separate level control enclosure. Relays must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Installing contractor shall make connections from relays to motor controls.

2.11 FLOW METER

A. Provide flow meter(s) and display(s) where shown on the project drawings and as specified elsewhere.

1. Meter shall be Sparling Model FM656-06-511-0 or equal.

B. Display mounted within the packaged station enclosure and strap on transducers mounted in/on final discharge piping as shown on the project drawings.

C. Flow meter signal to be connected to main pump control panel. Analog output from the pump control panel to the fault monitoring system is by the Electrical Contractor and as shown on project instrumentation and control drawings.

2.12 PUMP STATION CERTIFICATION AFFIDAVIT

A. A Pump Station Certification Affidavit must be completed in total. Failure to furnish the completed affidavit with bids for alternate, unnamed equipment shall be cause for rejection.

B. The affidavit is also provided to ensure that the proper pumping system is supplied to the owner.

2.13 FACTORY TESTS

A. All components of the pump station shall be given an operational test at the pump station Manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.

B. Each pump shall be capable of achieving the operating reprime lift while operating at the selected speed and the selected impeller diameter. Reprime test report(s) shall be prepared and certified by the factory's registered Professional Engineer.

C. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; Bourdon tube-type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator.

2.14 SPARE PARTS

A. A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions. An O-ring kit shall also be supplied.

B. An instructional video presentation on the pump mechanical seal system in DVD format shall be included. The DVD shall contain a presentation on the following subjects: purpose and location of the mechanical seal, signs of a defective mechanical seal, how to remove the mechanical seal, troubleshooting seal failure causes, seal components, required tools, how to reinstall the seal, and how to place the pump back into service. The video shall include footage of an actual seal replacement.

2.15 INSTALLATION AND OPERATING INSTRUCTIONS

A. Installation of the pump station shall be done in accordance with the written instructions provided by the Manufacturer.

B. Operation and maintenance manuals shall be furnished which will include parts lists of components and complete service procedures and troubleshooting guide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The Manufacturer shall provide the services of a factory-trained representative for a period of not less than one (1) total working day, which shall be broken down into one or two trips as necessary on-site to perform initial startup of the pump station, make final adjustments, supervise initial startup of each pump, and prepare a written test report thereof for the Owner, and to instruct the owner’s operating personnel in the operation and maintenance of the equipment.

B. If there are difficulties in operation of the equipment due to the pump station Manufacturer’s fabrication and programming, additional service shall be provided at no extra cost to the Owner.

3.2 HANDLING AND STORAGE

A. During loading, unloading and storage care shall be exercised to insure that the equipment is not dropped or otherwise damaged through impacting with solid surface. The process equipment shall be stored on a smooth surface, free of sharp objects, and if laid horizontally, shall be placed in such a way to avoid structural damage to the inlet and outlet channels. Slinging will be accomplished using nylon or other fabric material. Under no circumstances shall cable or chain slings be used.

3.3 INSTALLATION

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.4 ELECTRICAL

A. All motor starters, fusible safety switches, selector switches, pushbuttons, indicating lights, and all other pilot devices to form a complete operating electrical system will be supplied according to drawings.

B. All electrical equipment, conduit and wiring not indicated on the Drawings, but necessary to provide a complete operating system shall be provided in this item at no additional cost to the Owner.

C. Electrical Wiring: The external conduit and wiring required for power supply and control to electrical equipment supplied in this Section will be furnished according to drawings under Section 26.

D. Motor size: Any deviation in motor size must be approved by the Engineer. Any electrical equipment or wiring that must change to accommodate a different size motor will be at no additional cost to the Owner.

3.5 FIELD QUALITY CONTROL

A. Pumps
   1. The pumps provided shall be factory tested at three points to verify the pump performs at the design points and tested in the field at start-up to assure proper performance.
   2. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency, and brake horsepower, and at such other conditions of head and capacity to properly establish the performance curve.
   3. The standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

B. Operational Test
   1. Prior to acceptance by owner, an operational test of all pumps, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
   2. After construction debris and foreign material has been removed form the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Prior or with the delivery of equipment, the Manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintenance instructions, and a complete parts list and recommended spare parts list. The O&M Manuals shall be in compliance with the General Requirements.

3.7 DEMONSTRATION AND INSTRUCTIONS

A. Demonstration and Instruction: The Manufacturer of each piece of equipment shall furnish the services of a qualified representative for a period of not less than one (1) day to inspect and adjust the equipment furnished by the Manufacturer. This qualified representative shall also conduct such tests as necessary to demonstrate satisfactory operation and to instruct the Owner's personnel in the care and operation of the equipment.

3.8 PUMP SCHEDULE – AS SHOWN ON THE PLAN DRAWINGS

A. Pump Schedule is shown on the drawings. The five pump stations are:

1. Pump Station #1 = South
2. Pump Station #2 = South Main
3. Pump Station #3 = Middle
4. Pump Station #4 = North
5. Pump Station #5 = Winchester

END OF SECTION 333213

SECTION 333216 – PACKAGED DUPLEX GRINDER PUMP STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish and install a complete factory-built and tested Duplex Grinder Pump Station, consisting of a basin package, NEMA 4X control panel enclosure and electrical quick disconnect, grinder pump(s), pump removal system, discharge assembly with shut-off valve, check valve, alarm device, level control system, and all necessary internal wiring and controls to form a complete packaged system.

B. All equipment in the wet well shall be capable of constant submergence in sewage to a minimum depth of ten feet without electrical power being energized.

C. Contractor shall provide and install Duplex Grinder Pump Stations where indicated in the contract drawings.

D. For ease of serviceability, all grinder pumps and motors shall be of like type and horsepower thought the system.

E. The Contractor shall provide all labor, materials, tools and equipment required to furnish and install the pump station complete as shown on the Contract Drawings and as specified herein including electrical connection at the customer.

F. The contract drawings and specifications were prepared based on the named manufacturer in this item and the Contractor shall include in his base bid proposal, equipment by the specified manufacturer at the not to exceed pricing noted above.

