SECTION 5
SPECIFICATIONS

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION OF THE PROJECT

A. The project is located within the Village of Hiram, Ohio. The Constance Avenue Pump Station is scheduled to be rehabilitated and located across from 6969 Constance Avenue, Hiram Ohio.

1.2 PROJECT DESCRIPTION

A. The Base Bid consists of the improvements to the Constance Avenue Pump Station. Improvements include the replacement of the existing submersible pumps with new chopper pumps, modify piping within the existing wet well to accommodate new pumps, upgrade electrical components, replace existing valves, installation of a new bypass vault, and installation of a new grinder vault.

B. The project also has an Alternate for a Standby Generator. The bidder must bid the Base Bid and Alternate.

1.3 SPECIFICATIONS

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

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

1.4 DRAWING SCHEDULE

A. The work to be done under this Contract is shown within the Drawings – Sheets 1 – 11.

END OF SECTION 011100

SECTION 011419 – USE OF SITE

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor will be allowed the use of as much of the 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 shall maintain access to all residential homes and business through the duration of the work.

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 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.

1.6 SITE FACILITIES

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

1.7 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 012513 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 MATERIALS AND EQUIPMENT

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

B. Each major item of equipment shall be inspected by a manufacturer's representative during installation and upon completion of the work. The Contractor shall supply the Engineer with a certificate of such inspection.

END OF SECTION 012513

SECTION 013119 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION MEETING

A. Prior to the Contractor beginning any work on the project, the Owner will schedule and hold a preconstruction meeting to discuss all aspects of the contract work.

B. The Contractor shall be present and be prepared to comment in detail on all aspects of his work.

C. The Contractor shall bring to the preconstruction meeting a proposed construction progress schedule, erosion control plan, quality control program, concrete mix designs, asphalt mix designs (JMF), etc. Approval of each by the Engineer is required prior to the start of any work.

D. Included in the construction progress schedule shall be an implementation sequence of the proposed erosion control efforts required by the contract.

1.2 PROGRESS MEETINGS

A. Monthly progress meetings will be held at a location to be determined by the Owner on a regularly scheduled day mutually convenient to the Owner, Contractor, and Engineer.

B. The Contractor shall provide an updated construction progress schedule and be prepared to comment in detail on all aspects of his work.

END OF SECTION 013119

SECTION 013216 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 PROGRESS SCHEDULE

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

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

END OF SECTION 013216

SECTION 013223 – SURVEY AND LAYOUT DATA

PART 1 - GENERAL

1.1 STAKING

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

1.2 LAYOUT OF WORK

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

END OF SECTION 013223

SECTION 013236 – VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

A. Provide all labor, materials, equipment, and services, and perform all operations necessary to furnish to the Owner a complete color audio-video record on a USB Flash Drive of the surface features within the proposed construction zone of influence. This record shall include, but not be limited to, all audio-video USB Flash Drives, 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 color audio-video 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 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 USB Flash Drive.

END OF SECTION 013236

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 are 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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_____

_____

_____

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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: _____

_____

_____

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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.

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

1.3 ARCHAEOLOGICAL DISCOVERIES

Contractors and subcontractors are required under Ohio Revised Code (O.R.C.) Section 149.53, to notify Ohio’s State Historic Preservation Office (SHPO), and to cooperate with that office in archaeological and historic surveys and mitigation efforts if such discoveries are uncovered within the project area.

Contact: Ohio's State Historic Preservation Office
Diana Welling, Resource Protection & Review Department Manager
Phone: 1-614-298-2000
Email: dwelling@ohiohistory.org

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 Owner 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 Owner so orders, and shall not be re-employed unless express permission be given by the Owner. 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 015100 - TEMPORARY POWER SERVICE

PART 1 - GENERAL

1.1 ELECTRICAL POWER

A. The Contractor shall furnish at his own expense all electrical power which may be required for the project. All temporary lines shall be furnished and installed by the Contractor at his own expense in a manner which meets the approval of the Engineer and shall be removed by the Contractor at the completion of the construction.

END OF SECTION 015100

SECTION 015136 - TEMPORARY WATER AND DISTRIBUTION

PART 1 - GENERAL

1.1 WATER

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

END OF SECTION 015136

SECTION 015713 - TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

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

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

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

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

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

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

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

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

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

1.2 SUBMITTALS

A. Product Data

1. Filter fabric

B. Shop Drawings

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

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 SEQUENCING AND SCHEDULING

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

1.6 MAINTENANCE

A. Maintenance Service

1. Contractor shall maintain all erosion control devices through the duration of the work.
2. Contractor is responsible for preventing sediment transoport offsite.

PART 2 - PRODUCTS

2.1 SEED

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

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

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

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

* After November 1, use mulch only

2.2 ORGANIC MULCH

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

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

2.3 FERTILIZER

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

2.4 LIMESTONE

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

2.5 WATER

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

2.6 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.

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 016617 - MAINTENANCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section provides general requirements for the maintenance of equipment in the field. Storage maintenance requirements are provided by Section 016600, Product Handling and Protection. Specific maintenance requirements are provided by manufacturers per individual Sections in the Project Manual.

B. Maintenance is performed to ensure delivery to the Owner of equipment in an undeteriorated and fully serviceable condition.

C. This Section also includes requirements for preventive and corrective maintenance during operation of the equipment prior to the commencement of the Warranty period.

1.2 RELATED SECTIONS

A. Section 016600, Product Handling and Protection.

1.3 DEFINITIONS

A. Storage maintenance consists of establishing and maintaining the environment required by the stored materials and performing periodic servicing.

B. Preventive maintenance consists of activities performed on a periodic basis to maintain operating or operational items or equipment.

C. Corrective maintenance consists of correcting faults or failures in an item or equipment. This may include adjustments or replacement of defective parts.

1.4 SUBMITTALS

A. The Maintenance Log shall be submitted to the Owner upon completion of the Operational Demonstration and before the start of the Warranty period.

B. No submittals are required by this Section, except as noted above. Maintenance schedules and practices shall conform to approved submittals required by individual Sections in the Project Manual.

PART 2 – PRODUCTS

2.1 COMPONENTS, ACCESSORIES AND REPAIR PARTS

A. All components, accessories and repair parts used in maintenance shall be supplied by or approved by the equipment manufacturer for use on the equipment.

2.2 SOURCE QUALITY CONTROL

A. All parts and materials used in maintenance shall meet the quality control requirements provided for the item or equipment. These are specified in individual Sections of the Project Manual.

PART 3 – EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

A. The Contractor shall prepare a Maintenance Log for all equipment.

1. This log shall include a list of required maintenance services and inspections, as provided by the manufacturer, and submitted under individual Sections of the Project Manual.

2. The Maintenance Log shall include checklists for the periodic services and inspections required.

3. The Contractor shall initial and date the requisite log entries upon completion of the individual servicing or inspection.

4. The Maintenance Log shall be located in the Contractor's Field Office and shall be available for review by the Owner until it is submitted for record purposes upon completion of the Operational Demonstration and the start of the Warranty period.

3.2 PREPARATION

A. Before removing an item from storage per Section 016600, the Contractor shall review the installed location. Protection and services at the installed location must meet the equipment storage requirements.

B. Before moving equipment to the installed location, the Contractor shall have available materials for temporary shelter or services required to establish the proper storage environment after the equipment is installed until it is placed in service in its final operating environment.

3.3 PERFORMANCE OF MAINTENANCE

A. The Contractor shall perform all storage and preventive maintenance and inspections required by the manufacturer at the specified intervals.

B. When notified by the Owner, the Contractor will perform corrective maintenance. This will be performed at no cost to the Owner. Corrective maintenance will be performed per manufacturer's written instructions or by direction of the approved representative of the manufacturer.

C. The Contractor shall restore equipment to its operating condition before start-up.

D. The Contractor shall re-establish storage maintenance in the event an item or equipment is removed from service.

E. When the equipment warranty becomes effective, the Owner will assume responsibility for its maintenance.

END OF SECTION 016617

SECTION 017517 - STARTING OF SYSTEMS/COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes general requirements for the commissioning of the Work and start-up and operation of systems and equipment.

1.2 SUMMARY

A. Starting, testing, and operating the completed Work including systems and equipment until Substantial Completion is achieved and operation of the completed Work including systems or equipment are accepted by the Owner. Contractor shall cooperate and coordinate with the Owner in the operation, maintenance, and adjustment of the Work.

1.3 RELATED SECTIONS

A. Section 013323, Shop Drawings, Product Data and Samples

B. Section 016617, Maintenance

C. Section 017901, Operational Demonstration

D. Section 017902, Instruction of Owner’s Personnel

1.4 DEFINITIONS

A. Commissioning: Commissioning is the series of activities, or process, necessary to ensure that systems and equipment are designed, installed, functionally tested, started up and capable of being operated and maintained to perform in conformity with the design intent for the facility improvements. Commissioning includes, but is not limited to factory testing, field testing, dry testing, wet testing, performance testing, manufacturer's checkout, start-up, and Operational Demonstration.

B. Factory Testing: Factory Testing is performance testing, operation testing, or documentation verification conducted in the production facilities, or specialized test facilities, of the equipment supplier. Such testing shall conform to the requirements of the individual sections of the Contract Documents.
"Witnessed" Factory Testing shall mean that the testing is witnessed by the Owner or his designated representative.

C. Field Testing: Field Testing is performance testing, operation testing, or documentation verification conducted in the field after installation, to provide comparison with the results obtained in the Factory Testing.

D. Dry Testing: Dry Testing is performed by the Contractor without introducing either process material or other test material into the component, system, or unit process.

E. Wet Testing: Wet Testing is testing performed by the Contractor utilizing test material in the component, system, or unit process. Tankage shall be filled with test material to operating level.

F. Performance Testing: Performance Testing is performed by the Contractor to demonstrate system performance in accordance with the Project Manual requirements.

G. Manufacturer's Check-Out: Field inspection, testing, adjustments, and sign off by the approved representative of the Manufacturer, indicating that the component, system, or unit process meets the manufacturer's requirements.

H. Start-Up: Narrowly defined as placing a component, system, or unit process on-line. Start-up can be a commissioning activity or a normal operating activity.

I. Operational Demonstration: A commissioning activity performed by the Contractor wherein the Contractor operates and maintains a fully functional component, system, or unit process for a period of time after stable operation has been achieved.