G. The contractor shall furnish one (1) spare grinder pump unit, fully assembled and ready for use of the same type and model supplied with the Duplex Grinder Pump Station.

1.3 QUALITY ASSURANCE

A. All pump manufacturers must have been in the business of manufacturing complete grinder pump stations for a minimum of five (5) years successful field operation of actual proposed equipment and minimum of 10 installations at equivalent application.

B. The pump manufacturer shall be the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

C. Manufacturer Representatives, Distributors, or Packagers will not be considered to be manufacturers. The term “pump manufacturer” or “pump station manufacturer” shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a “pump manufacturer” or “pump station manufacturer” and is not an acceptable supplier.

D. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

E. Supplier shall provide a list of names and dates of similar installations for verification by the engineer or Owner’s Representative.

F. Manufacturer must demonstrate to the satisfaction of engineer that the proposed pump equipment will meet system flows and heads required. In addition, pre-submittal must also demonstrate to the satisfaction of the engineer that the equipment being proposed meets or exceeds all performance and safety requirements, materials of construction, and user benefits of the specified equipment. Only pre-approved grinder pump station manufacturers will be considered. All bids utilizing manufacturers not pre-approved will be considered non-responsive.

G. Certified Pump Test

1. Each pump shall be shop tested for capacity, head, speed, power and efficiency in accordance with Standards of the Hydraulic Institute.

2. Certified copies of each test curve shall be furnished to the Engineer for approval.

3. Test shall consist of checking each pump at its rated speed, head, capacity, efficiency, and brake horsepower.

4. The pumps shall not leave the manufacturer’s plant until receipt of the Engineer’s approval.

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

I. If Contractor chooses to submit a bid that does not meet all the requirements of this specification, the bid shall include a written description of the deviation with data that shows the magnitude of and justification for the deviation from this specification. The decision to accept material deviating from this specification shall be the responsibility of the SPECIFYING ENGINEER.

1.4 SUBMITTALS

A. The Contractor shall submit manufacturer’s technical data and application instruction in accordance with the General and Supplementary Conditions and Division 1 Specifications and any additional information listed herein.

B. Product Data: Submit the manufacturer's technical data and installation instructions including certified pump curves with efficiency, capacity, head, speed, brake horsepower required and operating point required for each pump. Submit all wiring diagrams.

C. Manufacturer's Data:

1. The Contractor shall submit, as a minimum, the following information:
   a. Motor data, including starting kVA, starting torque, full load current, full load torque efficiency curves, and power factor curves (typical motor test data from equivalent motors are acceptable).
   b. Materials of construction for all components.
   c. Details of the new pump installation.

2. Manufacturer's Certificates, including certified test curves with the design points clearly marked (computer model printouts are not acceptable). Performance curves shall be submitted for each pump to be supplied to both the Engineer and Owner.

3. The pump manufacturer must be certified to ISO 9001 by an accredited agency, with scope of registration including design control and service after sales activities.

D. Warranty: The Equipment Manufacturer shall submit a warranty certificate for review for all pump equipment. The date of the warranty begins after commissioning and operational demonstration.

E. After receipt of notice to proceed, the contractor shall furnish the engineer the shop drawings detailing the equipment to be furnished for the Duplex Grinder Pump Station, including dimensional data and materials of construction.

F. Prior to completion of equipment delivery, the contractor shall supply one (1) electronic digital copy in PDF format and three (3) paper copies of Operation and Maintenance instructions.

1.5 WARRANTY

A. The manufacturer shall provide a warranty on any defective part(s) and labor to replace defective parts for a period of thirty-six (36) months after notice of owner's acceptance. The owner will return any equipment found to be defective to the manufacturer for inspection and validation of the defect. Defective equipment will be repaired or replaced and shipped back to customer at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The pump models covered in this specification are single/three-phase grinder pumps. Acceptable grinder pump station manufacturer(s) are:

1. Liberty Pumps
2. Hydromatic
3. Or Engineer pre-approved equal.

2.2 STATION CONFIGURATION

A. Grinder Pump Station Configurations

1. Duplex Station Configuration: Basins shall be supplied in a wet well configuration, a minimum of 36” in diameter with an anti-floatation collar.

B. Factory Wiring

1. All wiring in the grinder pump station shall be installed and functionally tested prior to shipment from the factory. As a minimum requirement, all wire connections inside the basin wet well must be completed during factory assembly and 100% functionally tested prior to shipment. All electrical wires penetrating or passing through the silhouette of the pump station must be guaranteed to be watertight by the manufacturer and must be installed at the factory prior to shipment.

2. The submersible pumps shall be supplied with 25 feet of multi-conductor power cord (35 feet for external capacitor models). It shall be cord type SJOOW (1-phase), SEOOW (3-phase), or SOOW (external capacitor models), capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a watertight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.

2.3 GRINDER STATION AND ACCESS

A. Wet Well and Valve Vault Design

1. The basin shall be fiberglass with anti-floatation collar. The basin shall be furnished with 4" inlet hub with rubber seal. Inlet location can vary to accommodate ease of installation.

2. The basin FRP wall laminate thickness shall vary with the wet well depth to provide the aggregate strength to meet the tensile and flexural physical property requirements.

3. All piping inside the basin silhouette shall be at a level in the station that is lower than the frost depth or depth of bury specified for the low-pressure sewer piping, whichever is lowest.

4. The basin package shall be furnished with a NEMA 4X junction box for electrical collections.

5. Cover shall be a fiberglass bolt down cover capable of supporting normal foot traffic.

6. The manufacturer shall guarantee all bulkhead penetrations are watertight.

B. Factory Assembled Tank Systems with Guide Rail and Quick Disconnect Discharge

1. Factory mounted guide rail system with pump suspended by means of bolt-on quick disconnect which is sealed by means of nitrile grommets.

C. Check Valve

1. The pump discharge piping shall be equipped with factory installed gravity operated check valve built into the discharge piping.

D. Shut-Off Valve

1. The pump discharge piping shall be equipped with a factory installed shut off valve. All valves shall be operable from ground level. Shut off valve must be replaceable without excavating basin exterior.