1.5 SUBMITTALS

A. Quality Control Submittals:

1. Field Installation Reports – Submit reports by Manufacturer's Representative in accordance with Paragraph 3.4 of this Section.

B. Commissioning Documentation: Contractor shall prepare and submit all documentation for review and approval. The documentation shall include, but not be limited to, the following:

1. Certification by the preparer that he/she is the person responsible for the data, and that the data is authentic and accurate.
2. Certification by the Contractor or equipment or unit process systems supplier that the equipment or the unit process systems were operated continuously for the specified period and that the equipment or unit process systems operated in compliance with the specified operating conditions, parameters, and performance: and that the equipment or unit process systems are suitable for Performance Testing.

3. Pertinent background information shall include, but not be limited to, the following:

    a. Equipment or unit process systems Started-Up and Commissioned
    b. Start-Up and Commissioning dates
    c. Items or performance criteria tested clearly showing requirements and field data that verify requirements were met.
    d. Names of witnesses for Start-Up and Commissioning.
    e. Any repairs, corrections, or modifications required for the equipment or unit process systems to successfully complete Start-Up and Commissioning.
    f. Loop diagrams accurately depicting the installed condition of instrumentation and controls.
    g. Any other important background information.

4. Appendix

    a. A summary of all data used in the calculation, including source, formulas with all terms defined.
    b. Calculations for all data submitted, fully defined.
    c. Copies of all raw field data sheets, including those indicating sampling point locations, and notes.
    d. Production and/or operational data.
    e. Calibration procedures and worksheets for sampling equipment.
    f. Copies of calibration records for instrumentation.
    g. PLC Ladder logic documented with comments.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

A. The Contractor shall inspect systems and equipment prior to each start-up and verify their readiness for start-up. Conditions hazardous to equipment or personnel shall be corrected by the Contractor prior to start-up of equipment.

1. Start-up operations shall not proceed using temporary power or temporary instrumentation and control wiring. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.
2. Use of repair parts during start-up operations shall not be permitted, except in such situations where the actual on-site verification of such repair parts' operability is specified.

3. The Contractor shall verify that all initial copies of the Maintenance and Operating Instructions have received an acceptable disposition as defined in Section 013323, and the only outstanding item is the field verification of the Instructions.

B. On successful completion of Start-up, process flows and solids shall be used for commissioning the equipment and unit process systems to show the equipment and unit process systems function properly. Commissioning shall confirm the proper operation of the equipment and unit process systems with process fluids and process solids, adjustment shall be made, and the equipment or unit process systems shall be optimized and brought into compliance with design criteria in preparation for Operational Demonstration.

C. The Contractor shall coordinate all Start-up and Commissioning activities for equipment and unit processes. The Contractor shall develop a detailed start-up and commissioning plan that includes the following as a minimum:

1. Description of the overall general start-up and commissioning process.
2. List of equipment and unit process systems included for start-up and commissioning activities.
3. Detailed start-up and commissioning sequence of activities.
4. Listing of staff and responsibilities for activities.
5. Contractor shall use a form that will be provided by the Owner.

3.2 PREPARATION

A. Prior to start-up of equipment or systems, all necessary test equipment shall be in place and operable.

B. Approved representative(s) of the Manufacturer and Contractor shall be present for the initial start-up of systems or equipment.

C. The Contractor shall request permission to start-up equipment, including electrical gear, and notify the Owner using a standard Start-Up Request form.

1. The Start-Up Request shall be submitted to the Owner a minimum of 72 hours before the scheduled start-up. Requests shall be made during normal working hours.
2. The Contractor shall provide all information in the first Section of the Start-Up Request form.
3. The Owner will indicate approval or disapproval of the request.
4. Approval of the request is based solely on impact on plant operations. Approval does not relieve the Contractor of any responsibility for plant and personnel safety.
5. The Contractor shall obtain the approved Start-Up Request prior to the system or equipment start-up.

6. If training is to be conducted in conjunction with the start-up this should be indicated on the Start-Up Request form. All requirements of Section 017902, Instruction of Owner's Personnel must be met for training sessions.
7. Start-ups performed at the direction of the Contractor, per paragraph 3.3(G) of this Section, do not require advance notification to the Engineer.

D. Normal installation checks, such as for rotation, are not considered start-ups and do not normally require start-up notification. For all equipment and systems so designated in the Contract Documents, or so designated by the Engineer, such checks shall be under the supervision of the approved representative of the manufacturer and shall be reviewed by the Engineer.

1. All electrical apparatus which is energized shall be clearly marked.

3.3 CONDUCT OF START-UP AND COMMISSIONING

A. Start-up:

1. All initial start-ups of equipment or systems shall be performed under the technical direction of the approved representative of the manufacturer.
2. Any lack of readiness of associated systems or failure of a system or equipment previously started prior to the date of Final Completion of the Project shall require additional initial start-up service to be performed, under the direction of the approved representative of the manufacturer.
3. The Contractor shall repair, replace, or modify any equipment or system which fails to perform as specified in the Contract Documents. Such repair, replacement or modification of deficient work shall be performed under the terms of the General Conditions.
4. During the Operational Demonstration period per Section 017902, Operational Demonstration and at other times when the system is on-line and an integral part of the sanitary collection system operations and process, start-ups shall be performed as required by the Contractor.

B. The Contractor shall be responsible for commissioning all work. Final acceptance shall be by the Owner.

C. The Contractor is responsible for the performance and operation of the systems and equipment during commissioning.

D. When Owner personnel are operating systems or equipment, the Contractor shall make available, at all times, persons knowledgeable about the systems or equipment to direct the Owner personnel in its operation.

E. The Contractor shall make all adjustments and corrections necessary to achieve normal, stable operation of systems. Adjustment and corrections shall be in accordance with Section 016617, Maintenance.

F. Any failures of equipment or systems operated under the direction of the Contractor shall be considered deficiencies and shall be corrected in accordance with the General Conditions.

G. During the Operational Demonstration period as defined in Section 017901, Operational Demonstration and at other times, the work will be on-line and an integral part of the sanitary collection system operations and process. The Owner maintains control of sanitary collection system operations and processes at all times. Therefore:

1. The Contractor shall immediately, on a 24-hour per day, 7-day per week basis, adjust or repair any malfunction in the work which in the opinion of the Owner jeopardizes or may jeopardize the proper operation of the sanitary collection system.
2. The contractor is responsible for maintaining a flow bypass around the Constance Avenue Pump Station for the duration of the work. Any backups within the sanitary collection system are the responsibility of the Contractor.

3.4 QUALITY CONTROL

A. Reports of the Approved Representative of the Manufacturer:

1. The approved representative of the manufacturer shall prepare a daily report on each site visit for each system or item of equipment inspected, adjusted, started-up, or worked on.
2. The report shall state the purpose of the visit, the representative's observations and conclusions, and recommendations for further visits or action.
3. The reports shall be submitted in accordance with Section 013323, Shop Drawings, Product Data and Samples within three (3) days of the visit.

END OF SECTION 017517

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.

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.

END OF SECTION 017839

SECTION 017901 – OPERATIONAL DEMONSTRATION

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION

A. Work Included:

A demonstration of the operation of all systems is required. This Operational Demonstration shall be conducted, coordinated, and recorded by the Contractor in accordance with the requirements specified herein.

1.2 SUMMARY

A. Section Includes:

1. Requirements for the conduct and reporting of the Operational Demonstration. This work is additional to any other installation, shop and factory testing, field testing, dry testing, wet testing, performance testing, balancing, or adjustments required elsewhere in the Contract Documents.

1.3 RELATED SECTIONS

A. Section 017517, Starting of Systems / Commissioning

1.4 DEFINITIONS

A. Operational Demonstration is defined in Section 017517, Starting of Systems/Commissioning.

B. Operational Demonstration Log: A chronological record of the status of the system and equipment during the Operational Demonstration. All changes in status or system parameters, adjustments, and results of tests shall be included. Entries shall be made, noting the date and time, at the occurrence of each event. Operational Demonstration Logs shall be on a form acceptable to the Owner.

1.5 SUBMITTALS

A. Quality Control Submittals:

1. Test Reports:

a. Operational Demonstration log per subparagraph 3.4.A of this Section.
b. Report of Operational Demonstration per subparagraph 3.4.B.2 of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

A. Before beginning the Operational Demonstration, the Contractor shall verify that:

1. All required construction activities are completed, including any activities by any entity that would interrupt the normal operations of the system. Coordinate with the Owner to resolve such conflicts.
2. Adequate parts and supplies for routine maintenance and replacement are on hand to support system operation through the demonstration period.
3. Start-up of equipment and systems per Section 017517, Starting of Systems/Commissioning has been completed.
4. All Repair Parts and Maintenance Materials have been delivered to the Owner.
5. Certain Instruction of Operating Personnel (training) has been scheduled to take place during the Operational Demonstration where specified. All other training will occur within 45 days prior to initiation of Operational Demonstration. The training of Operations Personnel shall be scheduled to take place during the first half of the demonstration period, and the remaining training of Electrical, Instrumentation and Maintenance Personnel shall be scheduled to be complete before the end of the Operational Demonstration.
6. The field verification of the Initial Maintenance and Operating Inspections has been completed in accordance with the Specifications.

3.2 PREPARATION

A. The Contractor shall provide two (2) representatives, a prime and an alternate, who will be responsible for the Operational Demonstration. These representatives will:

1. Demonstrate the operation of systems and equipment to the Owner's operating personnel.
2. Direct maintenance and repair work, by either the Contractor or the approved representative of the manufacturer of the system components and equipment.
3. Maintain a log of the Operational Demonstration, as described herein.
4. Be available at all times during the Operational Demonstration to perform these duties.

B. Submit start-up notification to the Owner per Section 017517, Starting of Systems/Commissioning.

3.3 OPERATIONAL DEMONSTRATION

A. The Contractor shall perform an Operational Demonstration of the work. Unless otherwise specified, the Operational Demonstration shall be a continuous 30-day, (720 hours) period during which the work is operated and maintained in a continuously on-line, fully functional process status.

B. The Operational Demonstration shall encompass the entire work, or the portion thereof designated for Substantial Completion.

C. Filling, draining, heating, or cooling to temperature, stabilizing, adjusting, or other start-up activity time shall not be counted as Operational Demonstration time.

D. During the Operational Demonstration period, the Contractor shall provide 24-hour per day, 7 days per week supervision. The Contractor shall provide staff to make corrections to the system as required during the Operation Demonstration.

E. When systems are on-line, conform to the requirements of Section 017517, Starting of Systems/Commissioning, Paragraph 3.3(G) for alterations in the sanitary collection system processes.

F. During the first half of the Operational Demonstration of the system and equipment, Owner personnel will observe the Contractor's personnel operating systems and equipment. The Contractor shall cooperate with this familiarization process.

G. After the first 15 days of Operational Demonstration of system and equipment, operation of equipment will be assumed by the Owner personnel, under the direction of the Contractor, as described in Section 017517, Starting of Systems/Commissioning.

The Owner remains in control of the plant processes per Section 017517, Starting of Systems/Commissioning. The Contractor shall provide technical direction in the operation of equipment and systems.

H. Start-up and operation of the system and all associated equipment shall be in accordance with the Initial Maintenance and Operating Instructions which have received an acceptable disposition from the Owner. If deviations from these instructions are necessary, these shall be noted in the Operational Demonstration Log, and subsequently submitted as revisions to the Maintenance and Operating Instructions. During the period of time between the completion of the Operational Demonstration and the Date of substantial Completion, the system and equipment will be operated and maintained under the requirements of the second half of the Operational Demonstration. The Owner will not assume full responsibility for maintenance of the system and equipment until all conditions for Substantial Completion have been satisfied and both the Contractor and Owner and accepted the Certificate of Substantial Completion.

I. All required maintenance and servicing prior to the Date of Substantial Completion shall be performed by the Contractor at the specified interval and as necessary. All maintenance and servicing shall be noted in the Operational Demonstration Log.

J. All outages of equipment, system(s) should be noted in the Operational Demonstration Log. The Contractor is responsible for the safe and orderly shutdown and restart of equipment as necessary in the event of an outage. Outage time is not to be included in the Operational Demonstration period.

K. The Contractor shall attend operational coordination meetings as called by the Owner to review operating conditions of equipment and systems.

L. If, during the Operational Demonstration, any part of the work fails to fully conform to the requirements of the Contract Documents, the Operational Demonstration shall be considered to have failed, and the work shall not be considered to be Substantially Complete as defined in the General Conditions and the Owner shall so notify the Contractor in writing. If, during the Operation Demonstration, the provisions of the General Conditions are evoked to stop the work, the Operational Demonstration will also be considered to have failed.

M. Upon failure of the Operational Demonstration, the Contractor shall promptly remedy any defects in the work and shall promptly reschedule and re-start the complete 30 day, (720 hours) Operational Demonstration time period. No Operational Demonstration time will be considered to have accrued to any part of the work by reason of a failed Operational Demonstration.

N. During the Operational Demonstration, the Owner may require or permit the Operational Demonstration to be suspended:

1. As provided in the General Conditions.
2. Upon the written request of the Contractor to correct or adjust the work when in the judgment of the Owner such required correction or adjustment is insufficient to deem the Operational Demonstration to have failed.
3. If the Operational Demonstration is suspended for any reason except failure, Operational Demonstration time shall accrue to the work from the time of the beginning of the Operational Demonstration to the time of the suspension.

3.4 REPORTING

A. Daily: Copy of the Operational demonstration Logs shall be submitted to the Owner by 9:00 a.m. the following day.

B. Within two (2) weeks of the termination or completion of the Operational Demonstration, the Contractor shall submit for approval:

1. Any changes to the Maintenance and Operating Instructions.
2. A report of the Operational Demonstration, describing the equipment utilized and any repairs, modifications, adjustments, or other work performed during the demonstration period.

C. In the event the conduct of the Operational Demonstration or the submittals are unacceptable to the Owner, the Contractor shall perform the additional work or demonstrations required per the General Conditions.

END OF SECTION 017901

SECTION 017902 - INSTRUCTION OF OWNER'S PERSONNEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. General requirements for the conduct of training of permanent plant operating personnel on the care, maintenance, and proper operation of the equipment. Specific requirements for training materials and for training are included in the individual Sections of the Contract Documents.

1.2 SUMMARY

A. Work Included:

Except as otherwise specifically provided in individual Sections of the Project Manual, work under this Section includes the preparation of the detailed lesson plans and the conduct of detailed training for permanent plant operating personnel. Training shall be conducted on all components of equipment, as specified in individual Sections of the Project Manual.

B. Training sessions and hours for all equipment specified as requiring training shall be per the manufacturer’s recommendations. However, in no case shall the number of sessions be less than two (2) to accommodate multiple shifts. Sessions shall cover maintenance, operations and electrical.

1.3 RELATED SECTIONS

A. Section 013323, Shop Drawings, Product Data and Samples

B. Section 017901, Operational Demonstration

1.4 DEFINITIONS

A. Lesson Plan:

A Lesson Plan is a submittal containing a statement of the instructional objectives of the training, a training outline, credentials of the instructor, audio/visual requirements, a listing of training materials to be used, and the desired schedule times and dates.

B. Training Aid:

A mock-up, model, sample, or other device used during a training class to help demonstrate the maintenance, operation, or control of equipment.

1.5 SUBMITTALS

A. Submittal of Instructor's credentials, Lesson Plans, instructional materials, training aids, and other training information shall be coordinated with the Training Schedule.

B. Enough copies of instructional materials used for training for everyone present shall be provided at the time of the first training session.

C. Provide two copies of all audio/visual aids utilized during training including films, slides, mock-ups, videotapes, DVDs, or other training aids. All multimedia video shall be submitted in either Audio Video Interleave (AVI) format or Moving Pictures Expert Group (MPEG) format.

D. Submit the following:

1. Proposed training Schedule for the entire Contract showing tentative dates for each training session: include number, type, and duration of each session. This schedule shall be submitted 120 days prior to the commencement of any individual training being performed.
2. The detailed credentials of the representative of the equipment manufacturer who is to be the course Instructor for each category and type of training. Include Instructor's name, education, knowledge of equipment, experience as a trainer and employment history with the manufacturer. Include specific details of Instructor's experience pertaining to the operation and maintenance of, the training for, the equipment or system specified. These credentials shall be submitted 60 days prior to the commencement of any training.
3. The Lesson Plan shall be submitted sixty (60) days prior to the commencement of any training and shall cover all components of equipment, regardless of source of supply or manufacturer, and shall include:

    a. A title page containing: Title of the Lesson Plan, product name and model of equipment; name of manufacturer, manufacturer address and phone number; name and phone number of manufacturer's contact; job location (Name of Facility); contract no.; specification number; Contractor name, address and phone number; subcontractor name, address, phone (if applicable); submittal number assigned by Contractor; and submittal date.
    b. A table of contents listing the headings: instructional objectives; training outline; credentials of Instructor(s); audio/visual requirements; training materials to be used.
    c. A detailed instructional objective statement on the goal(s) intended to have been achieved by the end of the training session.

d. The credentials of Instructors are to include name; education; knowledge of equipment; experience of trainer; and employment history with manufacturer.
e. The audio/visual requirements listing specific equipment that is to be provided by the Contractor for training purposes.
f. A list of all training materials to be used. An initial Operations and Maintenance (O&M) Instruction Manual, which has received an acceptable disposition, for the equipment shall be required to be utilized by the Instructor in the training and therefore shall be included on this list.
g. A request of schedule dates and times for each training session.
h. A training outline indicating the category of training (maintenance and operation, electrical and instrumentation or system); description of the session; length, and type (classroom or field). The training shall include as a minimum:

    1) Electrical and Instrumentation Training: System Equipment) Overview:

        a) Describe system (equipment) fundamental operating principals and dynamics.
        b) Identify system's (equipment's) mechanical, electrical and electronic components, and features. Review system (equipment) wiring diagrams and process and instrumentation diagrams.
        c) Identify support systems (equipment) associated with the operation (e.g., air intake filters, valve actuators, motors).
        d) Identify and describe safety precautions and potential hazards related to maintenance.
        e) Identify and describe in detail safety and control interlocks.
        f) Identify and describe alarm conditions and response to alarms.
        g) Cover the supply of power to process equipment and related appurtenances, lighting, etc.
        h) Cover low voltage controls, monitoring devices, etc.

    2) Electrical and Instrumentation Training Equipment Preventive Maintenance (PM):

        a) Describe PM inspection procedures required to perform an inspection of the equipment in operation, spot potential trouble symptoms and anticipate breakdowns and forecast maintenance requirements (predictive maintenance).
        b) Define the recommended PM intervals for each component.
        c) Provide lubricant and replacement part recommendations and limitations.
        d) Describe appropriate cleaning practices and recommend intervals.

e) Identify and describe the use of special tools required for maintenance of the equipment.
f) Describe component removal and installation, and disassembly and assembly procedures.
g) Perform at least 2 "field" demonstrations of preventive maintenance procedures.
h) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
i) Define recommended torque settings, mounting, calibration and alignment procedures and settings, as appropriate.
j) Describe recommended procedures to check or test equipment following a corrective repair.

3) Electrical and Instrumentation Training Equipment Troubleshooting:

a) Define recommended systematic troubleshooting procedures.
b) Provide component specific troubleshooting checklists.
c) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

4) Maintenance and Operation Training: System (Equipment) Overview:

a) Describe system (equipment) operating (process) function and performance objectives.
b) Describe system (equipment) fundamental operating principals and dynamics.
c) Identify system's (equipment's) mechanical, electrical and electronic components, and features.
d) Identify support systems (equipment) associated with the operation (e.g., air intake filters, valve actuators, motors).
e) Identify and describe safety precautions and potential hazards related to operation.
f) For systems (equipment) comprised of several components: Identify and describe in detail each component's function. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.
g) Identify and describe in detail safety and control interlocks.

5) Operation and Maintenance Training, Operation of Equipment:

a) Describe operating principles and practices.
b) Describe routine operating, start-up, and shutdown procedures.
c) Describe abnormal or emergency start- up, operating, and shutdown procedures that may apply.
d) Describe alarm conditions and responses to alarms.

e) Describe routine monitoring and record keeping procedures.
f) Describe recommended housekeeping procedures.

6) Operation and Maintenance Training, Troubleshooting:

a) Describe how to determine if either corrective maintenance or an operating parameter adjustment is required.