2.4 PUMPS

A. Pumps

1. The submersible grinder pump shall be capable of handling residential and commercial sewage and grinding it to a fine slurry, including “foreign objects,” such as sanitary napkins, wood, plastic, glass, wipes, rubber and disposable diapers to finely divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter discharge piping. The temperature limitation of the liquid being pumped is 160 °F (71°C) intermittent and shall be capable of running dry for extended periods of time.

2. The pump shall be constructed of ASTM A48, Class 25 cast iron components.

3. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with a Buna-N O-ring. All fasteners exposed to the liquid shall be stainless steel. The motor shall be protected on the top side with sealed cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with a dual seal arrangement. The first seal is a double lip seal molded in fluoroelastomer or Buna-N. The second/main seal shall be a unitized hard face silicon carbide seal with stainless steel housings and spring.

4. The upper and lower bearing shall be capable of handling all radial thrust loads. The lower bearing shall have the additional ability to handle the downward axial thrust produced by the impeller and cutters by design of angular contact roller races. The pump housing shall be of the concentric design thereby equalizing the pressure forces inside the housing which will extend the service life of the seals and bearings. Additionally, there shall be no cutwater in the housing volute in order to discourage the entrapment of flowing debris. The pump shall be furnished with a stainless-steel handle having a nitrile grip.

B. Grinder

1. The cutter and plate shall consist of 440 stainless steel with a Rockwell C hardness of 55–60. The stationary cutter plate shall have specially designed orifices through it, which enable the slurry to flow through the pump housing at an equalized pressure and velocity. The stationary cutter shall consist of V shapes to maximize cutting action and arc shape exclusion slots to outwardly eject debris from under the rotary cutter. The rotary cutter shall have (4) blades and be designed with a recessed area behind the cutting edge to prevent the accumulation and binding of any material between rotary cutter and the stationary cutter. The cutting system must incorporate close tolerances for optimum performance. Ring or radial cutters, or those that grind on the outside circumference, shall not be considered equal.

C. Performance and Pump Schedule

1. In order to ensure proper operation in all conditions, pump(s) must operate without overheating in continuous operation, maximum head condition required by the system. Pump(s) must also be capable of operating at zero or negative heads without damage to the pump(s).

2. The pump(s) shall be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valve be allowed to create a false apparent head.

D. Construction

1. The pumps shall have a dual seal arrangement consisting of a lower and upper seal to protect the motor from the pumping liquid. The lower seal shall be fluoroelastomer OR Buna-N molded double lip seal, designed to exclude foreign material away from the main upper seal. The upper seal shall be a unitized silicon carbide hard face seal with stainless steel housings and spring equal to Crane Type T-6a. The motor plate/housing interface shall be sealed with a Buna-N O-ring.

2. The impeller shall be an investment cast stainless steel impeller, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be keyed and bolted to the motor shaft.

3. An upper radial and lower thrust bearing shall be required. The upper bearing shall be a single ball / race type bearing. The lower bearing shall be an angular contact heavy duty ball/race type bearing, designed to handle axial grinder pump thrust loads. Both bearings shall be permanently lubricated by the oil, which fills the motor housing. The bearing system shall be designed to enable proper cutter alignment from shut off head to maximum load at 10 feet of TDH. The motor shaft shall be made of 300 series stainless steel and have a minimum diameter of 0.670" Mechanical Seal.

2.5 ELECTRIC MOTOR

A. Design

1. All motors shall be oil filled and class B insulated NEMA B design, rated for continuous duty. Since air filled motors are not capable of dissipating heat as

effectively, they shall not be considered equal. At maximum load, the winding temperature shall not exceed 105°C for model LSG202 and 135°C for LSG202-C and LSGX models (unsubmerged). Single-phase motors shall be capacitor start/capacitor run and have an integral thermal overload switch in the windings for protecting the motor.

2.6 CONTROLS

A. The pumps shall be controlled with a NEMA 4X outdoor duplex control panel with three float switches and a high-water alarm or with optional IP-Series NEMA 4X outdoor duplex control panel with transducer, adjustable set-points, data logging, and a high water alarm.

2.7 CORROSION PROTECTION

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

B. The exterior of the casting shall be protected with powder coat paint.

PART 3 - EXECUTION

3.1 TESTING AND STARTUP

A. The pumps shall have a ground continuity check and the motor chamber shall be hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure integrity of the motor housing. The pump shall be run, voltage current monitored, and checked for noise or other malfunction.

B. The pumps provided shall be factory tested at three points to verify the pump performs at the design points.

1. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency and brake horsepower, and at such other conditions of head and capacity to properly establish the performance curve.

2. The standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

3. All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

C. The Contractor shall test all power and control devices in Control Panel for proper operation.

D. A factory trained service technician shall be provided for a minimum of one-half (1/2) day to test and make adjustments to the control panel and level system to place it into operation and provide training in operation and maintenance.

E. After all testing has been completed to the satisfaction of the Owner and/or Engineer, the entire Lift Station and Control Panel System shall operate satisfactorily for a minimum test period of 30 days.

1. Cumulative down time of all components furnished shall not exceed 1/2 hour as recorded by the Engineer during the test period.

2. System documentation shall be delivered on the last day of test period. Test period shall not end until system documentation has been delivered.

F. If the cumulative downtime limit is exceeded, the Engineer shall have the following options:

1. Extend the test period as required until the cumulative downtime during the preceding 30 days does not exceed 1/2 hour as recorded by the Engineer.

2. Sub-systems which have no components contributing to the cumulative downtime will be approved as a partial acceptance.

3. Subsystems which have components that contributed to the cumulative downtime shall have their test period begin after all repairs and adjustments have been made.

3.2 FIELD TESTING

A. Each grinder pump shall be submerged, operated and tested for performance compliance to its respective curve.

END OF SECTION 333216

SECTION 407113 - FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 through 16 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. This section includes furnishing and installing all required flow meters as shown on the Drawings, as specified or directed. The meter shall include a primary metering element, sensors, transmitter, and other appurtenances required for a complete installation.

B. It is the intent of this contract that the final installation shall be complete in all respects and the Contractor shall be responsible for minor details and any necessary special construction not specifically included in the Drawings or Specifications.