4. Once the Lesson Plan submittal has received an acceptable disposition but at least 3 weeks prior to the actual commencement of the training, Contractor shall submit the detailed training material as a Power Point presentation in an electronic format (either DVD, CDR, or flash drive/micro storage) with appropriate labeling. In addition to the electronic format the Power Point material shall be provided in hardcopy for Owner review and approval. The number of copies shall be as defined in Section 013323, Shop Drawings, Product Data and Samples. The text and lettering on the presentation slides shall not be smaller than 12 font size and shall be black in color. Slides shall have an appropriate light-colored background, resulting in a high contrast between the text and background.

5. Sample Evaluation Form: Submit with Lesson Plan a sample Evaluation Form. Form shall include area for comments and evaluation of Instructor, classroom training and field instruction. Form shall identify Contract name and number, Specification Section, Job location, date and time of training, title of training session, name of manufacturer, model number of equipment, Instructor name, and Contractor and Subcontractor's name.

PART 2 – PRODUCTS

2.1 QUALIFICATIONS OF INSTRUCTOR

A. The course Instructor shall be knowledgeable and experienced in the details of operation and maintenance of the equipment.

B. The Instructor must be knowledgeable of the equipment's application specific to this work.

C. The Owner will reject Instructors who are deemed not in compliance with the above stated minimum qualifications. The Contractor will submit for approval alternate Instructors for consideration. No additional cost will be allowed for replacement of Instructors who are unacceptable to the Owner.

PART 3 – EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

A. The training site for the classroom instruction will be provided by the Owner. The Owner will provide this location.

B. The Contractor shall coordinate and verify to ensure that, prior to the scheduled training time(s):

1. The equipment is ready for Operational Demonstration in accordance with Section 017901, Operational Demonstration.
2. That all associated construction required to operate the equipment in all normal and anticipated operating modes is complete.
3. That the equipment area is well lit and unobstructed, so that all training class attendees may access, hear, and view the training.
4. That the equipment area is free of construction activities that could present a hazard to training class participants.
5. That adequate training materials, as required by paragraph 1.5 of this Section, are on hand for use during the training session.
6. Any representatives of interfacing Contractors or equipment suppliers needed to perform supporting operations allowing demonstration of equipment operation have been notified and will be available.

3.2 PREPARATION

A. Training classes shall be approved by the state-regulating agency for continuing education. This is in the event of the facility choosing to apply for CH/CEU credits for their training program.

B. Videotaping of all training will be conducted by the Contractor. Before the start of training the Contractor, and the Contractor will review the training site(s) to establish acceptable sight lines, lighting, and locations for the participants.

C. Training classes shall be scheduled through the Owner. Training shall begin within 45 days to the beginning of the Operational Demonstration period. Certain training sessions will occur only during the Operational Demonstration period as specifically noted in the Contract Documents.

D. Training classes shall be conducted and separated for the following personnel:

1. Maintenance and Operation
2. Electrical and Instrumentation
3. Systems Training

E. Audio-visual equipment available at the Owner's training sites include:

1. Blackboards and/ or Whiteboards

F. Verify training materials are compatible with all equipment. The Contractor is responsible for providing other audio/visual equipment and training aids as needed.

G. Classroom and field instruction where specified shall be provided for each group. Field instruction will include attention to applied familiarization with the actual equipment. Training hours as required in the Contract Documents do not include travel, set-up or cleanup time by the Instructor.

H. Training may be either "field" or "classroom" as specified. If not specifically noted, provide field training. For field training, the Instructor will demonstrate all operations of the equipment and may be expected to show assembly and disassembly procedures, maintenance procedures, replacement procedures, and the like. Field training will generally occur at the installed location of the equipment or material unless mock-ups are approved in the Lesson Plan and provided by the Contractor. Such mock-ups will become property of the Owner after the training sessions unless previously requested in the Lesson Plan.

I. Systems Training:

The Lesson will provide a detailed description of the system design, intended operation, and interactions of systems components. The Contractor’s portion of Systems Training will provide additional detail descriptions of system's components and their interface with each other and other systems. Contractor's personnel for system training will be the same personnel who provided Operation and Maintenance training and Electrical and Instrumentation training.

J. Training shall be conducted to accommodate the Owner’s shift schedules. Contractor shall coordinate with Owner prior to scheduling the training sessions. Contractor shall anticipate multiple shifts.

3.3 CONDUCT OF TRAINING

A. All topics of the approved Lesson Plan shall be discussed, in the classroom or the field, in complete and sufficient detail to allow plant operating personnel to knowledgeably operate and maintain the equipment in accordance with manufacturer's recommended procedures and safety considerations during all anticipated operational and maintenance situations.

B. Safety concerns and features intended to enhance safety should be specifically addressed.

C. Tasks required to maintain the warranty should be specifically addressed.

D. Frequent reference shall be made to the Operation and Maintenance instructions.

E. Address all questions and comments proposed by the training session participants as they are raised to the maximum extent practicable. If questions or comments cannot be addressed during the training session, additional materials and/or training may be required as determined by the Contractor.

F. If any training session exceeds three (3) hours in duration, provide a 1/2- hour break.

G. Ensure that all parts of the training session are legible or audible on the final tape. The Instructor must repeat all questions to insure that they are audible. Final acceptance of the training is contingent on the acceptability of the videotape.

H. The Contractor will be back charged for cancelled training classes if the Owner is not notified at least 72 hours prior to scheduled training.

I. Training Sessions shall be attended not only by the Owner's Operating Personnel but also by members of the Contractor or any other entities designated by the Owner.

3.4 EVALUATION

A. Immediately following training, the instructor shall pass out an evaluation form to the Owner’s personnel. This form shall provide a means for the Owner's personnel to comment on the instructor and the quality, completeness, and value of the session.

B. Evaluation Forms shall be collected, along with the Attendance Sheet at the end of each training session and the original documents shall be submitted to the Owner for use in determining if additional training is required by the Contractor. If additional training is required due to the material as outlined in the Lesson Plan not being covered correctly or in its entirety or the inability of the instructor to answer questions pertaining to the operation and maintenance of the equipment, or if the training aids or equipment fail to operate as intended, the Contractor shall provide such additional training at no additional cost to the Owner.

END OF SECTION 017902

SECTION 018000 - SYSTEM PERFORMANCES

PART 1 - GENERAL

1.1 GENERAL

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

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

1.2 FACILITIES

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

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

1. Valves
2. Pumping Equipment
3. Rotating Equipment
4. Telemetry
5. Electrical

1.3 CERTIFICATION

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

END OF SECTION 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 site of the existing structure; 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 of the facility to the satisfaction of the Engineer, including but not limited to the following:

1. All of the equipment and associated piping located in the pump station.
2. The Contractor shall disconnect and remove cable from the electrical panel to all equipment.
3. The contractor shall remove manholes to be removed in its entirety. Sewers shall be removed as required for the construction of the proposed Grinder Vault.

3.2 OWNERSHIP & DISPOSAL OF MATERIALS

A. All salvaged material shall become the property of the Contractor.

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 land fill 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 MANHOLES AND SIMILAR STRUCTURES

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

3.4 EQUIPMENT REMOVAL

A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall be the property of the Contractor and shall be removed from the site. The Contractor shall dispose of the equipment as required by local, state, and federal regulations.

3.5 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.

3.6 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 312323.14.

END OF SECTION 024119

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. Precast concrete is specified in other Division-3 sections.
3. 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 anytime 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.

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, snapoff 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.

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

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

1. 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. Waterproofing Admixture:

1. Antimicrobial Crystalline Waterproofing Admixture: Xypex Bio-San C500 admixture as manufactured by Xypex Chemical Corporation, Richmond, British Columbia, Canada, (www.Xypex.com). Dosage rate shall be 1.0% by weight of total cementitious material content in the concrete. No substitution of this admixture shall be acceptable.

   This admixture shall be incorporated in Class D concrete where indicated on the design drawings, in accordance with manufacturer's recommendations and requirements.

2. Crystalline Waterproofing Admixture: Xypex Admix C-500 Cementitious Crystalline Concrete Waterproofing admixture as manufactured by Xypex Chemical Corporation, Richmond, British Columbia, Canada, (www.Xypex.com). Dosage rate shall be 2.0% to 3.0% by weight of total cementitious material content in the concrete. No substitution of this admixture shall be acceptable.

   This admixture shall be incorporated in Class A concrete and Class B fill where indicated on the design drawings, in accordance with manufacturer's recommendations and requirements.

M. 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.

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

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

C. 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.

D. 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.

E. 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.

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

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

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

H. 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.

I. 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.

J. 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.

K. 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	4500	0.40	6	**	**	6±1

*Maximum Water - Cementitious Materials Ratio
** See Item 2.3(F)8 below

1. All reinforced concrete shall be Class A or D as specified herein, except as otherwise indicated or shown on the design drawings:

    a. Class A concrete shall be used for non-WWTP, non-sewerage applications and shall include a crystalline waterproofing admixture in accordance with Item 2.1(L)2 above.
    b. Class D concrete shall be used for all WWTP and sewerage applications including pump stations and shall include an antimicrobial crystalline waterproofing admixture in accordance with Item 2.1(L)1 above.

2. All reinforced concrete shall be Class A, except as otherwise specified or shown on the drawings.
3. Concrete used for mud mats, fill and channeling in manholes and chambers shall be Class B unless otherwise noted on the drawings.
4. 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.
5. Class B concrete may be used for encasing pipelines, fill, and pipe bedding.
6. Class B concrete shall be used as concrete fill in concrete tanks for shaping or sloping bottoms.

    a. Concrete fill mix shall contain Xypex Admix C-500 Cementitious Crystalline Concrete Waterproofing Admixture as manufactured by the Xypex Chemical Corporation (substitutions not permitted). Xypex admix shall be added to the concrete mix at the time of batching at a rate of 2% - 3% by weight of total cementitious content and be mixed in accordance with the manufacturers specification and requirements.
    b. 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.

7. 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 crystalline waterproofing admixture in Class A concrete and Class B fill per item 2.1(L)2 above.
3. Use antimicrobial crystalline waterproofing admixture in Class D concrete per item 2.1(L)1 above.
4. Include Fly Ash **or** GGBFS pozzolan admixture in Class D concrete comprised of Type II cement in accordance with the specification constraints of Items 2.1(B) & (C) above, unless noted otherwise.
5. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
6. 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.
7. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
8. 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.

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).

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.

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.

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 034000.08- 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.

B. Shop Drawings

1. Precast concrete manholes showing:

a. Orientation plan for vault 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 vault connection details.
f. Casting and step orientation.

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 ASTM C 150, Type I, II or I/II and ASTM C595M, Type IP.

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: Ductile iron, AWWA C110.

B. Access Door:

1. Furnish and install where indicated on plans vault access door, size as indicated on the drawings. The floor access door shall be double leaf and pre-assembled from the manufacturer.
2. Performance characteristics:

    a. Covers: Shall be reinforced to support AASHTO H-20-wheel load with a maximum deflection of 1/150th of the span. Manufacturer to provide structural calculations stamped by a registered professional engineer upon request.
    b. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
    c. Operation of the covers shall not be affected by temperature.
    d. Entire door, including all hardware components, shall be highly corrosion resistant.

3. Covers: Shall be 1/4” (6mm) aluminum diamond pattern.
4. Frame: Channel frame shall be extruded aluminum with bend down anchor tabs around the perimeter.
5. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.
6. Drain Coupling: Provide a 1-1/2” (38mm) drain coupling located in the right front corner of the channel frame [note: can be placed at a different location if specified].
7. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4” (6mm) gusset support plate.
8. A removable exterior turn/lift handle with a spring-loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.
9. Hardware:

    a. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 1/4” diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.
    b. Covers shall be equipped with a hold open arm which automatically lock each cover in the open position.

c. Covers shall be fitted with the required number and size of compression spring operators. Springs and spring tubs shall be Type 316 stainless steel.
d. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the covers.
e. Hardware: Shall be Type 316 stainless steel throughout.

10. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

C. MANHOLE STEPS

1. 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.
2. Manhole steps shall conform to the requirements of ASTM C-478.
3. Acceptable manufacturers are:

a. M. A. Industries, Inc.
b. American Step Company, Inc
c. Lane International, Inc.
d. Or Approved Equal.

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 MANUFACTURER

A. The precast concrete vaults shall be a product of Mack Vault, Valley City, Ohio; Norweco, Norwalk, Ohio; 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.

3.2 DROP CONNECTION

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

END OF SECTION 034000.08

SECTION 312323.14 – COMPACTED GRANULAR BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

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

PART 2 - PRODUCTS

2.1 MATERIAL

A. Aggregate shall be No 57 gravel. Slag products are unacceptable.

B. Contractor shall submit current test reports for the lot(s) of the material to be supplied.

PART 3 - EXECUTION

3.1 PLACING AND COMPACTING

A. Compacted granular backfill shall be properly placed in layers sufficient to meet the compaction requirement of 100% of maximum laboratory dry density per ASTM D 698 throughout the entire layer and thoroughly compacted with mechanical compaction equipment with moisture adjustment as needed. Should after settlement occur, the Contractor must add and compact additional material, and he must maintain the backfill at the required finished grade or sub-grade until the project is satisfactorily completed and during the correction period.

B. Approved mechanical compaction equipment shall be used for tamping backfill. Flooding, jetting or puddling of backfill will not be permitted.

END OF SECTION 312323.14

SECTION 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.

1.3 QUALITY ASSURANCE

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

B. The Contractor shall have a soils test done at there expense and analyzed by a state approved testing agency. Soil tests shall be done on both the topsoil stockpiled from the site and new topsoil brought to the site. A minimum of two (2) tests shall be done. The tests shall include percent organic matter, pH, Buffer pH, Phosphorus, Exchangeable Potassium, Calcium, Magnesium, Cation Exchange Capacity and Percent Base Saturation with recommendations for nitrogen, phosphate, potash, magnesium, and lime based on plant type and use.

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 ½" in any dimension and any other extraneous or toxic matter harmful to plant growth.

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

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

2.2 SEED

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

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

2.3 MULCH

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

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

PART 3 - EXECUTION

3.1 PREPARATION - GENERAL

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

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

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

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

1. Prior to preparation of unchanged areas, remove existing grass, vegetation, and turf.

Dispose of such material outside of project limits. Do not turn existing vegetation over into soil being prepared for seed.

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

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

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

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

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

3.2 SEEDING

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

B. 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.

C. 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.

3.3 DORMANT SEEDING METHOD

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

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

3.4 RECONDITIONING EXISTING LAWNS

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

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

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

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

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

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

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

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

3.5 ESTABLISHMENT

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

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

1. Mowing
    a. Mow lawn areas during the period of maintenance to a height of 2 inches whenever the height of the grass becomes 3 inches. A minimum of 3 mowings is required during the period of maintenance.

2. Refertilizing
    a. Distribute fertilizer on the seeded area between August 15 and October 15, during the period when grass is dry, and in accordance with the manufacturer's recommendations. The fertilizer shall be as specified in the soils test.

3. Reseeding
    a. Reseed with the seed specified for the original seeding, at the rate of 4 lbs. per 1,000 S.F. in a manner which will cause minimum disturbance to the existing stand of grass and at an angle of not less than 15 degrees from the direction of rows of prior seeding.

4. Watering
    a. The Contractor shall keep all work areas watered daily to achieve satisfactory growth. Water shall be applied at a rate of 120 gallons per 1,000 square feet. If water is listed as a pay item, it shall be separately paid for based on the actual amount of water used, measured in thousands of gallons.

5. Any mulching which has been displaced shall be repaired immediately. Any seed work which has been disturbed or damaged from the displacement of mulch shall be repaired prior to remulching.

3.6 INSPECTION AND ACCEPTANCE

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

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

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

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

END OF SECTION 329219

SECTION 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, manhole reconstruction, and pump station rehabilitation or when flows must be interrupted to make connections to the new facilities as directed by the Engineer.

END OF SECTION 330130

SECTION 330519 - DUCTILE IRON PIPE

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 ductile iron 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 ductile iron pipe shall conform to AWWA C151 with the ends being designed for one of the type joints as specified herein.

B. To assure that the iron is suitable for satisfactory drilling and cutting, the chemical constituents shall meet the physical property recommendations of ASTM A 536.

C. The minimum wall thickness of the pipe barrel shall be that indicated in ANSI A21.50 (AWWA C150), CLASS 53 shall be the minimum thickness class for ductile iron pipe furnished under this specification unless otherwise shown on the drawings.

2.2 COATING AND LINING

A. The outside surface of all ductile iron pipe shall be shop coated with either a coal tar or asphalt base bituminous material. If this coating material is found to be damaged prior to the pipe trench being backfilled, the Contractor shall provide and apply additional material of that required to repair the damages. The Contractor shall have sufficient coating material available at the job site prior to laying the pipe.

B. The interior of the pipe shall be lined with cement mortar and seal coated in complete conformance with ANSI A21.4 (AWWA C104).

2.3 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: one-eighth (1/8) inch thick 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.

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 330519

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 SUBMITTALS

A. Product Data

1. PVC pipe, each type specified

B. Quality Control Submittals

1. Design Data
2. Test Reports
3. Certificates

a. Evidence of current membership in specified manufacturer's associations.

4. Manufacturers Instructions

C. Contract Closeout Submittals

1. Project Record Documents
2. Operation and Maintenance

1.3 REFERENCES

A. ASTM C-150 Standard Specification for Portland Cement

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

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

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

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

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

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

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

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

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

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

L. ANSI/AWWA C111/A21.11 American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

M. 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

N. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution

1.4 QUALITY ASSURANCE

A. Qualifications

B Regulatory Requirements

C. Certifications

1.5 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.

1.6 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.

C. Storage and Protection

1.10 SEQUENCING AND SCHEDULING

A. The Contractor shall establish a bypass of the existing manhole and pump station prior to the start of any work.

PART 2 - PRODUCTS

2.1 PIPE

A. Polyvinyl Chloride Pipe (PVC) 4" - 15" Diameter

1. 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 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.

2.2 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.

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.

C. 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.

D. 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.

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

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

G. 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.

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 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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 409123.39 - LEVEL SENSORS AND TRANSMITTERS

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 work of this section.

1.2 DESCRIPTION OF WORK

A. This section includes furnishing and installing level type sensors and transmitters. This Section also includes the furnishing of necessary start-up services and training of plant operating personnel in operation and maintenance of the equipment.

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.

1.3 QUALITY ASSURANCE

A. All work performed under this section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

1.4 STANDARDIZATION

A. All equipment shall be of the latest and most modern design. All sensor/transmitter assemblies, of the same type, shall be of the same manufacture and general model type.

1.5 SUBMITTALS

A. The level sensor and the level transmitter shall have an identifying tag (white plastic with black letters engraved on it) mounted on each piece of equipment with the following information:

1. Manufacturer's name
2. Part number
3. Serial number
4. Tag number
5. Calibrated range

PART 2 - PRODUCTS

2.1 RESPONSIBILITY AND COORDINATION

A. Under this Contract, the Contractor shall be responsible for the purchase, storage and installation of all level sensors, transmitters, and local indicators. Each device shall be completely wired, tested and be suitable for operation. Conduit and signal wiring for each device shall be installed between each converter and terminals at the designated area panel or as shown on the drawings. The drawings and specifications are intended to illustrate and define the equipment installation; however, the Contractor shall be responsible for all the details which may be necessary to 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 level sensors and the level transmitters, and level switches provided under this Contract shall conform to the following specifications unless otherwise noted on the instrument schedule.

2.2 HYDROSTATIC PRESSURE TYPE LEVEL DETECTOR

A. Operating Principle

1. Provide a level sensing device which shall operate on the Principle of Hydrostatic Pressure.

B. The level detector shall consist of a transducer mounted in a wetwell, a signal conditioner and transmitter assembly, mounted as specified and interconnecting cable. The transducer and cable shall be suitable for submergence in raw wastewater. The transducer shall be vented to the atmosphere through the transducer cable. The sensor cable shall be terminated in a NEMA 4X stainless steel outdoor weatherproof junction box to facilitate sensor change out. The contractor shall supply all special cables from the junction box to the transmitter unit.

C. The 316 stainless steel sensor housing shall be filled with silicone to protect the element. The transducer shall be attached to a stainless-steel chain or cable with all necessary mounting hardware to be provided. The bottom of the transducer shall be mounted 2 inches from the top of the wet well.

D. The transmitter shall be of solid-state construction and shall be enclosed in NEMA 4 enclosure; with a local indicator, calibrated in feet of water. The meter shall be visible through a transparent glass or plastic window. The enclosure shall be suitable for wall mounting.