C. Refer to Special Provisions for the type of flow meters required.

1.3 QUALITY ASSURANCE

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

1.4 RESPONSIBILITY AND COORDINATION

A. Under this Contract, the Contractor shall be responsible for the purchase, storage, and installation of the flow meter, transmitter, and any accessories required. The device shall be completely wired, tested, and be suitable for operation. The control equipment wiring between the device and the power supply, and piping between meter and transmitter shall be the responsibility of the Contractor. The Drawings and Specifications are intended to illustrate and define the equipment installation; however, the Contractor shall be properly install, adjust, and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Specifications.

1.5 SUBMITTALS

A. The Contractor shall submit manufacturer’s technical data and application instruction in accordance with the General and Supplementary Conditions and Division 1 Specifications and any additional information listed herein.

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

PART 2 - PRODUCTS

2.1 MAGNETIC METERS

A. Each meter shall include a magnetic metering tube, removable electrode, a signal converter with local indicator, flow totalizer and listed specials.

B. Each metering system shall be accurate to less than plus or minus 1% of the actual flow rate.

C. Metering tube

1. The magnetic flow meter shall operate on DC voltage in which the voltage induced is directly proportional to the volumetric flow through the meter.
2. The metering tube shall be constructed of 304 stainless steel with 150 lb. ANSI flanges for connections. The meter liner shall be Teflon.
3. By nature of its design, the meter shall feature zero stabilization with no drift, low power consumption and require no field calibration unless one of the control PC boards is replaced.
4. The meter and housing shall be capable of submergence and shall meet NEMA 6P standards, as a minimum. Refer to Special Provisions.
5. When required by the Special Provisions, especially on intermittent flows, the meter shall be provided with positive zero return.
6. Grounding of the meter shall be accomplished by the Manufacturer's standard method for use on lined or non-conductive pipe. Grounding rings shall be of Type 316 stainless steel.
7. The meter shall run on a 115 volt, 60 Hz, single phase power supply, which shall be provided by the Electrical Contractor.
8. The meter shall be accurate to plus or minus 0.5% of full scale under the specified operating conditions. Voltage or frequency fluctuations in the power supply of plus or minus 10% shall not produce an error of more than plus or minus 0.5% of full scale.
9. The meters shall be as manufactured by Brooks, Krohne, Siemens, Sparkling, Toshiba, or equal.

D. Electrodes

1. The electrodes or electrode cartridge shall be Type 316 stainless steel and shall be capable of being removed in the field for cleaning with the meter on-line, under pressure and without recalibration. This shall be accomplished by inserting the electrode through a corporation cock or valved assembly.
2. The electrode housing shall also be made of 316 stainless steel.
3. The electrode shall be screwed into the end of the valve fitting to provide a positive seal rated at the same pressure as the meter.
4. The electrode will be fastened to the valve or meter by a chain of a sufficient length that will allow cleaning, but prevent damage due to accidental dropping.

E. Signal converter – transmitter

1. The signal converter-transmitter shall be microprocessor based and shall be a product of the metering tube manufacturer. Each signal converter transmitter shall work with any of the flow meters provided. The unit shall be field scalable and shall require no zero-point adjustment. The unit shall be provided with self-diagnostics PC card, automatic data checking and data retention for a minimum of 10 years.
2. The signal converter-transmitter shall be wall mounted within 50 ft. of the flow meter. The signal converter-transmitter enclosure shall have a NEMA 4 minimum.
3. The signal converter-transmitter shall amplify and convert the DC input signal from the flow meter into a 4-20 ma DC signal proportional to the volumetric flow through the meter.
4. The DC signal shall drive an integral flow indicator.
5. The local flow indicator shall indicate flow in gallons per minute (GPM) and totalize.
6. The signal converter-transmitter shall run on a 115 volt, 60 Hz, single phase power supply, which shall be provided by the Electrical Contractor.
7. The signal converter-transmitter shall be accurate to plus or minus 0.5% of full scale under the specified operating conditions. Voltage of frequency fluctuations in the power supply of plus or minus 10% shall not produce an error of more than plus or minus 0.5% of full scale.

2.2 ULTRASONIC CLAMP-ON FLOW METERS

A. General:
1. The meter shall be a clamp-on design which mounts externally to the pipe and with no liquid contact.
2. The meter shall utilize the transit-time measurement technique and employ the use of two microprocessors with a sample rate of 1000 Hz.
3. The meter shall also employ an alternate Doppler measurement technique for liquids with high solid content. The meter shall automatically toggle from transit time to Doppler measurement if the signal decays due to high solids content and toggle back once the signal improves. The time delay for the toggle feature shall be programmable.
4. Transducers shall be supplied with a NIST traceable multi-point wet flow calibration certificate and shall have an accuracy of ±1% of rate. This calibration resides on an Eprom and is uploaded to the transmitter when the transducers are attached.

B. Transducer Features:
1. Transducers shall have built-in RTD for measuring the transducer block temperature and automatically compensating for temperature effects including changes in fluid viscosity and density.
2. Transducers shall be made of corrosion resistant PEEK and stainless steel (hermetically sealed) with an integral armored stainless steel cable. The use of COAX cable and BNC connectors is not acceptable.

3. Transducers shall be mounted in a fully sealed stainless steel PermaLok mounting track and have the ability to be coupled using permanent coupling pads. Use of grease is not acceptable.
4. Transducer markings shall be laser scribed and solvent resistant. Use of adhesive labels is not acceptable.
5. Transducers shall be rated IP66 with optionally available IP68 transducers for continuous submergence.