E. The transmitter shall output an isolated 4-20 mA signal, in direct proportional to the level, into a load impedance of at least 650 ohms. The transmitter shall have an accuracy of +0.5% of full scale, or better. Repeatability shall be + 0.25%.

F. The power supply to the transmitter shall be from 120 VAC, 60 Hz, single phase power source. Conduit connections shall be 1/2 inch. Provide terminal strip for field wiring.

G. Include all equipment needed to provide signal hook-up compatibility.

H. Manufactures;

1. Ametek,
2. Endress & Hauser
3. Or approved equal.

2.3 FLOATS, SWITCHES

A. The level detecting devices shall be at least 5 1/2 diameter or better, PVC or Polypropylene float with a mercury switch inside and flexibly supported by a PVC jacketed heavy duty cable.

B. The float switch shall have a 20 amp. rating at 120 Vac. The float switch shall close on rising level. Provide one SPDT relay per float switch, with 20 amp. rating at 120 VAC. mounted in junction box, or as specified in Special Provisions.

C. A weatherproof cast aluminum junction box with terminal strips shall be provided for power, float switch and relay connections.

D. The floats shall be mounted on one (l) inch PVC pipe using 316 stainless steel clamps. The PVC pipe shall be clamped to the wall using 316 stainless steel clamps. The length of the pipe and float cable shall be sized by the contractor.

E. Manufactured;

1. Anchor Scientific Company
2. Consolidated Electric Company
3. Or approved equal.

PART 3 - EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The level sensor and transmitter manufacturer shall provide the services of a qualified service engineer to supervise and inspect the equipment installation to insure that it is installed in accordance with the manufacturer's recommendations.

B. The manufacturer's service engineer shall field calibrate all equipment specified under this section. This service shall be performed at the time of complete start-up. A calibration certificate shall be submitted to the Project Engineer for each piece of equipment. The service engineer shall also make all adjustments necessary to place the equipment in trouble-free operation. In addition, the equipment manufacturer shall provide a qualified manufacturer's service engineer to train the plant operating personnel in the proper care, repair, calibration, and operation of the equipment.

3.2 INSTALLATION

A. The probe installation shall be isolated from vibration and possible physical damage. It shall not be mounted in the direct stream of process fluid. If required, use a deflecting baffle in front of the probe in the direction of flow. The probe shall be easily removable for cleaning or maintenance.

B. The probe shall be wired using a manufacturer's recommended flexible cable to a junction box close to the probe to facilitate withdrawal of the probe for maintenance. The wiring from the junction box to the transmitter shall be done using manufacturer's recommended wires and rigid conduit.

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 the General Requirements.

END OF SECTION 409123.39

SECTION 432139 - SUBMERSIBLE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work covered by this Section shall include the furnishing all labor, materials, transportation, tools, supplies, equipment, and appurtenances, unless hereinafter specifically excepted, necessary for the complete and satisfactory installation of submersible chopper pumps.

B. It is the intent of this Section that the final installation be complete in all respects. The Contractor(s) shall be responsible for minor or specific details, coordination with trades, equipment manufacturing, installation and start-up services, and any special construction not specifically included in the Drawings or Specifications.

C. The work shall include but is not limited to the installation of dual submersible chopper pumps with new rails, lifting chain, electrical controls, and level controls.

1.2 REFERENCES

A. ASTM A-48 Standard Specification for Gray Iron Castings

B. IEEE Std 112 Standard Test Procedure for Polyphase Induction Motors and Generators

C. NEC Article 500 Hazardous (Classified) Locations

D. NEMA MG-1 Motors and Generators

E. SSPC SP-1 Solvent Cleaning

F. SSPC SP-10 Near-White Blast Cleaning

1.3 DEFINITIONS

A. B-10 (or L-10) Bearing Life: The statistical probability that ten (10) percent of the population of similarly rated bearings will fail within the specified hours in a perfect environment.

B. BEP: Best Efficiency Point.

C. Nitrile: Buna-N

D. NPSH – Net Positive Suction Head: The absolute pressure plus velocity head, determined at the suction nozzle and corrected to datum, less vapor pressure, all expressed in feet of liquid.

1.4 SUBMITTALS

A. Product Data: Submit a one-page summary listing the following information.

1. Manufacturer: pump and motor
2. Pump: weight
3. Casing: material
4. Motor jacket: material
5. Casing bolts and nuts: material
6. Impeller: material, design, coating
7. Wear ring: number, location, material
8. Shaft: material, diameter, length
9. Mechanical Seals: type, upper and lower seal material, spring material, O-ring material, other material of construction
10. Motor: type, NEC Article 500 rating, insulation class, service factor, continuous duty ambient temperature, starts per hour
11. Thermal switches: number, temperature setting
12. Float switch: type, material
13. Coatings: primer type, finish type, number of coats, total dry film thickness, suitability for media being pumped
14. Guide system: type, size, material
15. Pressure gauges
16. Minimum submergence and NPSH required at all design points
17. Spare parts: number and type
18. Motor controls including enclosure, circuit protection, disconnects, starters, transformers, phase monitor, switches, relays and contacts, lights, meters, timers, alternators, strip heater, alarms, and fuses.

B. Shop Drawings

1. Dimensions of pump, discharge, and guide system.
2. Plan view of pump indicating clearances required for hatch openings.
3. Pump layout, spacing requirements.
4. Motor control ladder diagram.

C. Quality Control Submittals

1. Design Data

a. Pump performance curves showing head, capacity, speed, efficiency, NPSH required, and brake horsepower required.
b. The pump manufacturer shall submit a copy of the pump's L^3/D^4 calculation.
c. The pump manufacturer shall submit a copy of the B-10 bearing life calculation for the bearings to be furnished with the pump. The calculation shall list the bearing manufacturer, model number, and bearing type.

2. Installation Report

a. The equipment manufacturer shall also submit a written report stating the equipment:

1. Is properly installed.
2. Is in accurate alignment.
3. Is properly lubricated.
4. Has been tested and operated satisfactorily.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

1. The pumping units shall be shipped to the site F.O.B. in a manner designed to protect the pumping units against damage or damaging stress caused by sudden acceleration and deceleration.

B. Storage and Protection

1. The Contractor shall be responsible for provisions to protect the equipment and associated materials prior to and after installation until final acceptance by the Owner. The Contractor shall remove all protective measures at completion and acceptance.
2. Equipment shall be lubricated for storage as recommended by the equipment manufacturer.

1.6 PROJECT CONDITIONS

A. Existing Conditions

1. The pumps and appurtenances are to be installed in the existing wet well.
2. The arrangement shown on the Drawings is based upon the best information available to the Engineer at the time of design and is not intended to show exact dimensions for any particular equipment shown on the Drawings. It is anticipated that connecting piping and valves shown may have to be modified in order to accommodate the pumps and appurtenances.

B. Field Measurements

1. The Contractor shall be responsible for obtaining all field measurements required to provide a complete and satisfactory installation.

1.7 MAINTENANCE

A. Spare Parts

1. For each pump, supply one set of motor bearings, mechanical seals, and complete set of O-rings and gaskets.
2. For each pump, supply one set of wear rings, cutter, and one spare impeller.

PART 2 – PRODUCTS

2.1 GENERAL

A. Furnish and install submersible non-clog chopper-type pumps.

B. The same manufacturer shall produce all submersible pumps for this project.

C. Submersible pumps shall comply with the requirements for NEC Article 500, Class I, Division 1, groups C and D, hazardous location, explosion proof.

2.2 MANUFACTURER

A. Vaughan Co., Inc.

B. Or Approved Equal

2.3 PUMP CASING

A. The pump casing shall be close-grained gray cast iron ASTM A-48, Class 35B free from blowholes, sand holes, or other faults. The casing interior shall be smooth and free of surface defects, which might cause undesirable turbulence. Filling of interior casting imperfections shall not be allowed.

B. The casing shall include a replaceable Rockwell C60 steel cutter to cut against the rotating impeller pump-out vanes for removing fiber and debris.

C. All exposed bolts and nuts shall be of type 304 stainless steel.

2.4 IMPELLER

A. Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of 0.015-0.025” cold. Impeller shall be cast steel heat treated to minimum Rockwell C60 and dynamically balanced. The impeller shall have no axial adjustments and no set screws. Pumps with open type impellers or impellers without modified pump out vanes to shear against the upper cutter shall not be acceptable.

2.5 CUTTER BAR

A. Shall be recessed into the pump casing and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.030” of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Cutter bar shall be cast steel heat-treated to minimum Rockwell C60. Chopper pumps utilizing individually mounted shear bars shall not be acceptable.

2.6 CUTTER NUT

A. The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast steel heat treated to minimum Rockwell C60. Due to the solids handling demand in this application, impeller securing devices that lack the ability to cut debris from the pump suction shall not be acceptable.

2.7 UPPER CUTTER

A. Shall be threaded into the casing or back-plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. The upper cutter shall have no more than two anvils that are positioned as closely as possible to the center of shaft rotation to minimize cutting torque, the potential for binding, and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less. Upper cutter shall be cast steel heat treated to minimum Rockwell C60.

2.8 SHAFT

A. Shafting shall be heat treated steel, with a minimum diameter of 1.5 inches in order to minimize deflection during solids chopping. Mounting of the pump impeller directly to the motor shaft shall not be allowed on this project as this results in an unacceptable overhang distance from the impeller to the lowest mechanical seal.

2.9 BEARING HOUSING

A. Shall be cast ductile iron and machined with piloted bearing fits for concentricity of all components. Piloted motor mount shall securely align motor on top of bearing housing. A pump mechanical seal shall also be provided to isolate the pump bearings and the lower motor seal from the pumped media. Pumps that expose the lower motor seal to the pumpage shall be considered unacceptable.

2.10 BEARINGS

A. Shaft thrust in both directions shall be taken up by two angular contact ball bearings, or a single tapered roller bearing, with a minimum L-10 rated life of 100,000 hours. Overhang from the centerline of the lower thrust bearing to the seal faces shall be a maximum of 1.7". The bearings and pump seal shall be oil bath lubricated in the bearing housing by ISO 46 hydraulic oil. Shaft overhang exceeding 1.7 inches from the center of the lowest thrust bearing to the seal faces shall be considered unacceptable.

2.11 MECHANICAL SEALS

A. The mechanical seal is to be manufactured and warranted by the pump manufacturer. Pump manufacturer is to have at least 15 years' experience producing the mechanical seal and a documented history of 10 years of installations in the same application as specified. The mechanical seal shall be located immediately behind the impeller hub to maximize the flushing available from the impeller pump-out vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide (or tungsten carbide) faces. This cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a ductile iron seal gland.

2.12 AUTOMATIC OIL LEVEL MONITOR

A. An oil level switch shall be mounted at the top of the wet well, with a hose feeding down to the side of the bearing housing to monitor oil level and shut off the motor in event of low oil level. A relay shall be included for mounting in the motor control panel.

2.13 SHAFT COUPLING

A. The submersible motor shall be close coupled directly to the pump shaft using a solid sleeve coupling, which is keyed to both the pump and motor shafts. Slip clutches and shear pins between the shaft and the motor are considered unacceptable.

2.14 STAINLESS STEEL NAMEPLATE

A. Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed, and all pertinent data.

2.15 MOTOR

A. The submersible motor shall be U/L or FM listed and suitable for Class I, Group C & D, Division I hazardous locations, rated at 20 HP, 1,750 RPM, 230 Volts, 60

Hertz and 3 phase, 1.15 service factor (1.0 for Continuous In-Air) with Class F insulation.

B. Motor shall have tandem mechanical seals in oil bath and dual moisture sensing probes.

C. Moisture probes must be connected to indicate water intrusion.

D. The lower motor seal shall be exposed only to the lubricant in the pump bearing housing, with no exposure to the pumped media.

E. Motor shall include two normally closed automatic resetting thermostats connected in series and embedded in adjoining phases.

F. The thermostats must be connected per local, state, and/or the National Electric Code to maintain hazardous location rating and to disable motor starter if overheating occurs.

G. Motor frame shall be cast iron, and all external hardware and shaft shall be stainless steel.

H. Motor shall be sized for non-overloading conditions.

2.16 SENSORS

A. Motor over temperature protection shall be provided by thermal switches embedded in the stator lead coils. The thermal switches shall monitor the temperature of each phase winding and shall be set to open at 125°C.

B. A mechanical float switch located within the stem shall provide mechanical seal failure protection. Should the mechanical seal fail, liquid shall be directed into the float chamber, in which the rising liquid activates the switch. The float switch components shall be stainless steel material.

C. The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

2.17 CABLE/CABLE ENTRY

A. The cable and cable entry seal system shall ensure a watertight seal for a submergence depth equal to the depth of the wet well plus five (5) feet. There shall be a minimum of two watertight and submersible seals in series between the environment and the motor interior.

B. Elastomer grommets, epoxy, and sealed terminal boards are acceptable components of a cable entry system.

C. The electrical power cable shall be extra hard usage type suitable for Class I, Division 1, groups C and D, hazardous location, explosion proof.

2.18 MOTOR CONTROLS

A. The Contractor shall furnish all labor, equipment, and materials to install pump control centers as shown on the Drawings in a stainless steel NEMA 4X enclosure, for operation on a 230 volt, 3 phase, 60 Hertz, 3 wire service. For each pump motor, there shall be included: a combination circuit breaker/overload unit providing overload protection, short circuit protection, manual reset and individual disconnect for all phases; across-the-line magnetic contactor; a 120-volt control circuit transformer with disconnect and overload protection. Each pump starter shall include a phase monitor relay to monitor phase voltage unbalance, incorrect phase sequence and line under-voltage of a three (3) phase system.

B. If a motor is disabled, e.g. overload, overtemp, or in “off” position. it shall shut down and lock out. If the faulted motor is lead, an induced alternation shall occur. If the faulted motor is lag, the next motor shall automatically substitute. Overload and disconnect functions shall be provided by a single magnetic-hydraulic, temperature-insensitive component.

C. Units shall be precalibrated to match motor and control characteristics and factory sealed to insure trip setting is tamper-proof; hand/off/automatic pump operation selector switch; provide all necessary auxiliary isolated contacts for alarms and computer interface; pump running pilot lights on operator control plate; running time meters mounted on operator control plate; a minimum 100 watt strip heater to provide condensation protection, lightning arrestor and high level alarm with weatherproof alarm light with guard. A delayed start feature shall be incorporated into the control panel preventing simultaneous starting of both pumps upon restoration of power following an outage.

D. Terminal strips shall be provided, prewired to the pump motor controls, for wet well level float control wiring.

E. The pump manufacturer shall provide the pump control center.

2.19 DISCHARGE COUPLING

A. Each pump shall be connected to the discharge line by means of a quick-disconnect sealed flange mounted on the pump and the outlet line. Fittings shall be such that sealing is accomplished by a metal-to-metal watertight contact without bolts, fasteners, or extreme force.

B. The base elbow shall be manufactured of the same materials as the pump casing. All cast materials shall have smooth surfaces, free from blowholes, sand holes, and other faults.

C. The discharge base elbow shall be anchored to the floor of the wet well with type 304 stainless steel anchor bolts. Anchor bolt type, style, and size shall be as recommended by the pump manufacturer for the type of foundation specified or shown on the drawings.

2.20 GUIDE SYSTEM

A. The pumps shall come complete with sliding brackets, adequately braced type 304L stainless steel schedule 40 pipe guide rail, stainless steel pull chain reaching ground level with lifting rings located every 5 feet of chain.

B. A minimum of two rails shall be provided.

2.21 PAINTING

A. All surfaces shall be cleaned of dirt, grease, oil, rust, scale, or other injurious substances. All ferrous metal surfaces shall be prepared in accordance with SSPC-SP-10. Non-ferrous metal surfaces shall be prepared in accordance with SSPC-SP-1.

B. All metal surfaces that will be partially or wholly submerged shall receive a factory (shop) applied finish paint system. The paint system shall be applied in accordance with the manufacturers recommendations, be applied in at least two coats and have a total dry film thickness not less than 10 mills. Paint systems shall be specifically suited and designed for use in the media being pumped.

C. Manufacturers: Sherwin Williams; Tnemec Company, Inc.; Carboline; or approved equivalent.

2.22 EQUIPMENT SCHEDULE

A. Pump*(s)*

Location:	Constance Avenue Pump Station
Number Installed:	2
Impeller Type:	Semi- open
Pumped Liquid:	Wastewater
Solid Size, at least:	3 inch sphere
Design Point #1:	120 GPM @ 120 ft. TDH
Min. Hyd. Efficiency @ Pt.:	39 %
Discharge Size:	3 inches
Motor Hp:	20 Hp
Maximum Motor Speed:	1,835 RPM
Power Requirements:	480 VAC, ____ Phase, 60 Hz.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Prior to installation, carefully inspect the fabricated and installed work of all other trades and verify that all such work is completed to the point that this installation may properly commence.

B. Inspect all parts of the furnished equipment and verify the system may be installed in strict accordance with all pertinent codes and regulations, original drawings, referenced standards, and the manufacturer's recommendations.

C. Install equipment in accordance with approved shop drawings and manufacturer's recommendations, and as shown on the Drawings and specified herein.

D. Notify the Engineer immediately of all unsatisfactory conditions or discrepancies. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

E. The Contractor shall be responsible for furnishing and placing all anchorage systems including bolts, nuts, washers, gaskets, and any other items necessary for the proper installation of the equipment. The Contractor shall coordinate with the manufacturer in identifying proper size and locations of all anchorage.

3.2 MANUFACTURER'S FIELD SERVICE

A. After installation of the equipment has been completed, a field service mechanic from the pump manufacturer shall inspect and approve the installation, be present at start-up, and instruct the Owner's personnel in the operation and maintenance of the equipment.

3.3 LUBRICATION

A. As part of the equipment start-up and testing procedures, the Contractor shall service and lubricate the equipment for continuous duty in accordance with the manufacturer's recommendations.

END OF SECTION 432139

SECTION 462433 - SEWAGE GRINDER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Open-channel Grinder, Installation Frame and Controller.

1.2 REFERENCE STANDARDS

A. Equipment shall, as applicable, meet the requirements of the following industry standards.

B. ASTM International (ASTM):

1. ASTM A36 - Carbon Steel Plate.
2. ASTM A536 - Ductile Iron Castings.
3. ASTM A48 - Gray Iron Castings.
4. ASTM A564 Grade 630 condition H1150 (17-4) stainless steel

C. American Iron and Steel Institute (AISI):

1. AISI Type 1020 Steel
2. AISI Type 1045 Steel.
3. AISI Type 4130 - Heat Treated Alloy Steel.
4. AISI Type 4140 Heat Treated Alloy Steel.
5. AISI Type 18-8 Stainless Steel
6. AISI Type 303 Stainless Steel.
7. AISI Type 304 and 304L Stainless Steel.
8. AISI Type 316 and 316L Stainless Steel.

D. Society of Automotive Engineers (SAE):

1. SAE Type 660 Bearing Bronze.

E. National Electrical Manufacturer’s Association (NEMA) Standards.

F. National Electrical Code (NEC).

G. Underwriters Laboratory (UL and cUL).

H. International Electrotechnical Commission (IEC).

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer is documented as being engaged in the sale of similar products for a minimum of forty (40) years.
2. Manufacturer is single supplier for equipment listed in this section.
3. Manufacturer’s Service Center is located domestically for repairs and upgrades.

4. Manufacturer stocks all non-custom spare Parts.

B. Regulatory Requirements:

1. Manufacturer is U.L. listed for the construction of controller.

1.4 SUBMITTALS

A. Product Data:

1. Product description text.
2. Performance curves or capacity tables.
3. Catalog data.

B. Shop Drawings

1. General arrangement of installation.
2. Product Configuration.
3. Assembly

C. Operation and Maintenance Manuals:

1. Submit one copy of a suitable operation and maintenance manual with shipment of product. An electronic version shall be supplied to create additional copies.
2. The manuals shall include but not be limited to the following: Equipment descriptions, operating instructions, drawings, troubleshooting techniques, recommended maintenance schedule, recommended lubricants, and recommended replacement parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging, Shipping, Handling, and Unloading

1. Packaged in containers or on skids suitable for normal shipping, handling, and storage.
2. Protected from rain, snow, impact, and abrasion while in the possession of the carrier.

B. Acceptance at Site

1. Contractor shall review the contents of the shipment at time of delivery and promptly notify the carrier and supplier of any discrepancies.

C. Storage and Protection

1. Equipment to remain in the packaging provided by the supplier until it is installed.
2. Equipment to be stored in a dry environment between 40 and 100 degrees F.