C. Meter Features:
1. The meter shall have the ability to automatically recognize the transducers when they are connected.
2. The meter shall not require a "zero calibration" in the field. The zero calibration shall be factory pre-set and certified prior to shipment.
3. The meter shall have the ability to automatically calculate the Reynolds number and corresponding flow regime (laminar, turbulent, and transitional).
4. The meter shall provide automatic liquid sonic velocity compensation, and have built in liquid tables for liquid viscosity and density settings.
5. The meter electronics shall be housed in a NEMA4X enclosure and shall display flow rate, flow velocity, mass flow, total flow, signal strength, signal quality, liquid sonic velocity, and the flow regime.
6. The meter should also be FM approved for CL1 DIV2 locations where needed.
7. The meter shall provide 4–20 mA output(s) and (3) relay outputs.
8. The meter shall have the ability to provide a status alarm for conditions of fault, flow direction, sound velocity limit, and flow velocity limit.
9. The meter shall have the ability to set the 4–20 mA signal to a settable status and alarm condition.
10. The meter shall have RS-232 output and internal memory with a minimum storage of 100,000 data points.

D. Accessories:
1. Provide all necessary straps and anchors to affix the transducers to the pipe and meter to the wall.
2. Provide a stainless steel junction box and triax extension cable to extend the cable length.

E. Sizes and Ratings:
1. System Accuracy: ±1.0% of rate from 0 to 100% of range.
2. Drift: complete zero stability.
3. Process Fluid Temperature: -22°F to +260°F.
4. Ambient Temperature Range: +14°F to +140°F

F. Manufacturer:
1. The Ultrasonic Clamp-On Flow Meter shall be a model 7407 as manufactured by Flexim Americas.

2.3 TERMINAL POINTS

A. Flow meter units shall be provided with terminal points to facilitate the exchange of the central control functions between the units and the process control system as indicated on the Electrical Drawings.

2.4 SHOP PAINTING

A. The exterior surfaces of the metering tube shall be thoroughly cleaned of dirt, grease, oil, rust, scale, or other injurious substances. Exterior metal surfaces shall be sandblasted in accordance with SSPC-SP10, Near White Blast Cleaning.

B. All non-galvanized ferrous surface shall then receive a shop coat of a universally compatible primer.

PART 3 - EXECUTION

3.1 ERECTION

A. The equipment shall be erected in accordance with the manufacturer's recommendations.

3.2 INSPECTION, STARTUP, AND TESTING

A. The manufacturer of the flow meters shall provide a representative to check the installation, make final adjustments, supervise initial startup of each system, and prepare a written report thereof for the Owner.

B. The representative shall also instruct the Owner's personnel in the operation and maintenance of the equipment.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintenance instructions, and a complete parts list and recommended spare parts list. The O & M Manuals shall be in compliance with General Requirements.

3.4 SPECIAL PROVISIONS - SCHEDULE

A. Magnetic Meters:

Meter	Magnetic Flow Meter
Pipe Size/Material	4 inches, DIP
Liquid	Raw Municipal Sewage
Solids	1 - 2%
Flow Rate	0 to 500 GPM
Tube Mounting	F-F
Display Housing	NEMA 4X, Wall Mounting
Number Required	One (1)
Accessory(s)	One (1) 4 inch DIP Flanged Spool Piece

END OF SECTION 407113

SECTION 462133 - VERTICAL FINE SCREEN WITH VERTICAL SCREW CONVEYOR AND SCREENINGS COMPACTOR

PART 1 - GENERAL

1.01 SCOPE

A. The contractor shall furnish and install one (1) vertical fine screen for removing floating, particulate and fibrous material and for conveying, washing, dewatering, and compacting the screenings before discharging the compacted screenings into dumpster with bagger option as indicated on the drawings. Each vertical fine screen shall be manufactured from AISI 304L stainless steel shapes. Fabrication and assembly shall be in conformance with these specifications and drawings.

B. Each screen shall include a screen basket, screw, drive motors, gear reducers, support leg, anchor bolts, controls, and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

C. The contractor shall coordinate all details of the equipment with other related parts of the work. He shall verify that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations required to accommodate equipment differing in dimensions, weight, or other characteristics from these specifications and drawings.

D. The contractor shall install the equipment according to instructions and recommendations of the equipment manufacturer.

E. Power supply for main control panel is 460 V, 60 Hz, 3-phase.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:

1. Section A322: Carbon and Alloy Steel Bar Specifications.

2. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled

B. ISO 281:2007 Calculation Method for Fatigue Life for Roller Bearings.

C. American Institute of Steel Construction (AISC) Publications

D. American Welding Society (AWS), European Welding Federation (EWF), and International Institute of Welding (IIW) Publications

E. American Structures Painting Council (ASPC) Publications

F. International Organization for Standardization (ISO) Publications.

1.03 SUBMITTALS

The manufacturer will provide an electronic submittal for review by the engineer in accordance with Section 01300.

A. Product Data: Include the following:

1. Descriptive literature, brochures, catalogs, cut-sheets and supplementary material to define the equipment.

2. Motor characteristics and performance information.

3. Gear reducer data including service factor, efficiency, torque rating, and materials.

4. Parts list including a list of recommended spare parts.

B. Shop Drawings: Include the following:

1. Manufacturer's installation drawings.

2. Wiring and schematic diagrams.

C. Operations and maintenance manual.

D. Detailed mechanical and electrical installation instructions and procedures.

E. Equipment weights and lifting points.

F. Recommendations for short and long-term storage.

G. A copy of the manufacturer's warranty.

H. A copy of documents proving certification of the Manufacturer's Quality Management System according to ISO 9001 and Environmental Protection Management System according to ISO 14001.

I. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

1.04 QUALITY ASSURANCE

A. To ensure quality, conformance, reliability, and environmental practices with regard to the manufacturing and production of the machinery described in this section, the equipment manufacturer shall meet the requirements listed in this section.

B. Manufacturer shall have established an ISO 9001 certified quality management system. Manufacturers without an ISO 9001 certified quality management program must provide complete documentation of their existing quality management system with supplemental information clarifying why areas do not meet ISO 9001 standards. Meeting national quality management standards alone shall not be considered an acceptable substitute because ISO standards exceed national quality management standards.

C. Manufacturer shall have established an ISO 14001 certified environmental protection management system. Manufacturers without an ISO 14001 certified environmental protection management system must provide complete documentation of their existing environmental protection management system with supplemental information clarifying why areas do not meet ISO 14001 standards. Meeting national or local environmental protection management standards alone shall not be considered an acceptable substitute because ISO standards exceed national and local environmental protection management standards.

D. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid (pickling bath) to remove any residues that may be present on the material because of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer, which is critical to the long life of the stainless steel.

E. No stainless-steel components may be fabricated or assembled in a factory where carbon steel products are fabricated, in order to prevent contamination by rust.

F. The manufacturer shall have a minimum of twenty (20) years' experience producing the vertical screen described and upon request will submit to the engineer documentation of (30) installations in the United States that have been in operation for at least five (5) years.

G. All welding is performed in accordance with American Welding Society (AWS), European Welding Federation (EWF), International Institute of Welding (IIW), or equivalent.

H. Manufacturer shall provide screen, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

I. Manufacturer shall provide services by a factory-trained service technician, specifically trained on the type of equipment specified. Service technician requirements include, but are not limited to the following:

    1. Manufacturer shall have a minimum of ten (10) service technicians based in the United States for field service of the equipment. Manufacturer shall have multiple service locations with a minimum of one dedicated service location for both the eastern and western regions of the US.

    2. Service technician shall be present during initial energizing of equipment to determine directional testing.

    3. Service technician shall inspect and verify location of anchor bolts, placement, leveling, alignment and field erection of equipment, as well as control panel operation and electrical connections.

    4. Service technician shall provide classroom and/or field training on the operation and maintenance of the equipment to operator personnel.

5. Manufacturer shall state field service rates for a service technician to owner and contractor. In the event that the field service time required by this section should not be sufficient to properly place the equipment into operation, additional time shall be purchased by contractor to correct deficiencies in installation, equipment, or material without additional cost to owner.

J. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or installation, defective workmanship or materials, and breakage or other failure. Materials shall be suitable for service conditions.

K. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service prior to delivery, except as required by testing.

L. Each major component of equipment shall have the manufacturer's name, address and product identification on a nameplate securely affixed to the equipment.

1.05 DELIVERY, STORAGE, AND HANDLING OF EQUIPMENT

A. Equipment shall be shipped and delivered fully assembled, except where partial disassembly is required to conform to transportation regulations or for the protection of components.

B. Contractor shall be responsible for unloading and shall have equipment on-site at the time of delivery permitting proper hoisting of the equipment.

1.06 PRE-SUBMITTAL OF ALTERNATE EQUIPMENT

Manufacturers of alternative equipment shall submit a pre-approval package to the engineer at least two (2) weeks prior to bid date. Alternative manufacturers shall submit the following information and supporting documentation:

A. A complete set of drawings, specifications, catalog cut-sheets, and detailed descriptive material. Drawings shall show all relevant details of the unit. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification. If the proposed equipment does not meet these specifications, any deviation from the specification must be expressly noted. All deviations shall be listed on a single document.

B. Detailed installation drawings illustrating how the proposed screen will be installed. The drawings shall include plan, elevation, and sectional views of the installation. Drawings shall include details of the anchor bolt locations.

C. Structural calculations by a Professional Engineer either confirming the existing structural design is sufficient for the alternate equipment or detailing any changes required for the building design to use the alternate equipment.

D. Motor characteristics and performance information. Vendor data shall be furnished to confirm the torque and thrust rating of the drives.

E. Complete reference list of all installations of same and similar equipment including contact names and phone numbers, showing at least 20 municipal installations of the same size as the alternate equipment located in the United States.

F. Complete bill of materials for all equipment, showing dimensions and materials of construction of all components.

G. Certification by the manufacturer that all stainless steel equipment will be manufactured in a stainless steel only factory.

H. Certification that the entire equipment will be passivated by submersion in an acid bath as specified in chapter 2.03.

I. A copy of documents proving certification of the Manufacturer's Quality Management System according to ISO 9001. Manufacturers without an ISO 9001 certified quality management program must provide complete documentation of their existing quality management system with supplemental information clarifying why areas do not meet ISO 9001 standards. Meeting national quality management standards alone shall not be considered an acceptable substitute because ISO standards exceed national quality management standards.

J. A copy of documents proving certification of the Environmental Protection Management System according to ISO 14001. Manufacturers without an ISO 14001 certified environmental protection management system must provide complete documentation of their existing environmental protection management system with supplemental information clarifying why areas do not meet ISO 14001 standards. Meeting national or local environmental protection management standards alone shall not be considered an acceptable substitute because ISO standards exceed national and local environmental protection management standards.

K. Details of the control and instrumentation system including wiring diagrams. A Professional Engineer shall note any required changes to the project electrical drawings.

L. Information on equipment field erection requirements including total weight of assembled components and weight of each sub-assembly.

M. List of recommended spare parts and current cost of each spare part.

N. A maintenance schedule showing the required maintenance, frequency of maintenance, lubricants and other items required at each regular preventative maintenance period, including all ancillary equipment provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. ROTAMAT® RoK 4 Vertical Screen 500 by HUBER Technology, Inc.

B. Or pre-approved alternate (see 1.05 above)

2.02 DESIGN AND PERFORMANCE DATA:

A.	Number of units:	One (1)
B.	Nominal Screen Basket Diameter	500mm (20")
C.	Average Wastewater Flow per screen	0.25 MGD
D.	Max. Flow per screen	1.59 MGD
E.	Auger Tube Diameter	10.75 inch
F.	Wet screenings capacity	15.9 foot^3/hr
G.	Inflow Connection Flange Diameter	8 inch
H.	Perforation Diameter	1/4" (6 mm)
I.	Discharge Height from center of Inflow Connection	as shown on drawings
J.	Min. Screening Surface Area above Inlet Invert	13.8 ft^2

K. The fine screen shall be designed to withstand maximum forces exerted during operation. All structural and functional members shall be sized to prevent deflection or vibration which could impair operation.

L. The minimum screening surface area above the invert inlet to the screen basket shall be as specified in section 2.02.J. of the performance requirements.

M. The average perforation flow through velocity shall not exceed 3.3 ft/sec (1.0 m/sec) under any flow condition up to the maximum clean water flow specified above. The screen design shall minimize solids deposits in the channel.