D. Waste Management and Disposal

1. Contractor shall be responsible for discarding all packaging materials in an environmentally friendly manner and in accordance with local regulations.

1.6 WARRANTY

A. 12-month Limited Warranty

1. Manufacturer submits a standard twelve-month limited warranty document clearly identifying the scope, term, and exclusions from the coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. JWC Environmental Inc,

2.2 OPEN-CHANNEL GRINDER

A. Reduces solids conveyed in a wastewater stream to a size that is non-detrimental to downstream equipment. Grinder uses side rail with flow channel and specially designed fingers with a shape to create a pressure gradient increasing flow capacity and maximize capture of solids. Grinder uses low speed and high torque drive with two counter-rotating shafts stacked with intermeshed individual cutters and spacers supported on both ends of each shaft with mechanical seal and bearing cartridges, driven by an electric motor and speed reducer.

B. Basis of Design:

1. Maximum Design Flow Capacity: 120 GPM
2. Cutter Stack Height: 8-inches
3. Cutter Stack Configuration: Single Zone-Helical

C. Cutter Assembly

1. Stack Configuration: Single Zone-Helical Stack

a. Cutters stacked helically with a uniform type, thickness, and material throughout assembly.
b. Material: Alloy Steel.

1) Cutters: Through hardened to 45-52 HRC
2) Spacers: Through hardened to 34-52 HRC.

2. Cutters-Helical Stack

a. 11-tooth Cam style, .310-inch thick, 4.710-inch diameter. Designed specifically for waste streams containing municipal waste and moderate volumes of solids.

b. Precision ground individual cutter elements with a thickness tolerance of +.000/ -.001. Keyed to shaft with hexagon opening.

3. Spacers

a. Smooth O.D. .319-inch thick.
b. Precision ground individual spacer elements with a thickness tolerance of +.001/ -*.000.*
c. Keyed to shaft with hexagon opening.

D. Mechanical Seal and Bearing Cartridges-Standard

1. Seals and bearing incorporated into a cartridge style design requiring no external seal flush or lubricants to operate wet or dry.
2. Rated for maximum operating depth: 208 feet (90 psi).
3. Dynamic and Static seal faces to be Tungsten carbide with 6% nickel binder.
4. Cartridge bushing and housing are AISI 304 stainless steel.
5. O-rings to be Buna-N (Nitrile).

E. Shafts

1. 2-inch hexagon heat treated AISI 4140 alloy steel.
2. Minimum tensile strength of 170,000 psi.
3. Supported on either end by Mechanical Seal and Bearing Cartridges.
4. Cantilevered designs are not acceptable.

F. End Housings, Side Rails, Top Cover, Bottom Cover, and Gaskets

1. End Housings

a. Cast integral bushing deflector directs solids away from Mechanical Seal and Bearing Cartridge bushings.
b. Directional flow arrows on side of housings indicate correct installation orientation for solids discharge.
c. Cast ASTM A536-84 65-45-12 ductile iron.

2. Side Rails

a. Evenly spaced horizontal fingers and flow channels. Flows channel create additional open area through grinder increasing flow capacity. Horizontal fingers direct solids toward cutters by creating a pressure differential towards the cutters.
b. Shape of flow fingers creates a pressure gradient to force solids to cutters and minimize water head loss.
c. Fingers and flow channel are positioned on the upstream side of the grinder terminating even with the center of the cutter proving free discharge.
d. Side rails with flow channel running the entire length of the side rail are not allowed.
e. Cast ASTM A536-84 65-45-12 ductile iron.

3. Top Cover:

    a. Manufacturing identification plate mounting.
    b. Cast ASTM A536-84 65-45-12 ductile iron.

4. Bottom Cover:

    a. ASTM A36 Steel.

5. Gaskets:

    a. Cork and neoprene rubber.

G. Transfer Gears with integral interlocking lobes

1. Heat treated and hardened AISI 4140 alloy steel.
2. Number of teeth on gears creates ratio of cutter tip speed on low-speed shaft to cutter tip speed of highspeed shaft greater than 0.90 and less than 1.00 to promote cleanout of processed material in cutting stack.

H. Couplings

1. Low Speed Coupling

    a. Two-piece 3-jaw interlocking design.
    b. Hardened AISI 4140 alloy steel

2. High Speed Coupling

    a. Type L 3-jaw with elastomer
    b. Buna-N spider.

I. Lifting Eyes

1. Drop forged Steel
2. Rated for 1300 lb
3. Designed for lift of grinder.

J. Speed Reducer

1. Grease lubricated cycloidal design Cyclo Series 6000 with 29:1 reduction ratio.
2. Manufacturer: Sumitomo Machinery Corporation of America.

K. Motor

1. XPFC Explosion Proof Motor: Baldor Electric Company.

    a. Installed Horsepower: 5 HP.
    b. Motor Service Factor: 1.00.
    c. Minimum Motor Efficiency (at Full Load): 89.5 percent.

d. Minimum Motor Power Factor (at Full Load): 78.

2. Performance:

a. Grinder Peak Torque with Reducer: 1,514 lb-ft.
b. Grinder Peak Force at Cutter Tip: 7,724 lbf.

L. Identification:

1. Corrosion resistant nameplate affixed to top cover of Grinder.
2. Nameplate Information: Manufacturer's name and address, Model No., Serial No., Capacity, Max. psi, Weight, Manuf. Date.

M. Finishes:

1. Paint Coatings for Ferrous Materials: Prepared to SSPC-SP6 (Commercial Blast Cleaning) and coated with minimum 6 to 8 mils TDFT (total dry film thickness) of an aliphatic acrylic polyurethane paint in the color Hunter Green.
2. Paint Coatings for Previously Coated Components (Motors, Speed Reducers, etc.): Prepared to SSPC-SP1 (Solvent Cleaning) and SSPC-SP2 (Hand Tool Cleaning) and coated with minimum 6-8 mils TDFT (total dry film thickness) of an aliphatic acrylic polyurethane paint in the color Hunter Green.

2.3 INSTALLATION FRAME

A. Installation Frame provides structure for mounting and positioning of the grinder in an open channel or wet well. Installation frame secures the grinder in position and provides structure and baffling to properly support and prevent unwanted bypass of material.

B. Frame

1. Mounts to channel walls supporting weight of grinder with suitable anchors supplied by contractor for installation.
2. Frame design uses pocket or guide plate to allow grinder to be lifted or lowered in and out of frame with no removal of fasteners.
3. Where possible frame uses adjustable side flanges to mount to channel walls adjusting to taper or irregularities in the wall.
4. Fabricated of AISI 304L stainless steel.
5. Finish: No special requirements

2.4 MOTOR CONTROLLER

A. DESIGN: NEMA enclosure with programmable logic controller (PLC), operation and fail indicators, and selector switches.

B. Basis of Design:

1. Motor Controller Power Supply: 460 V/ 3 PH/ 60 Hz.

C. Enclosure, Selector Switches, Pushbuttons and Pilot Lights

1. Enclosure NEMA 4X

a. Stainless steel with hinged door and mounting flanges.
b. Selector Switches: 22 mm, three-position, rated equal or better than the enclosure and indicate On-Off/Reset-Remote.
c. Pilot Lights: 22 mm, LED (pilot lamp), rated equal or better than the enclosure and indicate POWER ON, grinder RUN, grinder JAMMED and MOTOR FAULT.

D. Programmable Logic Controller

1. Basis of Design: Panasonic FP-X series.

a. 16K program capacity.
b. (8) 24 Vdc inputs, (6) relay outputs.

E. Motor Starters, Overload Relays and Control Power Transformer:

1. Starters

a. IEC, full voltage, and reversing.
b. Maximum short circuit protective fault current 100 kA.

2. Overload Relays

a. Adjustable and sized to full load amperes (FLA) of the motor.

3. Control Power Transformer

a. Produce 120-volt AC power from the supply power. Sized and fused in accordance with code to accommodate the control power requirements.

F. Current Transducers

1. Discrete output type with an adjustable set point from 1-135A with 200ms or faster response time.

G. Operation:

1. Grinder Control: In accordance with ON-OFF/RESET-REMOTE Selector Switch.

a. OFF/RESET Position (OFF): De-energizes Grinder.
b. OFF/RESET Position (RESET): Clears all fault conditions.
c. ON Position: Energizes Grinder
d. REMOTE Position: Grinder operates as controlled by a remote start/stop dry contact.

2. Grinder JAM Condition: In accordance with setting of current transducer.

    a. Controller will stop and reverse the Grinder motor three (3) times and activate the Grinder FAIL indicator and relay.
    b. Grinder will stop operation.

3. Grinder MOTOR OVERLOAD Condition: In accordance with setting of Motor Overload Relay.

    a. The MOTOR FAULT indicator lamp will be illuminated, and the FAIL contact will be closed.
    b. Grinder will stop operation.

4. Grinder MOTOR OVERTEMP Condition: In accordance with setting of Motor Thermostat.

    a. The MOTOR FAULT indicator lamp will be illuminated, and the FAIL contact will be closed.
    b. Grinder will stop operation.

5. Power Failure:

    a. While System is Operating: System shall not return to normal operation until power is restored and START pushbutton is pressed.
    b. While System is in a Fail Condition: System shall return to a fail state when power is restored. The fail state shall not be cleared until reset.

6. Reset of Grinder: Accomplished from the controller only.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of the equipment in accordance with the manufacturer's installation instructions, approved submittals, and in accordance with OSHA, local, state, and federal codes, and regulations.

3.2 FIELD QUALITY CONTROL

A. INSPECTION

1. The manufacturer is required to provide the services of a factory or manufacturer's representative for a minimum of one day to inspect the equipment for proper installation, apply power for the first time and check for proper motor rotation, oversee the initial introduction of material into the system and confirm the equipment operates as intended.

B. TRAINING

1. Field training for operations, maintenance, and supervisory staff members is to be provided by a manufacturer or manufacturer's representative. Field instruction shall cover key components of the equipment, operating and maintenance requirements and troubleshooting techniques.

3.3 LUBRICATION

A. The equipment shall be lubricated by the Contractor when erected and he shall furnish the necessary oil and grease for one (1) year of operation. The grades of oil and grease shall be in accordance with the recommendations of the manufacturer.

3.4 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 Operation and Maintenance Manuals shall be in compliance with the General Requirements.

END OF SECTION 462433