N. The screen shall be capable of processing spherical objects with a diameter of 3-1/8". Such objects shall be conveyed through the auger and shall be discharged with the screenings. The unit shall be capable of processing the screenings load specified above.

O. The fine screen shall have a cylindrical screen basket made of perforated plate, and an integral screw conveyor and screenings press. The screw in the basket shall be provided with a brush on its flight for screen cleaning. The screen shall use a single drive for screening, conveying, dewatering and compressing the screened material. The axis of the fine screen shall be vertical.

P. Operation of the screen drive shall be automatically initiated at a preset high upstream liquid level. Screens which operate continuously or via timer only will not be acceptable. The screw shall remove solids from the screenings basket. The screenings shall be moved up by the screw conveyor and through a compaction zone and shall be discharged into bags

Q. All perforations of the screen basket shall be cleaned with a brush on the screw flights.

R. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-486.

S. To minimize odors and nuisance, the conveyance, dewatering and compaction zones shall be completely enclosed.

T. The control system shall be designed such that the cleaning characteristics of the screen system can be changed via the programmable controller. Systems which do not offer this feature will not be acceptable for this project.

2.03 MATERIALS

A. Unless otherwise specified in these specifications, the entire equipment shall be manufactured from AISI 304L austenitic stainless-steel shapes (rods, angles, and channels), pipes, and sheets. All mechanical parts shall be designed to handle the forces that may be exerted on the unit during fabrication, shipping, erection, and proper operation according to the O&M manual.

B. The entire equipment shall be manufactured in a stainless steel only factory to prevent contamination of the stainless steel with foreign contaminants.

C. The equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be classified with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection.

2.04 VERTICAL CYLINDRICAL SCREEN

A. SCREEN

1. The vertical fine screen shall be designed and built to withstand all static and hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized for the loads encountered during screening, conveying and pressing operations.

2. The screen shall have a circular body, a 32" tall circular screen basket with square inlet box and emergency overflow, and a bottom plate. Designs where the flow enters directly into the side of basket without the use of an inlet box are explicitly not acceptable.

3. The circular screen basket shall be attached to the circular screen body via a 0.16" flange with six (6) bolts and nuts, permitting easy removal of the screen basket.

4. The bottom of the screen body shall be welded to an inflow box. The upper end of the inflow box shall be open and serve as an emergency by-pass overflow. The inflow box shall be provided with a flanged inflow connection. The invert of the inflow connection into the inflow box shall have a height of 14" above the screen's bottom plate to prevent flow backing into the inlet pipe and causing increased machine run-time. Screens with a pipe inlet which do not incorporate an inflow box with overflow will not be acceptable.

5. Manufacturer shall provide a height-adjustable support leg supporting the bottom plate of the screen from the floor or from a support beam that is to be provided and installed by contractor according to the drawings. The screen shall also be supported laterally by sets of dual supports running the length of the machine at intervals as indicated in the manufacturer's drawings.

B. SCREENINGS CONVEYOR AND SCREENINGS COMPACTOR

1. The screen shall be cleaned with a stainless-steel screw with helicoid-shaped flights designed for vertical transport of screenings. The flights of the screw in the basket shall be provided with a ¼ inch thick hardened stainless-steel strip having the same width as the flights of the screw. The strip shall be welded to the face of the flight, on both sides, over the full length of the screen basket. The flights of the screw shall be machined to match the screen basket such that the face of the strip is parallel to the screen basket's inner surface.

2. A stainless steel backed nylon brush shall be attached to the screw flight over the entire length of the screen basket. The brush shall be attached by means of holding clips and fasteners made of stainless steel.

3. The screenings screw conveyor shall be 10.75" with a minimum wall thickness of 0.1". Four (4) anti-rotation bars shall be welded to the inside of the transport tube along its longitudinal axis. The screenings screw conveyor shall not be in contact with the anti-rotation bars during normal operation. Designs which do not incorporate a minimum of four (4) anti-rotation bars are not acceptable.

4. A flange shall be welded to the conical transition piece to support the screen basket. A gear box support flange shall be welded to the upper end of the auger tube for support of the drive assembly.

5. A shafted stainless steel screw with helical flight shall be installed in the auger tube for conveying and compaction of the screened material. The auger shaft shall have a diameter of 3.4" with a shaft wall thickness of 0.2". Designs utilizing shaft-less screws and/or carbon steel screws in the auger shall not be acceptable.

6. The discharge section of the auger shall be provided with a reverse flight with cutting blade welded on for added strength to actively cut through the screenings plug and positively discharge material without blockage.

7. The upper end of the screw conveyor shaft shall be fitted with a solid stub having a diameter of 2.4". The stub and the screw conveyor shaft shall be accurately machined and shrink-fitted with each other.

8. After all flanges are welded to the auger tube, the faces of the flanges shall be machined on a lathe such that they are exactly perpendicular to the tube axis.

9. A compaction zone shall be provided as an integral part of the screw conveyor and tube. The compaction zone shall be designed to form a plug of screenings material and to return water released from the screened material through 13/64" (5 mm) diameter perforations that are machined into the screenings transport tube in a square configuration.

10. The compaction zone shall be provided with split glass fiber reinforced housing, furnished with gaskets and bolts, and easily removable for access. Designs requiring removal of the drive assembly, discharge head, or screw conveyor to gain access to the compaction zone will not be acceptable. The housing shall be provided with a drain connection at its lowest point and a clamped flexible PVC hose for drain water. The plastic housing shall also be provided with a 1" flush connection for connection to a 31gpm plant water supply rated at 60psi.

11. The screen compaction zone flush connection shall be provided with a wash nozzle designed to flush the entire interior surface of compaction zone housing to ensure no debris buildup can occur. The compaction zone flushing system shall include a single solenoid valve for flow control.

12. The solenoid valve shall be minimum 1 inch diameter, brass body, 2 way, and designed for 120 VAC with an explosion proof rating. Solenoid valves shall be normally closed and rated for up to 100 psig.

13. The solenoid valves shall be operated by the programmable logical controller. Individual manual operation of each solenoid shall also be possible from the control panel.

14. The upper end of the auger tube shall be provided with a discharge chute for the screenings. The chute shall be 10.75" in width to match the width of the screen rising tube, have a 40-degree slope, and be provided with a bagging adaptor suitable for mounting 230ft endless screenings bags. The chute shall be provided with a removable cover to allow operator access in the event of blockage in the discharge zone.

15. The auger tube shall be provided with lifting lugs for connection of lifting gear, permitting installation and removal of the entire screen.

C. GEAR MOTOR DRIVE

1. The screw shall be driven by a shaft mounted geared motor with an output speed of approximately 9rpm. The geared motor shall have a minimum service factor of 1.0 equivalent to an AGMA Class I rating.

2. The gear reducer shall be bolted to a machined flange welded to the upper end of the auger tube.

3. The gear reducer shall be driven by a 3-phase, 60 Hertz, 230/460 volt, Class I, Division 1, continuous-duty motor with leads to a conduit box for outdoor operation. The motor power shall be a minimum of 2.0HP

D. BAGGER

1. A Paxxo Longofill continuous bagging system shall be provided to abate odors and to seal dewatered screenings to prevent any direct contact. The discharge bagging system shall provide a clean, odor-free means of collecting and containing the material discharged from the screenings equipment.

2. The bagging system components shall be attached to the screenings discharge. An accordion-folded plastic Paxxo Longopac cassette bag shall be fitted to the end of the bagging system and will collect any discharged material. The end of the cassette bag will be tied in a knot. When the operator decides that the cassette bag is full, the cassette bag shall be cut and the exposed ends tied in knots.

3. A Longofill stainless steel adapter flange and a Paxxo Longofill ABS plastic cassette bag holder shall be utilized to mount for the screenings discharge. The adapter flange shall be fitted to the discharge chute such that it is positioned as close to horizontal as possible. The plastic holder shall be attached to the stainless steel adapter and shall hold the continuous cassette bag.

4. The adapter flange shall be stainless steel. The holder shall be of ABS plastic and shall consist of two parts, a tube and brim, which shall be held together by a stainless steel ring. The cassette bag shall be 230 ft (70m) long, non-porous, three-ply, co-extruded polyethylene with a min thickness of 1.8 mils and a dart drop of not less than 1.80 lbs (820 g).

E. ANCHOR BOLTS

1. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be stainless steel. Anchor bolts shall be wedge or epoxy type.

2. The contractor shall set anchor bolts. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

F. OUTDOOR WEATHER PROTECTION

1. The screenings transport tube shall be furnished with thermal insulation made of mineral wool, with a heat tracing system for outdoor weather protection which shall enclose the screenings transport tube, compaction and dewatering zone and all spray wash piping, ball valves and solenoid valves.

2. The outdoor weather protection system shall include self-regulating heat tracing, adjustable thermostat, insulation and a stainless steel protective jacket.

3. The heat tracing system shall be suitable for operation in a Class 1 Division 2 hazardous environment, at a minimum temperature of -13 deg F (-25 deg C), and shall be powered from the main control panel.

4. Where the wash water supply and electrical wiring conduit penetrate the stainless steel cover bulkhead adapters shall be provided.

5. All components requiring service or maintenance shall be easily accessible.

G. CONTROL SYSTEM

1. All controls necessary for the fully automatic operation of the screen shall be provided, including a NEMA 4X main control panel, and a NEMA 7 local control station.

2. The electrical control system shall provide for automatic control of the screen via PLC control and a high liquid level using an inlet box mounted pressure sensor in combination with an adjustable timer.

3. Main control panel shall be suitable for outdoor, wall mounting. Enclosure shall be NEMA 4X Stainless Steel with continuous hinge and lockable door latch, and shall include the following:
   a) Door-interlocked and fused disconnect
   b) 600 VAC terminal block
   c) NEMA reversing motor starter and Circuit Breaker Branch Circuit Protection for screen motor
   d) Control power transformer with 120 VAC transient voltage surge compressor (TVSC) and fused primary and secondary
   e) Panel heater with Thermostat
   f) Programmable logic controller (PLC), Allen Bradley Micrologix 1400
   g) Operator Interface (OIU), Allen Bradley PanelView 800
   h) Hand-Off-Auto selector switches for the following
      i. Screen drive
      ii. Screen forward-off-reverse
   i) Pilot lights for:
      i. Control power on (white)
      ii. Screen running (green)
      iii. Screen high level (amber)
      iv. Screen fault (red)
   j) Screen reset push button (black)

k) Door mounted elapsed time meters for the following:
   i. Screen drive
l) Digital inputs for the following:
   i. High water level
   ii. One spare input
m) Remote dry contact outputs for the following:
   i. Screen running
   ii. One spare output
n) Plastic Nameplates

4. A local operator station shall be provided, and shall be suitable for wall-mounting. Enclosure shall be NEMA 7 cast Aluminum, and shall include the following:

   a. E-stop pushbutton (red)

PART 3 - SPARE PARTS

3.01 SPARE PARTS

A. The following Spare Parts shall be included and supplied by Manufacturer:

   1. Two (2) cleaning brushes

   2. Five (5) boxes with 230 feet endless bags

B. One set of all special tools, if required, shall be included and supplied by the Manufacturer.

PART 4 - EXECUTION

4.01 INSTALLATION, START-UP AND OPERATOR TRAINING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify engineer of significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations.

C. After installation, touch-up paint shall be applied to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting. Contractor shall passivate all field welds.

D. Supplier shall furnish the services of a factory-trained service technician one (1) trip including a total of two (2) workday to inspect the installation, observe start up, and provide operator training.

1. Equipment shall not be energized, or “bumped” to check the electrical connection for motor rotation without the service technician present.

2. The service technician shall make all necessary adjustments and settings to the controls.

3. The service technician shall demonstrate proper and sequential operation of the screening system. The screen shall be able to operate fully automatically.

4.02 WARRANTY

A. The manufacturer will warrant against any defects in material or workmanship to the screen and framework. This warranty will commence upon delivery of the products and will expire on the earlier to occur of one (1) year from initial operation of the product or 18 months from delivery thereof (the “Warranty Period”).

END OF SECTION 462133